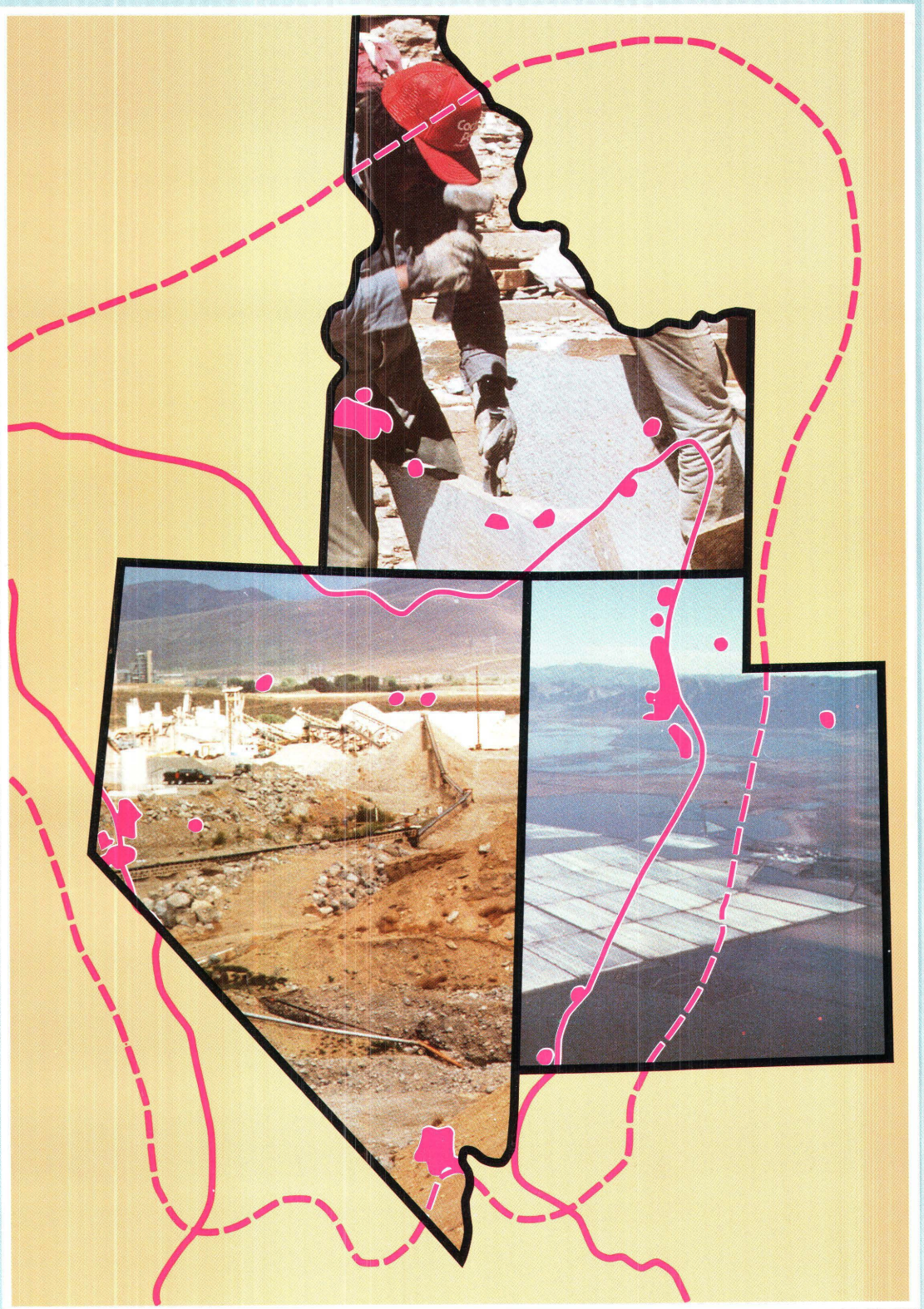
Industrial Minerals in the Basin and Range Region—

Workshop Proceedings



U.S. GEOLOGICAL SURVEY BULLETIN 2013

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COVER

Typical industrial-mineral operations in the Basin and Range States of Nevada, Utah, and Idaho.
LEFT—Gravel-mining operation of the Granite Construction Co. serving the Reno-Sparks-Carson City, Nev., area. Photograph courtesy of Nevada Bureau of Mines and Geology.
TOP—Idaho Quartzite Corp. Hale quarry, showing splitting of quartzite blocks into plates ready for production of tiles. Photograph courtesy of Don Seehusen, Idaho Quartzite Corp.
RIGHT—Great Salt Lake Minerals and Chemicals, Inc., plant facilities near Ogden, Utah, which produce potassium sulfate, sodium sulfate (salt cake), and magnesium chloride. Photograph by Howard Newman, Salt Lake Brine Shrimp, Inc.
Superimposed is the Great Basin physiographic section (solid line) of the Basin and Range Province, based on Fenneman (1931), and the broader tectonophysical-anomaly area (dashed line), based on Eaton (1979). Areas of high population in Nevada, Utah, and Idaho (solid red) are based on a U.S. Air Force defense meteorologic satellite photograph taken on a clear night.

Industrial Minerals in the Basin and Range Region—Workshop Proceedings

EDWIN W. TOOKER, Compiler-Editor

Prepared in cooperation with the U.S. Bureau of Mines, the Nevada Bureau of Mines and Geology, the Utah Geological Survey, and the Idaho Geological Survey

Presentations and discussion at a workshop held May 30, 31, and June 1, 1990, in Salt Lake City, Utah, to consider the current status, regulatory problems, projected needs, and future plans for improving the availability of industrial-mineral resources in the Basin and Range States of Nevada, Utah, and Idaho

U.S. GEOLOGICAL SURVEY BULLETIN 2013

U.S. DEPARTMENT OF THE INTERIOR
MANUEL LUJAN, JR., Secretary

U.S. GEOLOGICAL SURVEY
Dallas L. Peck, Director

Text and illustrations edited by George A. Havach

UNITED STATES GOVERNMENT PRINTING OFFICE, WASHINGTON : 1992

For sale by
Book and Open-File Reports Sales
U.S. Geological Survey
Federal Center, Box 25286
Denver, CO 80225

Library of Congress Cataloging-in-Publication Data

Industrial minerals in the Basin and Range region : workshop proceedings / Edwin W. Tooker, compiler-editor.
p. cm. — (U.S. geological survey bulletin : 2013)
Includes bibliographical references.
Supt. of Docs. no. : I 19.3:2013
1. Mineral industries—West (U.S.)—Congresses. 2. Mines and mineral resources—West (U.S.)—Congresses. I. Tooker, Edwin Wilson, 1923- . II. Series.
QE75.B9 no. 2013
[HD9506.U63A17]
553.6'0979—dc20

91-45204
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ABBREVIATIONS AND ACRONYMS

AC	asphaltic cement
AIME	American Institute of Mining and Metallurgical Engineers
AMC	American Mining Congress
ARA	Acid Rain Act
AZGS	Arizona Geological Survey
BLM	U.S. Bureau of Land Management (DOI)
BWPC	Bureau of Water Pollution Control (Utah)
C of E	U.S. Army Corps of Engineers (DOD)
CAA	Clean Air Act
CEQ	Council on Environmental Quality
CERCLA	Comprehensive Environmental Response Compensation Liability Act
CMA	California Mining Association
CPA	certified public accountant
CWA	Clean Water Act
DCED	Department of Community and Environment Development, Division of State history
DMG	Division of Mines and Geology (California Department of Conservation)
DNR	Department of Natural Resources (Utah)
DOA	U.S. Department of Agriculture
DOC	U.S. Department of Commerce
DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOGM	Division of Oil, Gas, and Mining (Utah Department of Natural Resources)
DOH	Department of Health (Utah)
DOI	U.S. Department of the Interior
DOT	U.S. Department of Transportation
DPS	Department of Public Safety (Utah)
EA	environmental assessment
EIS	environmental-impact statement
EPA	U.S. Environmental Protection Agency
EPCRA	Emergency Planning and Community Rights to Know Act
FHWA	Federal Highway Administration
f.o.b.	free on board
FWPCA	Federal Water Pollution Control Act
GAO	General Accounting Office
GIS	Geographic Information System
GNP	gross national product
HUD	U.S. Department of Housing and Urban Development
ICP-MS	inductively coupled plasma mass spectrometry
IGS	Idaho Geological Survey
IMCC	Interstate Mining Compact Commission
MAS	Mineral Availability System (USBM)
MC	materials classification
MILS	Mineral Industry Location System (USBM)
MOU	memorandum of understanding
MRDS	Mineral Resource Data System (USGS)
MSHA	U.S. Mine Safety and Health Administration
MWTF	Mine Waste Task Force (EPA)
NAMRAP	National Mineral Resource Assessment Program (USGS)
NBMG	Nevada Bureau of Mines and Geology
NCGMP	National Cooperative Geologic Mapping Program (USGS)
NEPA	National Environmental Policy Act
NDM	Nevada Department of Minerals
NIMBY	not in my back yard!
NMA	Nevada Mining Association
NOPE	not on planet Earth!
NPDES	National Pollution Discharge Elimination System
OMB	U.S. Office of Management and Budget
OSHA	Occupational Safety and Health Administration
OSM	Office of Surface Mining
PBS	public broadcasting service
PM-10	very small (less than 10 μm) particulate matter
PR	public relations
PSD	prevention of significant deterioration
R&D	research and development
R-2	residential-type zoning

RCRA	Resource Control Reclamation Act
ROW	right-of-way
SIC	Standard Industrial Classification (EPA)
SFS	Superfund site
SMARA	Surface Mining and Reclamation Act (California)
SMCRA	Surface Mining Control and Reclamation Act
SMCRCA	Surface Mining Control Resource and Conservation Act (California)
T&E	threatened and endangered
TEU	20-ft equivalent
TPY	tons per year
TSP	total suspended particulates
TV	television
UGS	Utah Geological Survey (Department of Natural Resources)
UIC	underground-injection control
UMA	Utah Mining Association
UNR	University of Nevada, Reno
UNLV	University of Nevada, Las Vegas
UPDES	Utah Pollution Discharge Elimination System
USBM	U.S. Bureau of Mines (DOI)
USFS	U.S. Forest Service (DOA)
USGS	U.S. Geological Survey (DOI)
UST	underground storage tank
VOC	volatile organic compound
WGA	Western Governors' Association
WSMA	Western States Mining Association
XRF	X-ray fluorescence

Industrial Minerals in the Basin and Range Region—Workshop Proceedings

Edwin W. Tooker, *Compiler-Editor*

ABSTRACT

This volume is an edited transcript of the sessions at the Basin and Range industrial-minerals workshop held in Salt Lake City, Utah, in May 1990 (see app. 1). The 60 participants represented a "resource constituency" that included major segments of the industrial-minerals industry and related, broad public and private scientific, economic, land-management-regulatory, and environmental-protection components. Interrelated factors, such as the present national and regional status of industrial-mineral reserves and resources, future needs for them, and problems of their availability both locally and in the interstate region of the Basin and Range, were considered during informal round-table panel presentations and participant discussions. This review led to a recognition of the increasing requirements for industrial minerals in widely separated local centers of rapid population growth in the Basin and Range, the increasing environmental concerns accompanying accelerated use of industrial minerals to meet new demands, and the interstate problems arising from local congestion, pollution control, expanding infrastructure, waste management, and reclamation. Panel members evaluated economic problems of marketing, taxes, royalties, and financing of industrial-mineral production and development of the support systems, such as adequate power and water, favorable transportation rates, and availability of skilled labor. Former Governor Scott Matheson of Utah stressed the need to develop political support for industrial minerals by increasing the visibility and image of the industry through proactive participation with governmental bodies.

The proposals examined for expanding industrial-mineral opportunities in the Basin and Range region include development of advanced (high value, low volume) materials for specialized strategic and industrial needs of the future, consideration of new market-development possibilities for existing high- and low-value materials, and a strategy for increasing the industry's visibility and expanding the role of industrial minerals in the domestic economy. The use of PR expertise and technology in public education to explain the special economic benefits of mining was also described. Finally, a proposal for developing an ongoing discussion group or coalition of the resource constituency was advanced to form a visible base of community support and to increase understanding of this industry by the public.

This report is the third in a series to evaluate the status of industrial-mineral resources in the rapidly growing regions of the Western United States. The first workshop was held in Tempe, Ariz. (Tooker, 1989), and the second in Marina Del Rey, Calif. (Tooker and Beeby, 1990).

INTRODUCTION

By E.W. Tooker

This volume contains the proceedings of the Basin and Range industrial minerals workshop held in Salt Lake City, Utah, on May 30 through June 1, 1990. This workshop, the third in a series held in the Western United States beginning in 1988 in Arizona, followed in 1989 in California, completed an examination of the major factors that directly or indirectly affect the important, yet poorly recognized, industrial-mineral-resource industry. The workshop considered the current status of these mineral materials, the projected needs for them, some of the problems associated with mining them, and the development of a strategy or plan for assuring their future availability in the Basin and Range region of Utah, Nevada, and Idaho. Workshop sessions were sponsored by the geological surveys of the Basin and Range States (IGS, NBMG, UGS) and the USBM and USGS.

The workshop format was structured as an informal, open-square, face-to-face meeting; panel presentations were followed by discussion or comments by workshop participants. A total of 60 participants and observers (see inside front cover) were invited to the workshop to consider the topics presented; they represent segments of a "resource constituency" that includes the mining industry and supporting public and private groups which, in one way or another, provide scientific and environmental expertise, economic support, and governmental regulatory and land-management responsibilities. Formal technical papers were not required of conveners and panelists, to encourage greater participation and stimulate more lively discussion. The sessions were recorded and subsequently transcribed, compiled, and edited into their present form. Participants' discussions and comments are anonymous; panelist's replies to discussion are acknowledged.

Workshop Objectives

The primary objective of the workshop was to develop a clearer understanding of the availability of and demand for industrial-mineral resources in the Basin and Range region of Utah, Nevada, and Idaho, and the mining and reclamation problems associated with rock and mineral extraction. As the population of this region increases, more land, water, mineral, and energy resources and the supporting industry and infrastructures are needed by the new residents. These needs lead inevitably to increasing risks of degrading area resources. Therefore, there is an urgency to alert and educate the public, thereby to assure a more balanced consideration of resource needs and the environmental situations that arise in meeting those needs.

Ancillary goals of the sponsors were to identify and meet with the industrial-minerals "grass roots" constituency in this region, to develop a better understanding for future resource-program efforts of the sponsoring agencies, and to discuss how to share the responsibility for disseminating resource information and technology to both public and private decisionmakers. To accomplish these goals, the question asked was how a constituency composed of such diverse elements as the industrial-minerals industry, government agencies, universities, environmental-planning consultants, government political managers, and the public at large can develop into a credible "force" whose expertise is recognized and acted on. One of the most serious difficulties to be overcome in obtaining such a force is the fiercely independent and competitive industrial-minerals industry itself, which produces a wide variety of commodities, yet shares common problems.

Highlights of Previous Workshops

It seems appropriate at the conclusion of this series of industrial-minerals workshops to sketch the highlights and contributions of the previous sessions. Each workshop has contributed distinctive elements to an emerging picture that reflect the special resource characteristics of each region. Thus, the intrinsic value of the Arizona, California, and Basin and Range workshops is that they consolidate a body of information concerning the current and future availability of industrial-mineral resources that is not available in one place elsewhere. This information, therefore, may be unique for the Western United States, which contains vast tracts of Federal and State lands. Moreover, the proceedings identify many somewhat-divergent viewpoints, all of which must be considered in developing equitable solutions to resource problems. Thus, the workshop proceedings acquaint the broad public and governing officials and regulatory agencies at the Federal, State, county, and local municipal levels of the societal importance of industrial minerals. The problems to be solved are difficult, but not insurmountable if the warnings and recommendations are acted on promptly.

The workshops began by defining industrial minerals, demonstrating their importance to the local and regional economies and infrastructures, and reviewing the status of the local industrial-mineral industry, and concluded with recommendations for improving access to these resources. Each workshop then diverged to consider typical industrial-mineral-resource aspects in its particular State and region.

The Arizona workshop proceedings (Tooker, 1989) stressed the need for computer access to resource-data systems, reproducible standard analyses, and testing facilities for industrial-mineral materials. The impediments to mining industrial minerals that result from a multitude of sometimes-overlapping local-, State-, and Federal-agency requirements for land management, environmental protection, and reclamation were considered; local planning and zoning, State and Federal permitting, and environmental constraints were discussed. To help industry and land managers, some governmental and academic computer data (in GIS, MAS, and MRDS); new geologic, geophysical, and geochemical research; and deposit resource models, which should facilitate resource exploration and development, were described. The workshop session ended with an analysis of the specific needs voiced by the various segments of the resource constituency.

The California workshop proceedings (Tooker and Beeby, 1990) examined the special land-access and permitting issues of potentially withdrawn State and Federal lands and of rapidly expanding urbanized (zoned) regions, as well as the environmental impact of mining and mitigation of the adverse effects of mining. There have been numerous detailed analyses of the impact of mining in existing and proposed wildernesses and wilderness study areas (for example, Anderson, 1989; U.S. Bureau of Land Management, 1990); however, very little comparable information is available for existing and expanding urban areas in the State. Recognition that these are areas where the effects of necessary expanded industrial-mineral-resource development will be greatest led to the recommendation that these resources be identified, evaluated, and dedicated. Then, effective plans should be made for their segmented development and for acceptable reclamation of the mined lands. The economics of resource production, specifically on transportation-infrastructure requirements, and regional planning in the State were considered. Assistance available to the resource constituency from universities, government agencies, and scientific societies was described. Finally, the poor image of mining in the public eye and the special need for education of that public were addressed, with the strong recommendation that an effort to roll back the damaged public image of mining begin as soon as possible.

Present Situation

Although there are repetitions of information and recommendations in the three workshops, they cover several important current concerns, identify some of the overlaps and opportunities for streamlining governmental management and regulation of mining, and offer suggestions for ways to expand the uses of industrial minerals and an improved public awareness of these resources. An editorial in the London Mining Journal (1990) summed up the "Catch–22" situation facing the resource industry worldwide today. It also showed that the industrial-minerals problems are not only U.S. problems; the resource situation in Great Britain reflects a contracting domestic mining industry, the mining profession's poor job prospects and pay, and mining's tarnished image. In the United States, where mining remains an important part of the economy, its operational problems are also due to adverse public perceptions, particularly the association of mining with environmental damage. Few people are aware of just how essential mineral resources are to their everyday lives. Mining companies have yet to convince society that they are creators of wealth and not despoilers of the environment. The editorial concluded that a better understanding of mining's role in society for those who will eventually be making the key decisions can be achieved only through more effective public earth-science education.

Economic, environmental, and, possibly, some other problems considered in the workshop certainly are well known to the workshop participants and some readers but less well known, if at all, to many other readers, even some of us within the resource constituency, and to the public at large. The seriousness of this lack of information about such problems and their effect on access to (production of) necessary industrial minerals made it imperative that these subjects be included in these workshop proceedings.

Future Challenge

The potential conflict between industrial-mineral mining and environmental protection must be resolved to meet society's needs with a minimum of disruptions. The industrial-minerals constituency must educate not only those currently making the decisions that affect, directly or indirectly, the officials in local villages, counties, States, and the Federal Government, but also the people who currently vote for decisionmakers. An editorial in Mining Magazine (1990) concluded that "too often the mineral industry's replies to attacks [on environmental issues] are so quiet that the public does not hear." The editorial continued to say that business people should realize that they have to sell not only their products but also their business existence. To this end, advocacy skills are a true art that must be mastered.

The resource constituency itself has to recognize how the present situation developed. From his perspective as a mining-company executive and lawyer, Stanley Dempsey (1990) traced the evolution of the relation between the environmental movement and mining and considered the primary issues for the 1990's. He concluded with these thoughts:

> In retrospect, it seems clear that we have not yet reached a national consensus on how to manage the environmental impacts of mining in the United States. The Nation is spending a lot of money on environmental cleanup, but much of that money goes to lawyers and public-relations firms. Agreement on ways to manage the environment and actual physical cleanup of waste sites continues to elude us. * * * The political system imposes political solutions to technical and economic problems, and there is little collaboration between the regulators and members of the regulated community. Science takes a back seat to politics. If one is optimistic about the future, it is safe to predict that the United States will eventually sort out a more satisfactory approach to environmental management and regulation. * * *. If this occurs, technical people will be encouraged to come up with effective mechanisms for managing the environmental impacts of mining.

The workshop participants recognized the need for developing broad public support for more effective public and private resource management at all levels. One proposal to obtain that support is to mobilize a coalition composed of members who represent the broad range of resource issues and technologies. Such an organization could begin to put science back into the equation by developing credible, well-balanced information on which to make reasonable decisions. The sponsors of the three industrial-minerals workshops hope that these proceedings volumes and the basic information and thought-provoking discussions therein will spur action within a concerned resource community as soon as possible.

Acknowledgments

The workshop organizing committee greatly appreciates the encouragement, participation, and support of the IGS, NBMG, and UGS and of the USGS and USBM in developing the workshop program and in selecting participants who represent the broad resource-oriented constituency in this part of the Basin and Range. Special thanks are also accorded the session moderators, conveners, and panelists for their vital contributions to the workshop

program. In turn, the committee thanks the workshop participants (see inside front cover) for their insights and contributions to the discussions that followed the presentations. Members of the organizing committee who contributed to the tenor and success in planning and assistance in conducting the workshop include E.H. Bennett, Idaho State Geologist; S.B. Castor, geologist, NBMG; R.W. Gloyn, senior economic geologist; B.T. Tripp, geologist, UGS; C.W. Berry, professor, University of Utah; J.E. Christensen, president, Utah Mining Association; Peter Behrens, president, Lake Chemical Co.; Glenn Eurick, geologist, American Barrick Mining Co.; D.P. Bauer, geologist, BLM; B.W. Buck, J.B.R. Consultants Group; A.F. Barsotti, chief of the Branch of Industrial Minerals, and M.J. McKinley, former chief of the Branch of Industrial Minerals, USBM; and M.P. Foose, deputy chief, Office of Mineral Resources, E.H. McKee, former chief of the Branch of Western Mineral Resources, and E.W. Tooker, geologist, USGS.

The organizing committee tenders special appreciation to the following persons, and to those individuals and firms who assisted them, for contributions to the success of the workshop. J.G. Price, Nevada State Geologist, provided practical advice regarding the proposal considered in session 5 for organizing State coalitions of the resource constituency, and he conducted a pre-workshop survey of the Western State geologists' views and opinions about such a coalition. B.T. Tripp, UGS, organized and arranged the information poster and literature exhibits used during the sessions. Laboratory tours on June 1, 1990, to the USBM's Field Center Laboratory, the UGS' computer-data and map-information facility, the National Cold Fusion Institute, and the University of Utah's College of Mines Research Center, as well as a field visit to the Staker Co.'s Salt Lake City crushed-rock open pit, followed by a tour of the adjoining Monroc precast-prestressed-concrete plant, were planned and conducted by C.W. Berry, University of Utah. E.W. Tooker coordinated the workshop.

WELCOME

By M.L. Allison

It is my privilege, as director of the UGS and your local host sponsor, to welcome you to these sessions. It's exciting to see this group assembled here in Salt Lake City to discuss industrial minerals, a subject ordinarily perceived to be mundane but one that, in reality, just isn't well understood by the general populace. These 2 days should begin to dispel those notions.

This workshop is something sorely needed. Industrial minerals aren't "sexy"; they're not glamorous. Yet, the industrial-mineral production in this country last year was twice the value of metallic-mineral production. Industrial minerals are a conglomeration of 50-odd commodities, each with unique problems. High-volume, low-cost materials mean, for example, that transportation may be a major cost factor. Thus, the resource must be located in or near urban centers, but these are precisely the areas where environmental concerns and urban developments are squeezing out the very industry needed to support the same centers of urban growth.

All of us recognize that much can be done to improve the industrial-mineral industries. Some of the solutions are scientific or technical; others are political, economic, and social. These latter solutions may be the most critical factors governing the development of industrial minerals. Your agenda is quite broad based, covering land-use planning, Federal and State land-use policy, research on geologic, mining, and environmental science and technology and their transfer, resource identification, and data inventory.

One important reason for our being here is to address how we might better solve some of our problems. There are many possible directions to take, but it isn't clear which direction is best for most of the people we serve or who serve us. What roles should Federal and State agencies play in the resource area? How should government interact positively with industry? How can highly diversified and competitive industries thrive, and is there enough of a common basis for them to work together to meet the challenges ahead?

By tomorrow afternoon, perhaps we'll have a better idea of where we need to go and how to answer some of the important questions that lie ahead. I look forward to that and to the laboratory and industry field tours that follow. Again, welcome to the workshop sessions and to Salt Lake City!

STATUS OF INDUSTRIAL-MINERAL RESOURCES

E.H. Bennett, *Moderator*

We begin these proceedings with an overview of the national status of industrial minerals, looking at the construction-aggregate materials in some detail, in a panel discussion by A.F. Barsotti, chief of the USBM's Branch of Industrial Minerals in Washington, D.C., and V.V. Tepordei, USBM commodity specialist, also from Washington, D.C. There follow presentations of State summary assessments of present and future industrial-mineral production from the NBMG by S.B. Castor of Reno, Nev., from the UGS by B.T. Tripp of Salt Lake City, Utah, and from the IGS by E.H. Bennett, Idaho State Geologist, of Moscow, Idaho. On the basis of this information about

industrial-mineral materials, we then move to a second panel convened by B.W. Buck, a partner of the J.B.R. Consultants Group in Salt Lake City, to consider some of the future resource needs and problems in the Basin and Range region.

Industrial-Mineral-Supply/Demand Perspectives for Idaho, Nevada, Utah, and the Nation, with a Focus on Construction Materials

By A.F. Barsotti, V.V. Tepordei, *and* G.T. Austin

Contrary to what many people believe, the United States is not totally self-sufficient in industrial minerals. When discussing self-sufficiency, a distinction must be made between foreign dependency and reliance. Dependency occurs when domestic resources of a particular mineral are insufficient to meet U.S. demand, whereas in the case of reliance, the United States may have sufficient resources of a mineral but, for other reasons, usually economic, chooses to rely on foreign sources. The Nation depends nearly totally on imports for sheet mica, strontium, gem stones, and natural industrial diamonds; more than 70 percent for potash; at least 50 percent for fluorspar, barite, asbestos, and iodine; and less than 50 percent for dimension stone, pumice, peat, gypsum, quartz crystal, cement, and sodium sulfate. Some of the countries that supply significant amounts of minerals to the United States are Canada, China, India, Israel, Mexico, the Republic of South Africa, and Spain.

Traditionally, production and consumption of bulk construction materials have been limited to local markets. In some areas adjacent to navigable waters, markets can be regional or interstate in scope. Today, however, because of conflicting interests in access to land, environmental restrictions, and, in some cases, general public resistance to mining, the costs for delivered bulk materials in many areas have increased to the point where foreign imports from as far away as Scotland are becoming commonplace. The coastal areas of the United States, despite their vast domestic resources of stone, are now slowly becoming import reliant.

The USBM analyzes industrial-mineral production and consumption trends to assist national planning to assure adequate and reliable supplies so as to meet U.S. strategic and economic needs. Such planning also assures that the Nation's needs are met at acceptable social, environmental, energy, and financial costs. To complete these analyses, USBM commodity specialists monitor approximately 50 commodity industries, which constitute essentially all of the nonmetallic, nonfuel minerals. These industries consist of about 8,000 companies operating approximately 30,000 domestic mines, quarries, brine facilities, and processing plants that produced commodities valued at $23.3 billion in 1989.

National Perspective for Industrial Minerals

Supply

Recently, the makeup and structure of the industrial-mineral industry has been undergoing major changes and adjustments as a result of a shrinking manufacturing sector, new technology, more liberal economic but stricter regulatory policies, urban growth, mergers and acquisitions, vertical integration, and a need to rebuild the infrastructure of the Nation. To keep pace with these changes, the USBM has broadened its role with respect to industrial minerals, by becoming more proactive in the fostering of a sound domestic minerals industry and by addressing various problems through policy recommendations and research activities.

Industrial minerals are grouped into two general categories by the USBM—construction materials and chemical materials. Fertilizer commodities are an identified subgroup of the chemical materials. Construction-material commodities account for more than 60 percent of the total value of industrial-minerals production. Together, three of these commodities—crushed stone, cement, and sand and gravel—represent almost 59 percent of the total production value of industrial minerals in the United States.

Sulfur, lime, soda ash, and salt represent more than 80 percent of the value of chemical materials, not including the fertilizer subgroup, which includes nitrogen, peat, phosphate rock, and potash. About 92 percent of the sulfur produced in the United States is used in the manufacture of sulfuric acid, of which 69 percent is consumed in the making of phosphate fertilizer. Because of its desirable properties, sulfuric acid is the most universally used mineral acid and the largest-volume inorganic chemical in terms of the quantity produced and consumed. The chemical- and steel-manufacturing industries consume 90 percent of the lime produced. The glass and chemical industries are the major consumers of soda ash, and salt is used principally in the manufacture of chlorine and caustic soda.

About 80 to 90 percent of the minerals in the fertilizer subgroup produced in 1989 were consumed either directly or indirectly by the fertilizer industry. The Gulf and South Atlantic States supply the bulk of the nitrogen, phosphate rock, and peat.

Several of the industrial minerals grouped with the construction materials and chemical materials are included more for convenience than for their industrial uses. They include abrasive materials, clay, feldspar, gem stones, graphite, industrial sand and gravel, kyanite, quartz crystal,

sheet mica, wollastonite, and zeolites. These industrial minerals are used primarily in the refractory, ceramic, electronic, paper, plastics, coating, and manufacturing industries.

Demand

Demand has decreased for some industrial minerals used by the steel and petroleum industries, such as fluorspar and barite. This demand will continue to decrease or remain soft until the market for U.S. steel and petroleum improves. The phosphate-rock industry underwent a major restructuring due to the depletion of low-cost reserves, increased foreign production, continued slack in domestic fertilizer demand, and the ban on the use of phosphate chemicals in detergents in many parts of the country.

For other industrial minerals, business in 1989 ranged from very good to excellent. Demand for most construction materials continued to remain strong, at least partly owing to the materials demand associated with the need to rebuild the Nation's infrastructure. Until recently, business could not have been better for many materials for which growth and production are closely tied to the ceramics, refractory, electronics, paper, coatings, and plastics industries.

Infrastructure

As discussed earlier, the quantities of industrial minerals required to rebuild the Nation's infrastructure are very large. The USBM recently began to examine the material requirements and costs associated with this rebuilding. The goals of this study are to determine the extent or percentage of material costs as a component of total infrastructure costs and which materials constitute the greatest or most significant proportion of material costs. Additionally, the study will determine the most important cost components for any significant material—in short, the overall industrial-mineral demands and their associated costs.

The FHWA of the U.S. Department of Transportation (1989, 1990) provides national and State statistics, including 3-year annual averages of quantities of selected materials consumed per million dollars spent on highway construction. These materials include aggregates, asphalt, cement, concrete pipes, and steel. Using average unit prices for each item, assuming that delivery costs are included, material costs are estimated to be almost a third of the total highway costs in the United States; the "other" component represents administration, capital, labor, expendable items, ROW's, and energy costs. Preliminary examination of State costs suggests that these costs vary significantly among the States and from year to year.

A similar study was done by using public information obtained on the new Denver Airport construction project. Current estimates for completion of the first phase are about $1.7 billion. The major cost items include land acquisition and relocation, new utilities, excavation, terminal construction, runways, parking facilities, and cargo and ancillary facilities. Using engineering estimation methods, major bulk-material requirements and costs were then calculated. On the basis of preliminary calculations, bulk-material costs (for aggregate, cement, and asphalt) are estimated to be from 22 to 26 percent of total costs during the first phase of construction, depending on the hauling distance for aggregates. Hauling aggregate 30 mi for the Denver Airport project is estimated to cost as much as $33 million.

Regulatory Activities

Recently, regulatory actions have significantly affected the industrial-mineral industry. As mention earlier, the phosphate-rock industry was impaired by the regulatory removal of phosphate from detergents. We're all aware of the asbestos issues these days, and even given extraordinary regulations, amazingly, two asbestos mines are still producing in the United States. Currently proposed regulatory actions by OSHA and MSHA could adversely affect the talc and crushed-stone industries as well.

The USBM recently completed a study based on proposed OSHA regulations on the standards for occupational exposure to asbestos, tremolite, anthophyllite, and actinolite. It was estimated that under the proposed regulations, a fourth of the crushed-stone producers would be adversely affected, costing the industry about $22 million annually. About 7 percent of that industry would probably be forced to close. Additionally, the talc industry could lose approximately $12.3 million annually in sales, and at least one major producer in the East could shut down. On the basis of these findings, the USBM, on behalf of the DOI, recommended that OSHA not regulate these non-asbestiform amphibole minerals under the asbestos-exposure standard, but that separate rulemaking on the regulation of these minerals be proposed. It was also recommended that OSHA incorporate a mineralogic definition of asbestos into its revision.

A study of the effect on the domestic industrial-mineral industry of classifying crystalline silica as a potential human carcinogen under OSHA's Hazard Communications Standards is underway. The ramifications of this finding could be considerable for the mining industry because crystalline silica occurs in a wide variety of rock types, including dolomite, limestone, shale, and other industrial-mineral source rocks. Even the general public could be indirectly affected because the raw materials for many consumer products, such as kitty litter, children's play sand, ceramic tiles, paints, and plastics, come from deposits that contain crystalline silica.

Table 1. Production of aggregate in the United States in 1989

[All values in billions of tons]

Resource	Total production	Amount used in construction aggregate
Crushed stone	1.2	1.03
Sand and gravel	.897	.852
Total	2.1	1.9

Table 2. Regions of major production of crushed rock and sand and gravel in the United States in 1989

[All values in millions of tons]

Region	Crushed stone	Sand and gravel	Total
South Atlantic	316	77	393
East North-Central	212	177	389
Pacific	87	190	277
Middle Atlantic	154	66	220
Mountain	32	121	153

Table 3. Five leading States in order of production of crushed stone, sand and gravel, and aggregate in 1989

[All values in millions of tons]

Crushed stone (30.7 percent of U.S. total)		Sand and gravel (34 percent of U.S. total)		Total aggregate (28.8 percent of U.S. total)	
Pennsylvania	93.1	California	138.3	California	231.4
Florida	84.0	Michigan	48.0	Pennsylvania	132.0
Texas	76.8	Ohio	44.4	Texas	121.2
Virginia	64.1	Texas	43.9	Florida	108.0
Illinois	60.8	Washington	37.8	Ohio	98.6

Idaho, Nevada, and Utah Industrial-Mineral Perspectives

The USBM estimated the total value of mine production of industrial minerals in Idaho, Nevada, and Utah in 1989 at approximately $566 million. The value of production of construction aggregates, largest of the industrial minerals, in the tristate area was $179 million, or 32 percent of the total value of industrial-mineral production. Phosphate rock was the second largest commodity, followed by cement, salt, lime, diatomite, lithium minerals, industrial sand and gravel, and gypsum, which together accounted for 61 percent of the total value of production. The remaining 7 percent was barite, clay, dimension stone, feldspar, fluorspar, garnet, gem stones, perlite, potassium salts, pumice, and sodium sulfate.

Construction Aggregates

A National Overview

Crushed stone and sand and gravel are the two main sources of natural construction aggregates in the United States, as well as in the world. Both of these natural resources are widely used and produced in every one of the United States except Delaware, where only sand and gravel is being produced (Davis and Tepordei, 1985; Tepordei, 1985). The production of aggregates in a particular area is a function of the availability of natural resources, the size and growth of the population, and the local economy. Crushed stone and sand and gravel have one of the lowest average unit values of all mineral commodities. The low unit price and large volume of aggregates generally required for most uses, plus the relatively high cost of transportation, force these industries to be local.

A total of 2.1 billion tons of crushed stone and sand and gravel valued at $8.9 billion, f.o.b. at the plant, was produced in the United States in 1989. If shipping costs to the first point of use are added, the total value of delivered aggregates becomes $15 billion to $18 billion. The production of construction materials in the several regions of the United States is compared in tables 1 through 3.

The crushed-stone and, especially, sand-and-gravel industries are represented by numerous companies and operations: A total of 5,934 companies operating 9,160 stone quarries and sand-and-gravel pits were active in 1987 through 1988, of which 1,759 companies operating 3,473 quarries produced crushed stone, whereas 4,175 companies operating 5,687 pits produced construction sand and gravel. Most of the tonnage, however, comes from large operations. The structure of both industries has continued to change in the past 10 years, caused primarily by mergers and acquisitions. As a result of these changes, most large operations are now owned by only a few companies.

Preliminary figures for 1989 indicate that the five leading crushed-stone companies operated 398 quarries and accounted for 19.3 percent of the total U.S. production, whereas the five leading sand-and-gravel companies

operated 120 pits and accounted for 10.3 percent of the total U.S. production. Some of the mergers and acquisitions that occurred in the 1980's were associated with an influx of foreign capital. At the end of 1989, of the top 10 U.S. producers of aggregates, 2 companies were owned by British companies, 1 by an Australian company, and 50 percent of 1 by a Japanese company. Their combined production represented 8.3 percent of the total U.S. production.

Another trend in the aggregate industries is toward diversification, especially into intermediate construction products, such as ready-mixed concrete and concrete products or construction work.

Production and Growth

In the past 40 years, crushed-stone and sand-and-gravel production has grown significantly, as listed in table 4. These data represent an average annual growth rate of 4.3 percent for crushed rock and 2.6 percent for sand and gravel. During this time period, two distinct growth rate intervals can be identified (fig. 1).

For sand and gravel:

- 1948 to 1966, with an average annual growth rate of 6 percent; and
- 1966 to 1989, with an annual growth rate of only 0.1 percent.

For crushed stone:

- 1948 to 1966, with an average annual growth rate of 7.4 percent; and
- 1966 to 1989, with an annual growth rate of only 1.9 percent.

A major reason for the low growth rate since 1967 in both industries was the significant reduction in the Interstate Highway Program during the late 1960's. The sand-and-gravel industry has shown a significantly lower growth rate than the crushed-stone industry in the past two decades, mainly because of the increasing difficulties of developing new mining operations. Restrictive zoning regulations, increasing land values, and urbanization, which routinely occurs atop some unmined aggregate deposits, are the major factors responsible for slower growth.

Availability of Aggregates—the SMARA Solution

Although natural aggregates are widely distributed throughout the United States (Langer, 1988), they are not always available for production where needed. The significant growth registered by the construction-aggregate industries during the past 40 years has also generated some of the major problems facing them today. Sources of construction aggregates are still sufficient for most of the country, but more and more metropolitan areas are experiencing supply difficulties, mostly due to urbanization and

Table 4. Growth of production of construction material in the United States between 1948 and 1989

[All values in millions of tons]

Year	Crushed rock	Sand and gravel
1948	224	319
1989	1,240	897

restrictions imposed by existing land uses and zoning regulations. Thus, operations are moving farther and farther from consumer markets, and aggregates must be brought in from outside the areas, or recycled aggregates or artificial aggregates must increasingly be used.

Because these resources are low-value, high-volume mineral commodities, the prices of delivered aggregates are drastically affected by transportation distances. Trucking 1 ton of aggregates a distance of 25 mi in southern California adds about $3–5 to the $5–6 average cost of the ton. If the shipping distance increases to 60 mi, the shipping costs become $6 to $7 per ton, equal to or more than the cost of the aggregates. This case isn't just hypothetical; in cities like Boston, New York, Houston, Los Angeles, and San Francisco, shipping distances may be 50 to 100 mi or more, and even higher shipping costs are not at all unusual.

Urbanization, more often than not, has occurred atop unmined aggregate deposits without adequate recognition of the resources' existence or analysis of the effect of their loss. The social and economic consequences of such inadequate planning result in higher consumer costs, environ-

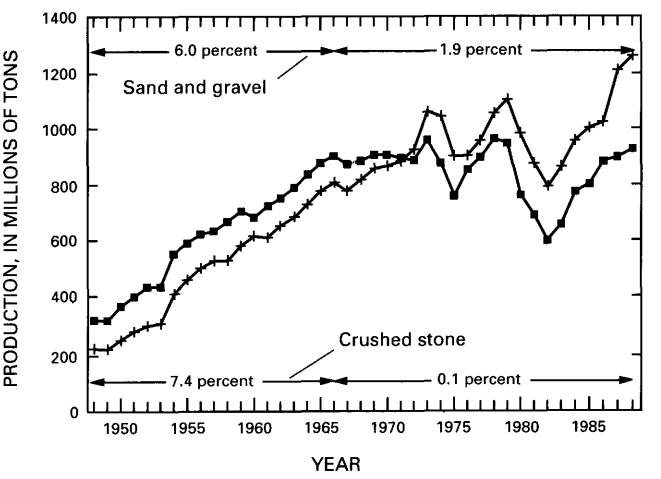

Figure 1. Annual production of crushed stone (crosses) and sand and gravel (squares) in the United States, 1948–88, showing steady growth but with two distinct growth-rate intervals (arrows).

mental damage, and creation of an adversarial relationship between the aggregate industry and the community.

The effect of premature loss of mineral resources on the future development of an area was recognized by the State of California early in the 1970's. The Division of Mines and Geology of the California Department of Conservation estimated that $17 billion worth of resources, primarily construction aggregates, would be preempted from mining in California by the year 2000 if then-current land-use practices continued. The problem was later recognized by the California Legislature, which passed a bill establishing the Surface Mining and Reclamation Act (SMARA) of 1975 (see app. 4; Beeby, 1988; Tooker and Beeby, 1990). Although many States and the Federal Government had previously enacted mined-land-reclamation laws, California was the first State to address the issue of long-term mineral-resource availability.

Under SMARA, local governments retain all land-use decisionmaking authority relative to the granting of mining permits, while responsibility for preparing an accurate, objective, and quantified aggregate-resource inventory is assigned to the State. Designation of specific deposits as being "of statewide or regional significance" is the second stage of the mineral-resource inventory, if applicable. The resource information is then available for use by State agencies, the aggregate industry, and local governments as a basis for their long-term-planning decisions.

A resource of more than 50 billion tons of high-quality aggregate has been identified and designated under SMARA; thus, this program seems to be working well in California and may serve as an example to other areas of the country. SMARA demonstrates that planned management of our natural resources can provide for better development of our communities and more efficient management of our environment.

Effect of Public Works: Past and Present

Between 80 and 95 percent of the aggregates produced in the United States is used for construction purposes, such as highways, roads, airports, dams, buildings, and private homes. Public-works projects represent a significant part of the construction activities in most areas of the country, as well as nationally. The importance of public works for promoting economic development and national defense was recognized early in the growth of this Nation. Much of the core infrastructure, such as bridges, water systems, and sewers, in use today in America's older cities was put into place during the first half of the 20th century; the post-World War II period witnessed an even greater growth.

In 1956, the U.S. Congress designated the National System of Interstate and Defense Highways, also known as the Interstate Highway System, and created the Highway Trust Fund to finance its construction and maintenance. The project was intended to promote interstate commerce, maintain the Nation's international competitiveness, and strengthen the national defense. It became the single largest public-works project ever undertaken by a nation. A period of constant growth and rapid economic development followed into the 1970's.

As the construction of the Interstate Highway System approached completion, construction activity decreased, and the aggregate industry became much more sensitive to the ups and downs of the economy. The roads and highways built during the 1960's and 1970's were used by more cars and heavier trucks than originally anticipated and designed for. The volume of maintenance and expansion work needed by these roads could no longer be adequately supported by the old mechanism in place, the Federal Highway Trust Fund. Recognizing this fact, the U.S. Congress approved the Surface Transportation Assistance Act of 1982, which increased the Federal fuel tax from 4 to 9 cents per gallon, increased other fees paid by highway users, and extended the Federal Highway Trust Fund to September 1988. This long-overdue adjustment of the Federal fuel tax provided the highest funding for highways and mass transportation to that date and was responsible for the significant increase in the demand for aggregates during the past 5 years.

Still, the Nation's highways and roads are not the only part of the infrastructure that is recognized as important for the development of the country. A critical index of national economic vitality includes reliable transportation, clean water, and safe disposal of wastes. These are basic elements of a civilized society and a productive economy. (All of these elements will require additional construction materials to complete.) In recognition of these needs, the U.S. Congress passed the Public Works Improvement Act of 1984, which created the National Council on Public Works Improvement. The council was instructed to prepare and submit a report on the state of the Nation's infrastructure to the President and the Congress. The final report of the council, entitled "Fragile Foundations: A Report on America's Public Works," was released in February 1988. It reported that "the quality of America's infrastructure today is barely adequate to meet current requirements and insufficient to meet the demands and support future economic growth and development." The Council concluded that the causes for the poor state of the Nation's infrastructure are largely monetary. The overall investment in public works has slowed in the past 10 to 15 years, both in absolute terms and in relation to the demands generated by economic growth and increasing environmental concerns (fig. 2). Total public spending for infrastructure dropped from 3.6 percent of the GNP in 1960 to 1.6 percent in 1985. Spending for operations and maintenance has remained relatively steady, but costs have

increased. Capital spending has dropped drastically, from 2.3 percent of the GNP in 1960 to just 1.1 percent in 1985. Public works, as a proportion of total spending at all levels of government, dropped from nearly 20 percent in 1950 to less than 7 percent in 1984.

With nearly $1 trillion of public-works assets in the United States, reduced spending over the short term does not mean that individual facilities or particular regions are in immediate peril. However, a declining infrastructure inevitably will jeopardize the productivity of our economy and our quality of life. The Council recommended:

- That a national commitment be shared by all levels of government, the private sector, and the public to vastly improve America's infrastructure. Such a commitment could require an increase of as much as 100 percent in the amount of capital the Nation invests each year in new and existing public works. In 1985, this amount was approximately $45 billion.
- That State and local governments continue to play their traditional leadership roles in the construction and management of the Nation's infrastructure, and that the Federal Government be a full and responsible partner on a long-term basis in the national effort to increase and sustain public capital investment.

In March 1990, the DOT released a comprehensive report on U.S. transportation policies and strategies, entitled "Moving America, New Directions, New Opportunities." This report underlines the fact that "the Nation's vitality has always been linked to mobility. Transportation is an engine for economic growth and a link between regions, businesses, and people. After more than 100 years of industrial and technological development, the U.S. has a mature transportation system that was developed decades ago." As Americans and American industries have increased their reliance on highways for both passengers and movements of goods, the highway infrastructure has deteriorated faster than originally anticipated. According to FHWA statistics, 23 percent of the 575,000 highway bridges in the U.S. are structurally deficient, and another 19 percent are functionally obsolete. The transportation infrastructure is "now at risk," and inadequate maintenance and inefficient use of various transportation modes reduces the overall capacity of the system and contributes to congestion.

The report "sets the framework for the future" by defining a Federal transportation policy. It outlines short- and long-term milestones and objectives for improving our Nation's transportation system. Thus, an eventual greatly increased need for construction materials is evident.

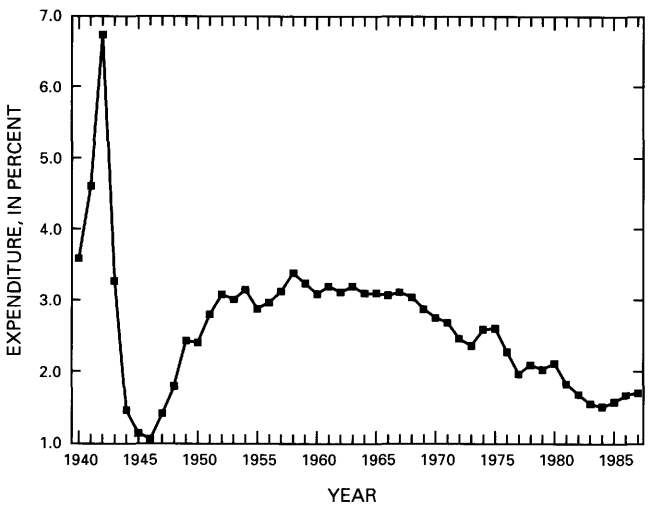

Figure 2. Annual public expenditures on construction work as a percentage of the GNP, 1940–87.

National Infrastructure Needs

Release of the DOT's report on transportation constitutes a major step forward; it follows the recommendations made by the National Council on Public Works and establishes a blueprint for future work on the Nation's infrastructure. The report also indicates that a significant increase in the volume of work for the infrastructure should be expected in the next 5 to 10 years. One major unknown is the magnitude of this increase. The value of public construction work as a share of the GNP has declined from about 3 percent in the 1950's and 1960's, through about 2 percent in the 1970's, to 1.7 percent in the 1980's (fig. 2). If this trend begins to reverse and the share of public works returns to 2.5 to 3 percent of the GNP, an increase in spending of $40 billion to $60 billion per year could be expected.

Can These Resource Needs be Met?

The big question that arises is, if such a spending increase does occur, how much aggregates, concrete, asphalt, steel, and other construction materials will be needed to do the job? Since the beginning of the construction of the Interstate Highway System, the FHWA and the State departments of transportation have been collecting and publishing information on highway-construction-materials-usage factors. These average usage factors indicate how much aggregates, cement, bitumen, steel, and other materials were used on Federally funded highway-construction projects over a 3-year period. The average usage factors are reported as quantities of materials per million-dollar construction-contract cost, and so they represent put-in-place costs. The latest statistics available from the FHWA, for 1986-88, indicate that at the U.S. level, an average of about 20,000 to 23,000 tons of aggregates was used for each million dollars spent on highway projects. At an average unit price of $10 to $15 per ton, this usage factor represents a total of about

$200,000 to $345,000 in aggregates per million dollars spent, or 20 to 34.5 percent of the total cost of the project.

If average delivered prices instead of put-in-place prices are applied to the same average usage factors, the cost of aggregates represents about 16 to 18 percent, bitumen 5 to 6 percent, cement 4 to 5 percent, and steel 3 to 4 percent of the total project cost. The unit prices of materials vary from State to State and even from project to project, but still FHWA statistics indicate that construction aggregates are a significant component of public-works projects. Similar statistics that are available for each State provide valuable information for planners, designers, and analysts.

Construction Materials in the Basin and Range Region

A few statistics regarding the construction-aggregates industry within the Basin and Range region will serve to show what current needs are being met domestically. What the future holds must be assessed realistically; importation of these resources will result in greatly increased costs for them. Let's review the current status of construction materials in the Basin and Range States of Idaho, Nevada, and Utah.

Idaho

Idaho ranked 40th nationally in the production of aggregates, 40th in crushed stone, and 42d in sand and gravel. Idaho's 1989 total production of aggregates was 12.9 million tons valued at $32.5 million, of which 3.3 million tons was crushed stone valued at $13.6 million, and 5.8 million tons was construction sand and gravel valued at $18.9 million. Per capita production of aggregates in Idaho was 12.9 tons, in comparison with the U.S. per capita production of 8.6 tons.

Major producers of aggregates in Idaho are the Nelson-Deppe Construction Co., Central Pre-Mix Concrete, Seubert Excavators, Inc., the Monsanto Co., and the Ash Grove Cement Co.

Nevada

Nevada ranked 32d nationally in the production of aggregates, 43d in crushed stone, and 13th in sand and gravel. Nevada's 1989 total production of aggregates was 22.3 million tons valued at $79 million, of which 1.9 million tons was crushed stone valued at $8.6 million, and 20 million tons was construction sand and gravel valued at $70 million. Per capita production of aggregates in Nevada was 22.1 tons.

Major producers of aggregates in Nevada are Las Vegas Building Materials, Inc., the Gibbons and Reed Co., the CSR-W.M.K. Transit Co., Las Vegas Paving Corp., the Granite Construction Co., Centex Corp., and Wells Cargo, Inc.

Utah

Utah ranked 25th nationally in the production of aggregates, 33d in crushed stone, and 22d in sand and gravel. Utah's 1989 total production of aggregates was 33.6 million tons valued at $61 million, of which 6 million tons was crushed stone valued at $19.5 million, and 145.3 million tons was construction sand and gravel valued at $41 million. Per capita production of aggregates in Utah was 20 tons.

Major producers of aggregates in Utah are the Geneva Rock Products Co., the Lost Dutchman Construction Co., the Gibbons & Reed Co., Savage Industries (Savage Rock Products), and Monroc, Inc.

Conclusions

Even though the value of U.S. production of industrial minerals in 1989 was significant, $23.3 billion, the United States is not self-sufficient. We depend on foreign imports of certain industrial minerals because we lack adequate domestic resources, but for other industrial minerals we rely on foreign sources because of reduced domestic productions or because foreign minerals are more economical, not because we lack domestic resources. The production and economics of domestic production are adversely affected by conflicting interests in land use, environmental restrictions, stricter regulatory policies, and, in some cases, general public resistance to mining.

The demand for most industrial minerals will continue to remain strong in the future and, for construction materials, will most likely grow. The growth in demand for construction materials will be related to the rebuilding of the country's infrastructure. Changing regulatory policies and shifts in domestic and world economies may result in short-term increases and decreases in the demand for certain industrial minerals.

The USBM will continue to monitor and analyze the industrial-minerals industry to ensure that accurate and timely commodities data and information are available to government and industry decisionmakers. The USBM will continue to undertake special studies to augment information from its routine commodities work to assure that mineral-policy decisions can be based on a complete understanding of the situation.

Assessment of Present and Future Production of Industrial Minerals in the Basin and Range Region

Industrial Rock and Mineral Production in Utah, 1990

By B.T. Tripp

Utah contains a wide variety of industrial rocks and minerals. Mining of these commodities constitutes

an important segment of Utah's economy, with sales exceeding $400 million in 1989 (Charles Berry, University of Utah, oral commun., 1990). The most important minerals, according to USBM production figures, are construction sand and gravel, Portland cement, halite, potassium salts, phosphate, crushed stone, lime, clay, and gypsum (Greeley, 1989).

The DOGM and the USBM provided data essential to the production of this article. The mining-operation files of the DOGM provided much information about current operations (see app. 2); Wayne Hedberg and Holland Shepperd of the DOGM also provided important new data. Commodity-production graphs were compiled from USBM Mineral Yearbook data.

Sand and Gravel

The bulk of sand-and-gravel production in Utah comes from Pleistocene Lake Bonneville shoreline deposits along the Wasatch Front urban corridor from Provo on the south to Brigham City on the north. Sand-and-gravel production is divided into industrial-sand and construction-sand-and-gravel operations. Three operators produce industrial sand in the Salt Lake City area: The Salt Lake Valley Sand and Gravel Co. produces engine-traction sand and mold-making sand for metal casting, Blackhawk Slag Products crushes smelter slag to produce grit for sandblasting, and Union Pacific Resources processes slag into railroad ballast, road metal, and sand-blasting grit. The construction industry, however, uses most of the sand and gravel mined in Utah; 10 large and dozens of smaller operators produce construction sand and gravel.

There are four major sand-and-gravel-bearing Lake Bonneville deposits or benches, which mark long-lived, stable shorelines bordering the lake. The two highest, the Bonneville and Provo benches, provide most of the sand and gravel in the State. The Bonneville bench, which was deposited about 15,000 years ago, is now at an elevation of 5,090 ft above mean sea level and nearly 900 ft above the current elevation of the Great Salt Lake. The Provo bench was deposited about 14,000 years ago at the present elevation of 4,740 ft above mean sea level (Currey and others, 1983).

Annual production of sand and gravel (fig. 3) has increased at a steady rate for the past 30 years, with some notable spikes, apparently due to large construction projects. The extreme spike in 1957 and 1958 reflects the huge amount of sand and gravel used in the base of the railroad causeway across the north end of the Great Salt Lake during reconstruction of that causeway. The spike starting in 1983 reflects the use of sand and gravel to construct dikes around the rapidly rising Great Salt Lake during a period of above-average precipitation. In 1987, about 21 million tons was produced, the largest production since 1958. In 1988, 1989, and, probably, 1990, production has declined somewhat, in part owing to decreases in new-home building and highway construction. However, the long-term production trend is upward.

Portland Cement

Two operators now produce Portland cement in Utah (fig. 4): Ideal Basic Industries, which was recently purchased by Holderbank and renamed Holnam, Inc., and Ash Grove Cement West, Inc., which purchased Martin Marietta's Leamington cement operation. A third operator, the Portland Cement Co. of Utah, recently suspended production from their 400,000-TPY Salt Lake City operation after 92 years of production at the same location.

Holnam, Inc., in Morgan County, uses limestone from the Jurassic Twin Creek Limestone (fig. 4), a natural-cement rock, along with silica from the Triassic(?) and Jurassic(?) Nugget Sandstone, gypsum from the Jurassic Arapien Shale, and iron ore from the Iron Springs mining district in Iron County. The company has recently opened a limestone quarry at Poverty Point at the south end of the Lakeside Mountains. Material from this quarry presumably will be blended with natural-cement rock to produce a uniform product. Fuel used at its Morgan County plant is primarily natural gas, with coal as a backup. Type 1 cement (a general construction cement) accounts for about 30 percent of its production, and type 2 cement (a sulfate-resistant cement with a moderate heat of hydration) about 50 percent. Holnam, Inc., also produces several other types of cement.

Ash Grove Cement West, Inc., uses limestone and shale from the Cambrian Ophir Shale adjacent to its plant. Silica used in Ash Grove's cement formulation is mined from the Permian Diamond Creek(?) Sandstone(?) at the Nielson quarry, a few miles east of Ash Grove's plant. Kennecott slag and Nucor mill scale are purchased to provide the necessary iron. Gypsum is obtained from the Jurassic Carmel Formation on the west flank of the San Rafael swell. The 650,000-TPY plant is coal fueled.

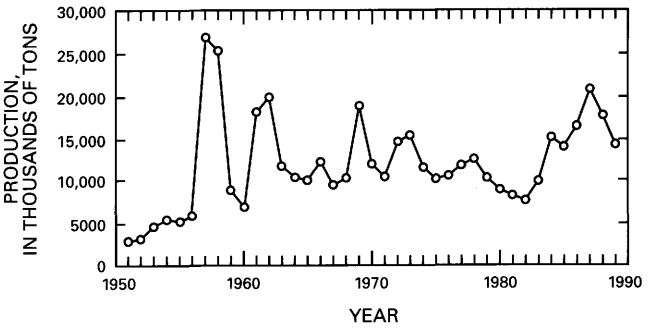

Figure 3. Annual production of sand and gravel in Utah, 1950–90. Data from USBM.

Halite

Significant halite resources are found at seven places in Utah (fig. 5): in the Paradox Basin, in the Jurassic Arapien Shale near Richfield, in salt domes in the Delta area, at Sevier Lake, in the Jurassic Preuss Sandstone in northeastern Utah, in the Great Salt Lake desert, and in the Great Salt Lake. In the Paradox Basin near Moab, Moab Salt, Inc., a subsidiary of Texasgulf, Inc., recovers Pennsylvanian salt from a salt diapir; it employs solution mining followed by solar evaporation. In central Utah, the Redmond Clay and Salt Co. mines halite underground from the Jurassic Arapien Shale for use as livestock salt and table salt. Near Delta, oil and gas drilling at the Argonaut well revealed the presence of a salt dome in Tertiary rocks. The saline section in this well is more than 5,000 ft thick (Mitchell, 1979); no development of this deposit has taken place. At Sevier Lake (dry throughout most of historical time), Crystal Peak Minerals Corp. is developing shallow subsurface brines; it is now producing its first salt harvest and hopes to add a potash plant. In northeastern Utah, the Jurassic Preuss Sandstone contains a poorly known and presently undeveloped salt resource. The Great Salt Lake desert in northwestern Utah contains a large salt resource in three subsurface aquifers; however, there is no current production of halite from these brines. Also in northwestern Utah, the Great Salt Lake has long been the site of an important salt industry. Four

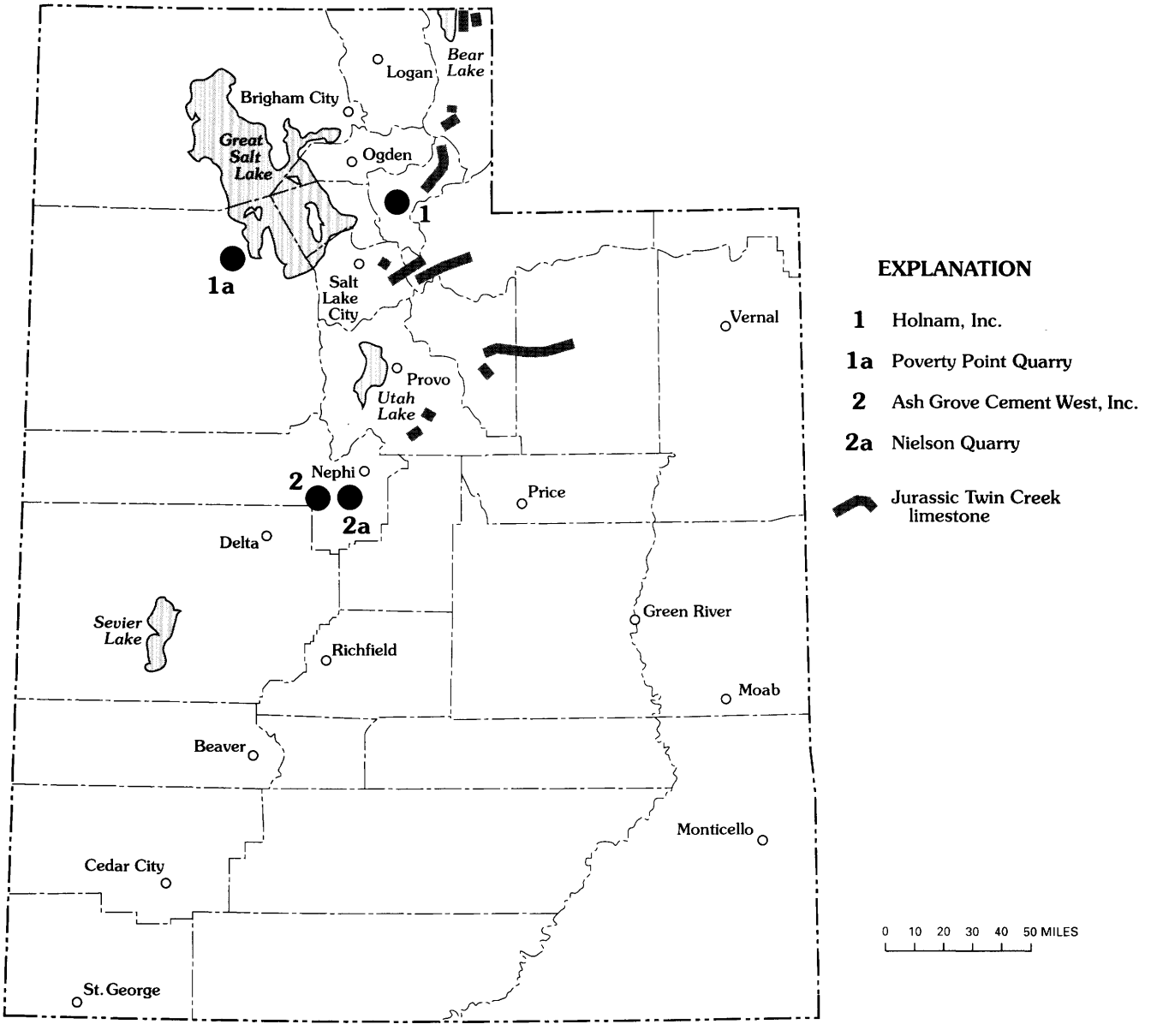

Figure 4. Utah, showing locations of cement-rock occurrences and cement operations in 1990.

operators now produce halite from the surface brine of the lake: the Great Salt Lake Minerals and Chemicals Co., the Morton Salt Co., Akzo Salt, Inc., and the American Salt Co. Salt is recovered through controlled solar evaporation in shallow harvest ponds. The lake consists of four separate brine bodies, owing to density stratification and the presence of the railroad causeway. Lighter brine floats on denser brine in both the northern and southern arms of the lake. The railroad causeway prevents complete mixing of waters between the two arms of the lake. The lake brine contains commercial concentrations of sodium, potassium, and magnesium salts but is not particularly rich in other salable commodities, such as lithium, bromine, and boron (Sturm, 1980). One challenge faced by the Great Salt Lake brine industry is the historical variations in the elevation of the Great Salt Lake. Falling lake elevation strands salt operations miles from the edge of the lake, commonly requiring them to dredge canals to have access to the brine. As the lake rises, the salt resource is diluted, and the dike system around the solar ponds often is severely damaged.

Salt production (fig. 6) has shown a strong growth in the past 30 years, with a more than sixfold increase during that period.

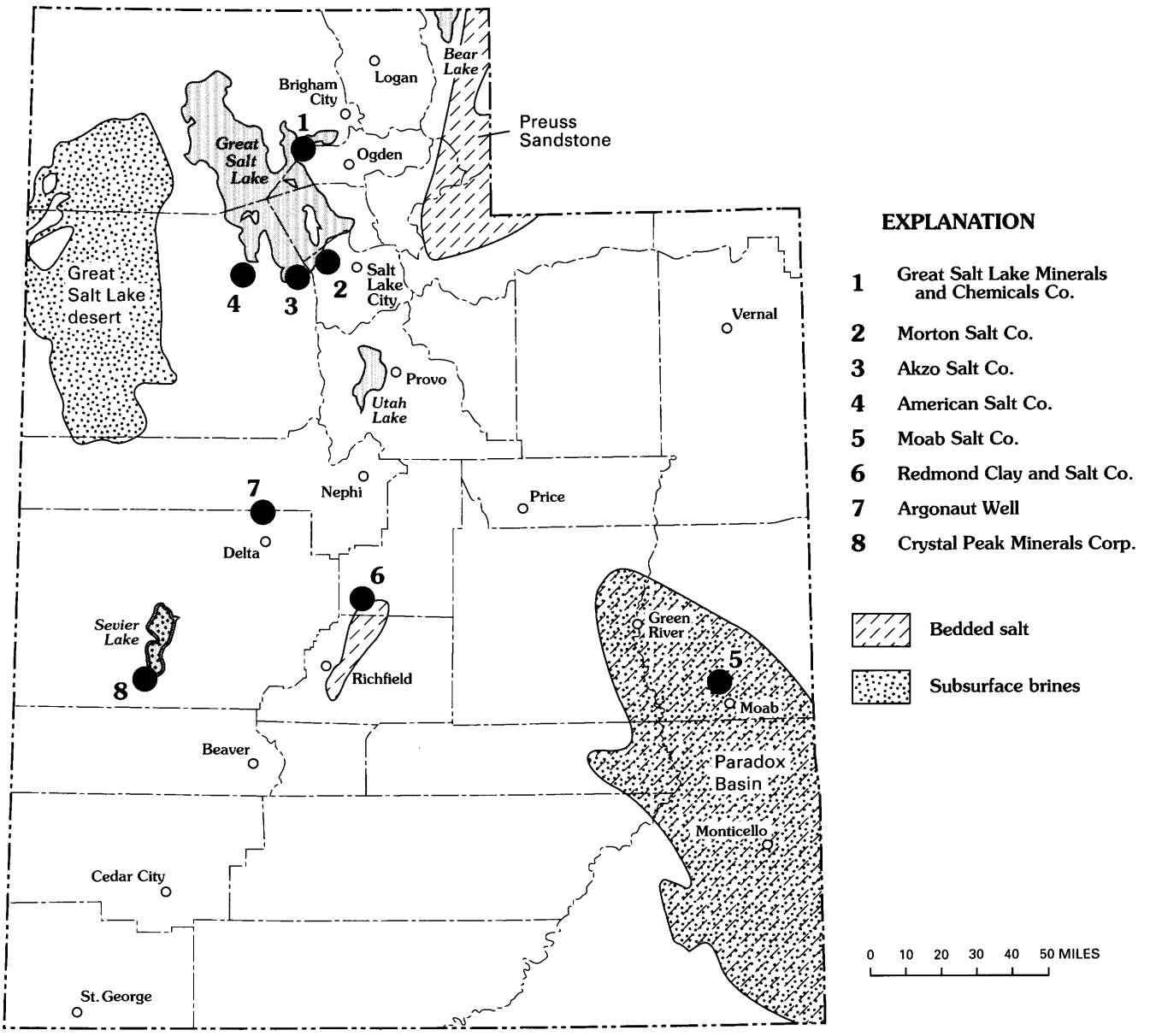

Figure 5. Utah, showing locations of halite occurrences and operations in 1990.

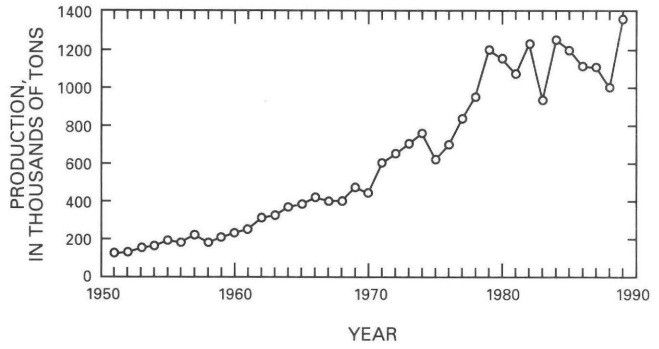

Figure 6. Annual production of halite in Utah, 1950–90. Data from USBM.

Potash and Other Salts

Four localities in Utah contain significant amounts of potassium and magnesium salts and sodium sulfate: the Great Salt Lake, the Great Salt Lake desert, the Paradox Basin, and Sevier Lake. In addition, large alunite deposits in southwestern Utah may be potential sources of both potash and aluminum (fig. 7).

Great Salt Lake

The two Great Salt Lake operations that produce salts other than halite are Magnesium Corp. of America

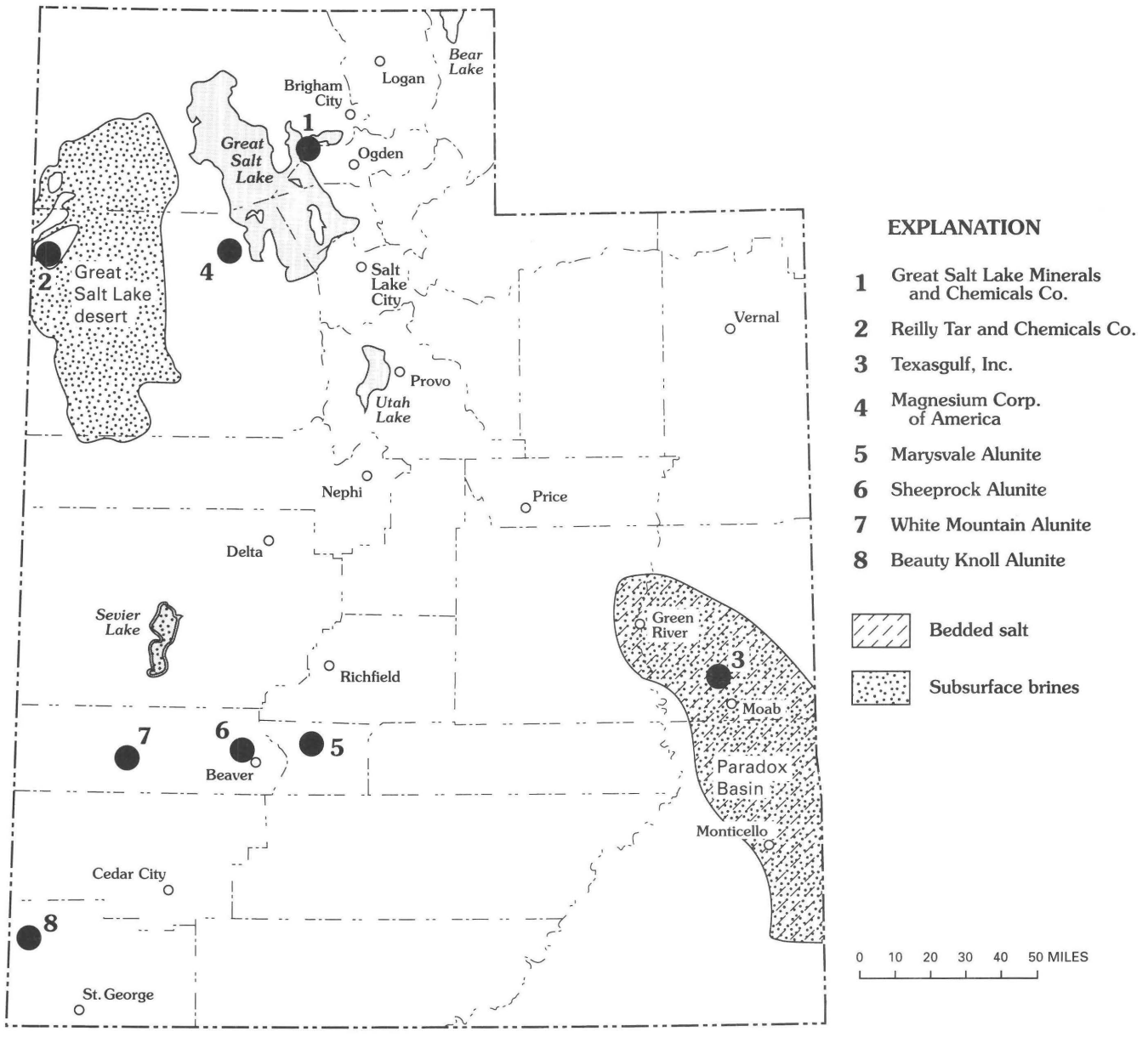

Figure 7. Utah, showing locations of potash, magnesium chloride, sodium sulfate, and alunite occurrences and operations in 1990.

(Magcorp) (fig. 8), which produces magnesium chloride brine for conversion to magnesium metal and chlorine gas, and the Great Salt Lake Minerals and Chemicals Co., which produces potassium sulfate, sodium sulfate (salt cake), and magnesium chloride (see cover). An additional salt resource, buried at shallow depth within Quaternary sedimentary rocks at the north end of the lake, consists of a bed of mirabilite, a hydrated sodium sulfate, which reaches a maximum thickness of about 32 ft. Construction crews discovered the mirabilite while building the original wooden-trestle railroad causeway across the lake in 1903 (Hite, 1964).

Great Salt Lake Desert

Reilly Tar and Chemicals Corp. (Reilly Wendover Division)'s potash plant produces potassium chloride salt and magnesium chloride brine from brines of three subsurface aquifers at the Bonneville Salt Flats near Wendover. The shallowest aquifer, generally less than 20 ft deep, provides most of the brine, which is gravity drained through canals and the plant. Brine "elevators" raise the brine from the canals to the evaporation ponds for solar evaporation. A froth-flotation circuit separates the valuable sylvite from the sylvanite (a sylvite/halite salt mixture) harvested from the solar ponds. Less concentrated brine from a deeper aquifer is produced from wells as deep as 2,051 ft. Wells as deep as 200 ft in an alluvial aquifer north of Reilly's plant provide water used in the plant for processing sylvite (Bingham, 1980).

Paradox Basin

Bedded sylvite, carnallite, and associated subsurface brines underlie a large part of the Paradox Basin. The potash resource occurs within 18 of 29 evaporite cycles in the Paradox Formation of the Hermosa Group; 11 of these cycles contain significant amounts of potash (Hite, 1961). Texasgulf, Inc., produces about 118,000 TPY of potash by solution mining the rooms and pillars of their former underground mine (Phillips, 1975). It produces potash from an 11-ft-thick sylvite bed in the fifth evaporite cycle down from the top of the evaporite sequence. This bed is present at depths of less than 4,000 ft (Hite, 1964). Water for the solution operation comes from the Colorado River.

Sevier Lake

Sevier Lake, dry throughout most of historical time, contains subsurface brines comparable to those of the Great Salt Lake, although the Sevier Lake brines have a higher sulfate-to-chloride ratio and a lower Mg content (Whelan, 1969). Crystal Peak Minerals Corp. is presently producing halite at the south end of the lake and hopes to enter the potash market as well.

Alunite Deposits

The large alunite deposits of southwestern Utah represent an unconventional potash and aluminum resource. These deposits are the largest of their type in the United

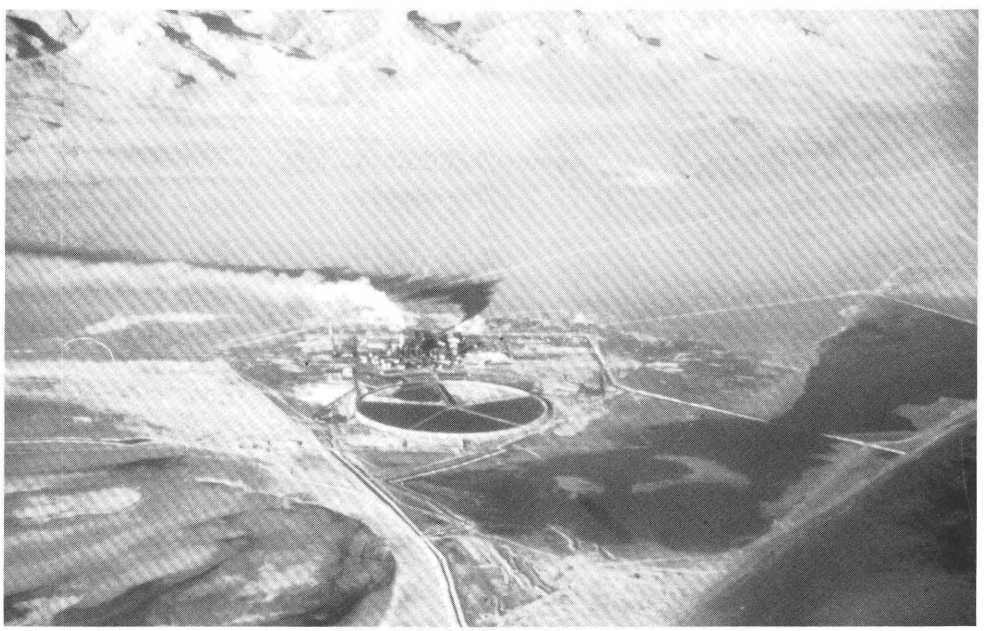

Figure 8. Magnesium Corp. of America (MAGCORP)'s operation on the Great Salt Lake for production of magnesium and chloride brine. Photograph by Howard Newman, Salt Lake Brine Shrimp, Inc.

States. The White Mountain replacement deposit contains an estimated resource of 232 million tons of ore containing 33 percent alunite and an additional 402 million tons of ore containing 28 percent alunite (Hall, 1978). A consortium of companies planned to produce aluminum and potash from this deposit in the 1970's but decided that the economics at that time were unfavorable. The Marysvale vein and replacement deposits were the sites of minor potash production during World Wars I and II.

Phosphate

Three categories of phosphate deposits are found in Utah (fig. 9): bird and bat guano, which accounted for minor early production; Mississippian phosphatic shales of the Delle Phosphatic Member of the Deseret Limestone and the Delle Phosphatic Member of the Little Flat Formation, which have not been exploited; and phosphatic shales of the intertonguing Park City and Phosphoria Formations of Permian age. The only present commercial operation is the Chevron Resources Co.'s Little Brush Creek mine on the south flank of the Uinta Mountains in the Park City Formation. In the past, trucks hauled phosphate concentrates from Chevron's operation into the Garfield plant at Salt Lake City for treatment with sulfuric acid from Kennecott Corp.'s smelter; concentrates were also hauled to the Phoston railroad terminal for shipment to Canada. In May 1986, the Chevron Resources Co. completed a slurry

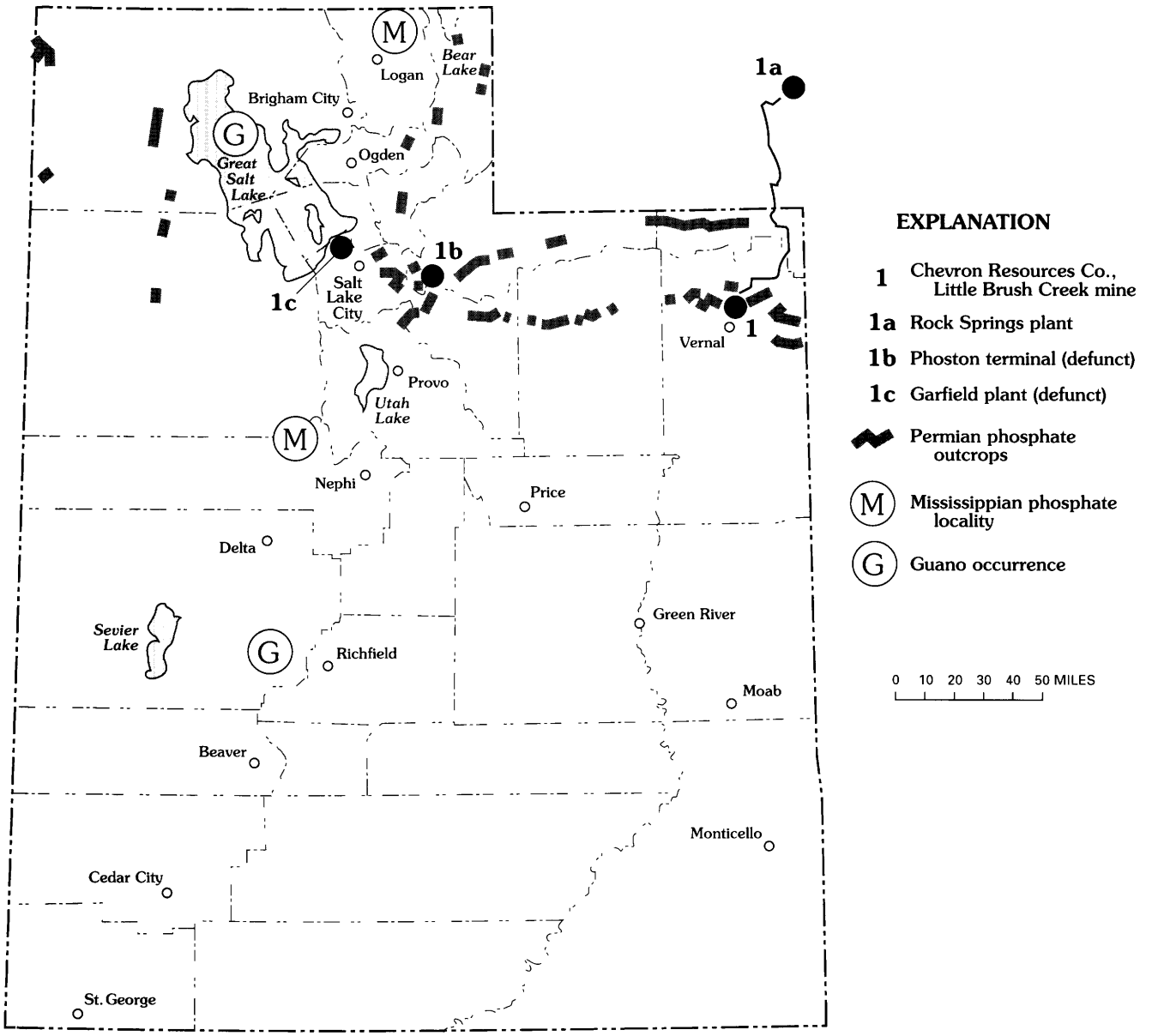

Figure 9. Utah, showing locations of phosphate occurrences and operations in 1990.

pipeline through the eastern Uinta Mountains and now slurries their concentrates to Rock Springs, Wyo., for treatment with byproduct acid from the oil and gas fields in the area (Woody, 1986).

Crushed Stone

Utah has nearly unlimited sources of high-quality rock suitable for crushed stone throughout the State. Paleozoic carbonates constitute the largest amount of material mined for this purpose. The importance of this resource will increase as sand-and-gravel deposits along the Wasatch Front are depleted, or made inaccessible by residential development.

Crushed-stone production (fig. 10) has increased slowly, except during construction of the Great Salt Lake railroad causeway in 1957–58 and during construction in 1983–87 to raise the level of the causeway in response to the rising waters of the Great Salt Lake. An interesting footnote about the quarrying in 1957–58 is that only two blasts at the railroad quarry on the north end of the Great Salt Lake generated a large part of the total production. On July 21, 1957, 1.8 million lb of explosives produced 4 million tons of broken rock. On January 15, 1958, 2.14 million lb of explosives produced 5.9 million tons of rock (Newby, 1980). Seismograph stations in California and Colorado measured the second blast as a magnitude 3 seismic event (William F. Case, UGS, oral commun., 1990).

Limestone and Dolomite

Cambrian to Mississippian formations provide most of Utah's carbonate production. Calcite veins and Holocene oolitic sands of the Great Salt Lake are other sources of present or past production. The eight operators shown in figure 11 produce a wide variety of products. Chemstar, Inc., produces dolomitic lime from the Ordovician Fish Haven Dolomite for construction and water treatment. The Utah Marblehead Co.'s quarry provides dolomite from the Cambrian Lynch Dolomite, which is mined by a contract miner and burned at the nearby U.S. Pollution Control, Inc. (USPCI)'s kiln to provide dead-burned dolomite for refractory use by Geneva Steel Corp., and to provide dolomite-lime for waste stabilization at USPCI's waste-disposal facility. Continental Lime, Inc., located east of Sevier Lake, produces high-calcium lime from the Cambrian Dome Formation for various uses, including scrubbing of sulfur dioxide smokestack emissions from the Inter-mountain Power plant near Delta. Geneva Steel Corp. quarries its own limestone and dolomite from a Cambrian carbonate section for use as a flux at its Orem steel mill. Geneva also ships limestone powder to the coal mines of central Utah for rock dust (to coat flows and walls of mines to reduce the possibility of coal-dust explosions). The Western Clay Co. mines limestone from the Tertiary Flagstaff Limestone for coal-mine rock dust and for crushed stone. Magcorp uses oolitic sand from the shores of the Great Salt Lake as a stack-gas neutralizing agent in their process for making magnesium metal. The L&M General Engineering and Construction Co. apparently will begin producing lime for Hecla's Apex mine in Washington County, if it opens. Cedarstrom Clay and Calcite produces small amounts of calcite for poultry grit from an underground mine in the Mississippian Deseret Limestone and Humbug Formation west of Utah Lake. The Larsen Limestone Co. produces limestone from the Deseret Limestone for sulfur dioxide scrubbing at the Bonanza powerplant near Vernal.

Lime production (fig. 12) has shown a steady increase over the past 30 years. Stockpiling by operators may explain the spike in production in 1985.

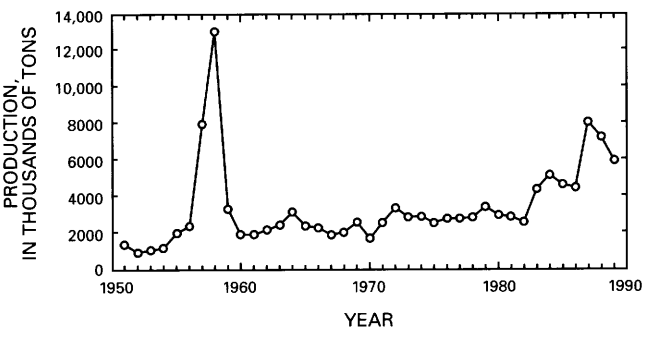

Figure 10. Annual production of stone in Utah, 1950–90, including crushed and dimension stone before 1977 but only crushed stone after that date. Data from USBM.

Clays

Utah has an assortment of sedimentary and hydrothermal clays, including bentonite, bloating clay, common clay, fuller's earth, halloysite, and kaolinite. The two largest clay producers in Utah are the Interstate Brick Co. and Interpace Industries, Inc. (fig. 13), both of which blend common clays from many quarries to produce brick. The Redmond Clay and Salt Co., Inc., produces bentonite for construction and for use in well-drilling fluids. The Western Clay Co. produces bentonite for use in construction and fuller's earth for decolorizing and clarifying. Utelite Corp. mines an organic-rich Cretaceous shale, which expands upon heating into a lightweight aggregate.

The erratic pattern of clay production (fig. 14) largely reflects the cycles in the construction industry. Other factors affecting clay production include the demise of the fireclay industry in Utah, changing public taste in construction materials, and the capture of some of the commercial building market by relatively new, large, rebar-reinforced bricks.

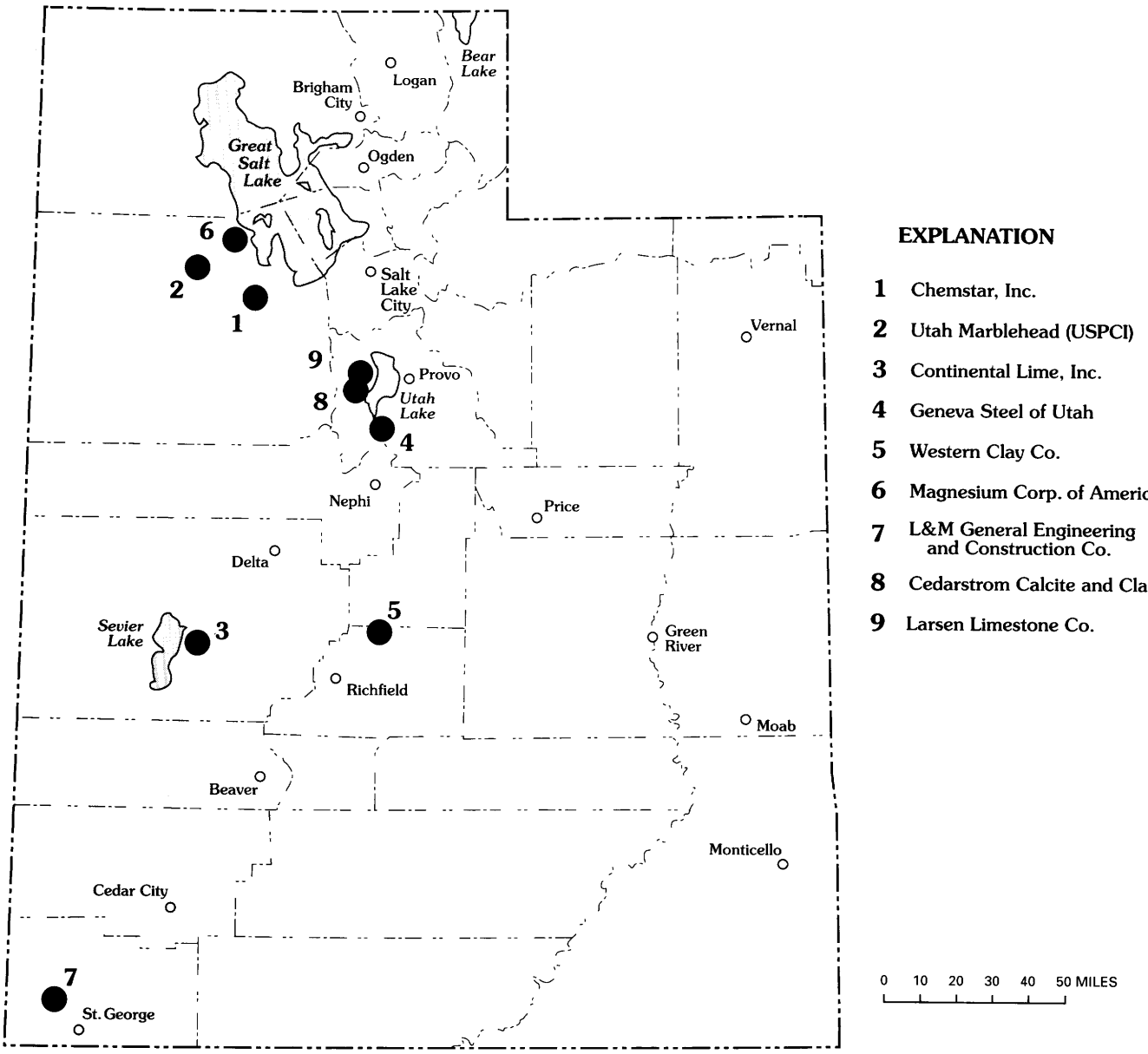

Figure 11. Utah, showing locations of active limestone and dolomite operations in 1990, including producers of calcite but not carbonates used for crushed stone, cement, or dimension stone.

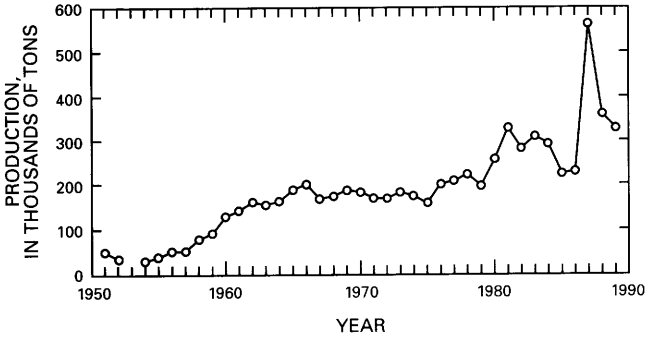

Figure 12. Annual production of lime in Utah, 1950–90, with data withheld for 1953. Data from USBM.

Gypsum

Utah has one of the largest gypsum resources in the United States. Withington (1964) estimated reserves of 2 billion tons of material averaging more than 85 weight percent gypsum in beds a minimum of 4 ft thick within 30 ft of the surface. Although numerous geologic formations contain gypsum (fig. 15), the Pennsylvanian Paradox Formation of the Hermosa Group, the Jurassic Arapien Shale, the Jurassic Summerville Formation, and the Jurassic Carmel Formation contain most of the resource. Georgia Pacific Corp. produces gypsum from three quarries to feed their Sigurd plant, which produces wallboard, plaster, and fireproof cores for doors. The U.S. Gypsum Co. mines

Arapien Shale gypsum near their Sigurd plant for the manufacture of wallboard, plaster, and wallboard joint compound. T.J. Peck and Sons, Inc., mines gypsum from the Arapien Shale near Nephi for export to a cement plant in Inkom, Idaho. H.E. Davis mines gypsum from the Arapien Shale near Levan for shipment to Holnam, Inc.'s, cement plant in Morgan County. Lanny Jensen mines gypsum from the Jurassic Carmel Formation on the west flank of the San Rafael swell for shipment to Ash Grove Cement West's plant at Leamington. Standard Gypsum Products, Inc., mines gypsum from the Early and Middle(?) Triassic Moenkopi Formation in Washington County for export to the San Joaquin Valley of California for use in

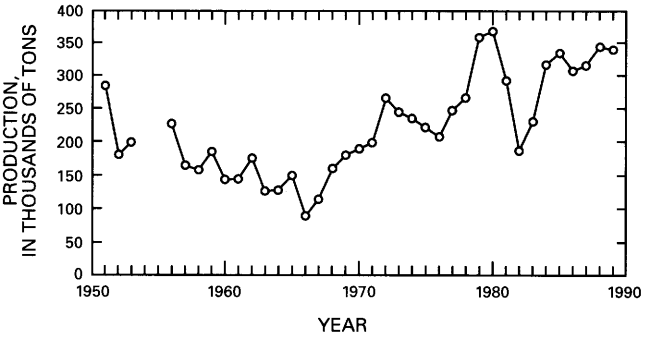

Figure 14. Annual production of clay in Utah, 1950–90, with data withheld for 1954–55 and excluding one or more types of clay for most years. Data from USBM.

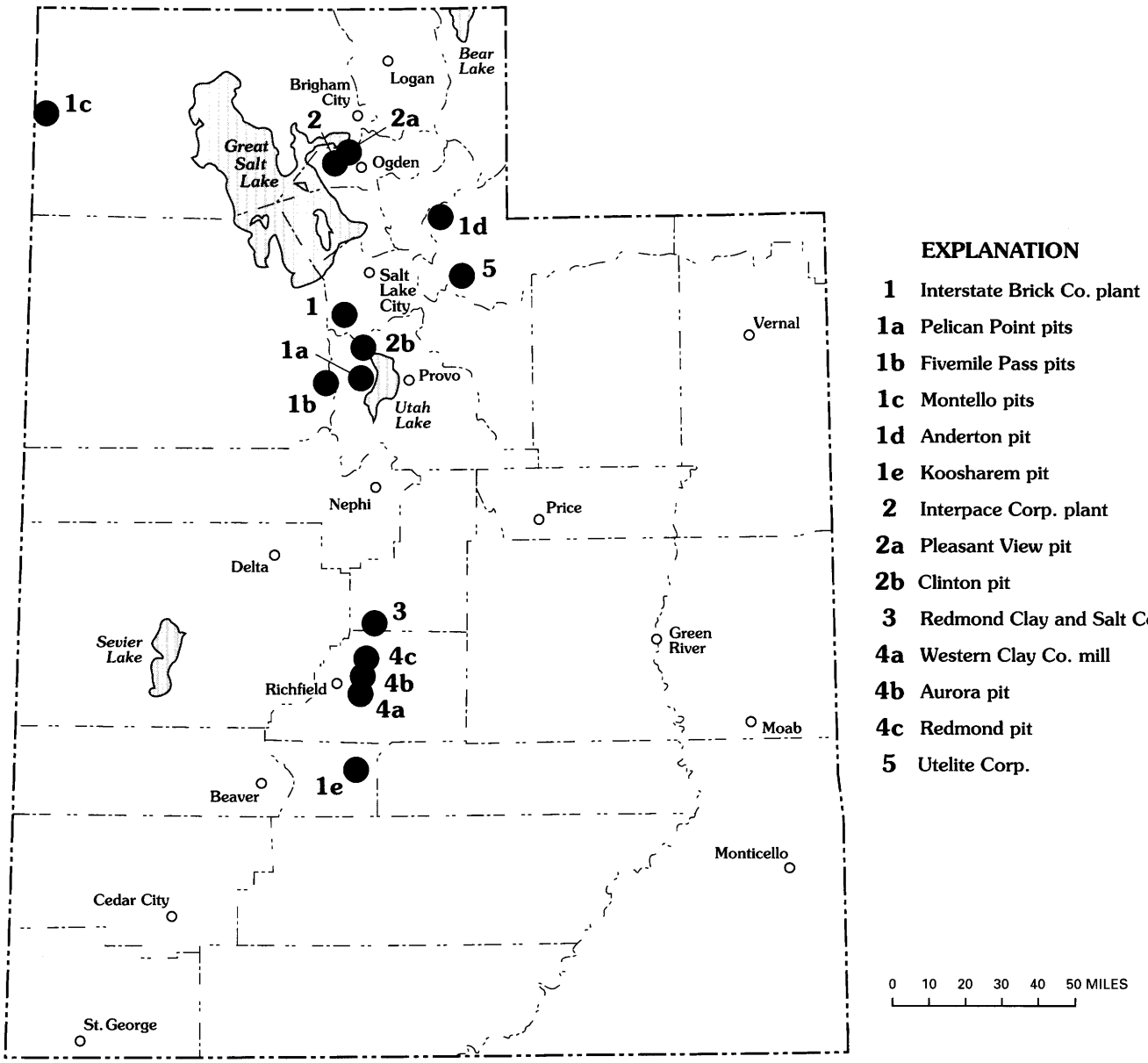

Figure 13. Utah, showing locations of active clay operations in 1990.

agriculture. The White Cloud claims in Emery County recently produced a small initial production of gypsum, probably from the Jurassic Carmel Formation; future development and marketing plans are unknown.

Gypsum production in Utah (fig. 16) has been erratic, but a general upward trend is recognizable. Production figures before 1973 were withheld to protect industry confidentiality.

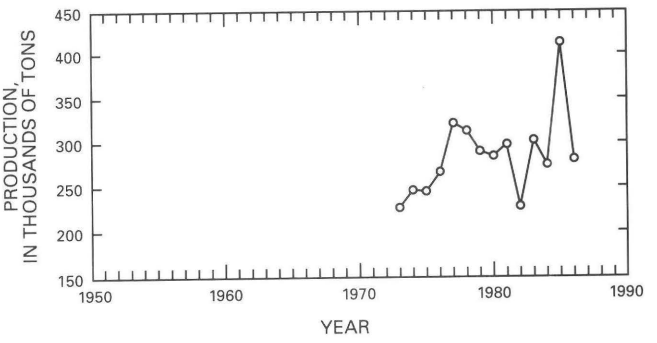

Figure 16. Annual production of gypsum in Utah, 1973–90, with data withheld for 1950–70 and 1987–88. Data from USBM.

Miscellaneous Commodities

Other industrial rocks and minerals that are lower in total dollar value than the nine commodities previously

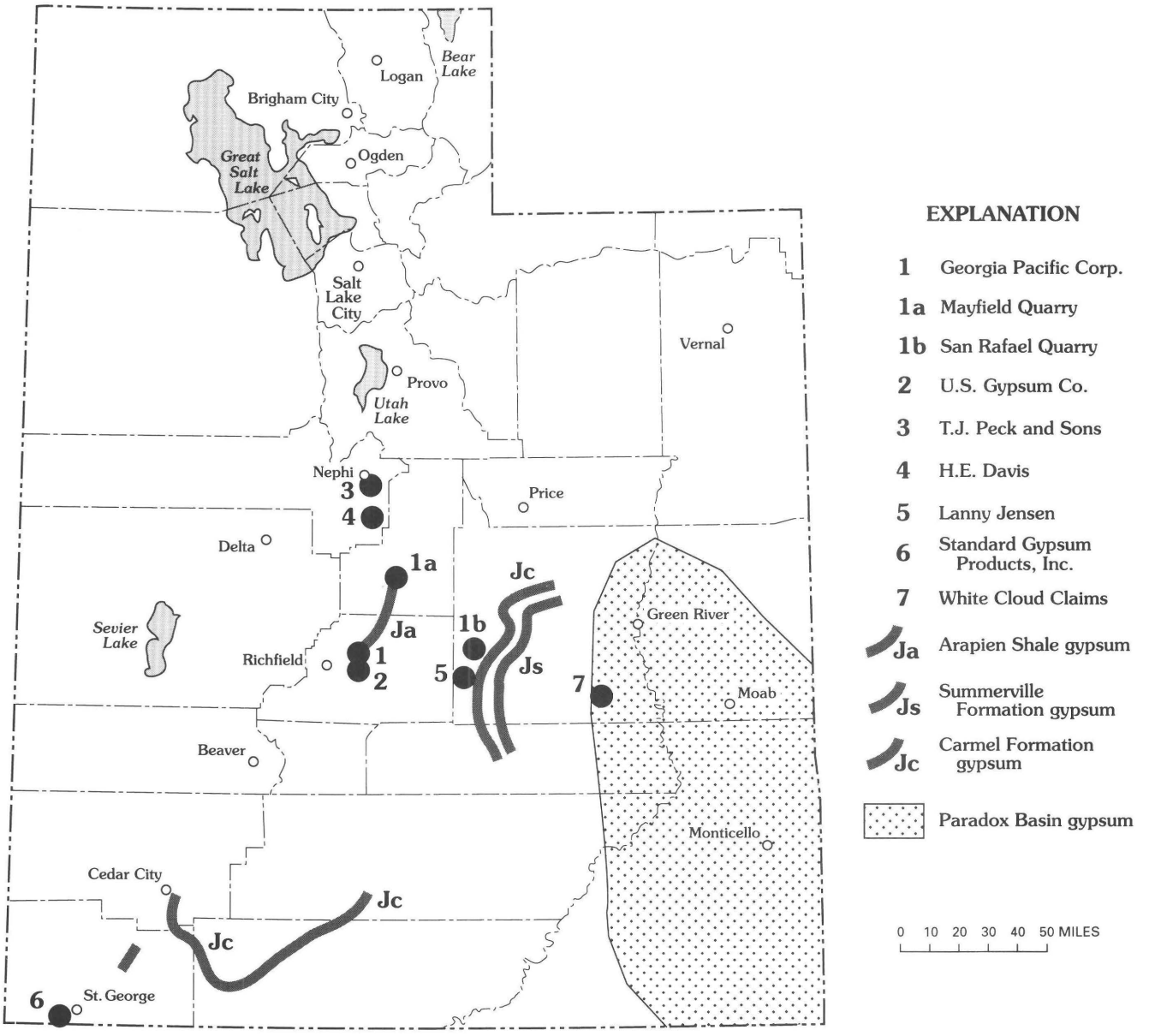

Figure 15. Utah, showing locations of gypsum occurrences and operations in 1990.

Table 5. Industrial minerals produced in Nevada.

High value (more than $500/ton)
Lithium carbonate
Specialty clays
Moderate value ($50–500/ton)
Barite, ground
Cement
Colemanite
Commodity clays
Diatomite
Fluorspar
Lime and dolime
Magnesia
Perlite
Zeolite
Low value (less than $50/ton)
Aggregate
Barite, crude
Dolomite and limestone
Gypsum
Salt
Silica

discussed but that are still important include gem stones, silica, scoria, fluorite, and dimension stone. Commodities present in significant amounts in Utah but not currently in production include barite, diatomaceous earth, magnesite, perlite, pumice, wollastonite, and zeolites.

Industrial Minerals in Nevada

By S.B. Castor

The total value of industrial minerals produced in Nevada in 1989 is estimated at $255 million, a substantial increase over 1988. Nevada's industrial minerals range from low-value commodities, such as aggregate, which sells for an estimated average price of slightly more than $4 per ton, to high-value commodities, such as lithium carbonate and some specialty clays, which may have values of more than $3,000 per ton (table 5).

Industrial minerals now constitute about 10 percent of the total mineral production in Nevada, a relatively minor percentage in comparison with that between 1976 and 1981, when industrial minerals represented more than 50 to 70 percent of the total value of Nevada mineral production (fig. 17). During this period, a boom in barite production coincided with the metal-mining hiatus between the demise of Nevada's copper-mining industry, which dominated the 1950's and 1960's, and the dramatic increase in Nevada's gold production following price increases in the early 1980's. The total value of industrial minerals produced in Nevada has increased over the years. Fluctuations in industrial-mineral production have been influenced mainly by regional construction activity, except during the period between 1972 and 1985, when barite mining, spurred by increased oil-well drilling, became the dominant factor (fig. 18).

In general, Nevada industrial-mineral operations are clustered in the most populated areas to take advantage of local markets and transportation facilities. The locations of operations with verified production in 1989–90 (exclusive of aggregate producers) are shown on figure 19 and listed in table 6.

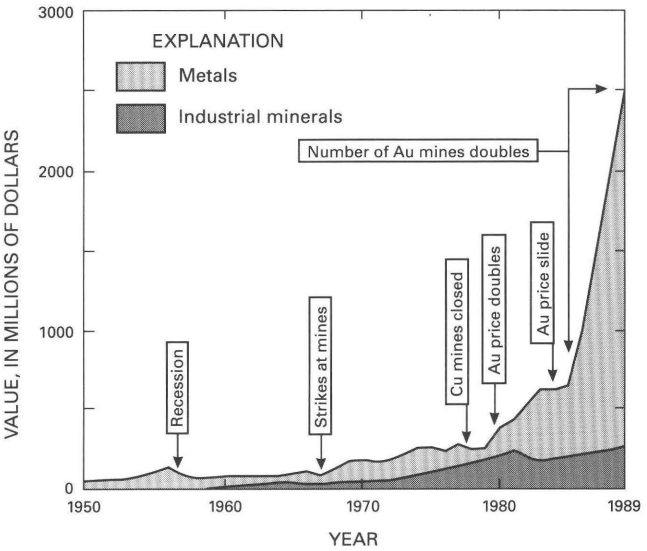

Figure 17. Value of annual production of industrial minerals and metals in Nevada, 1950–90.

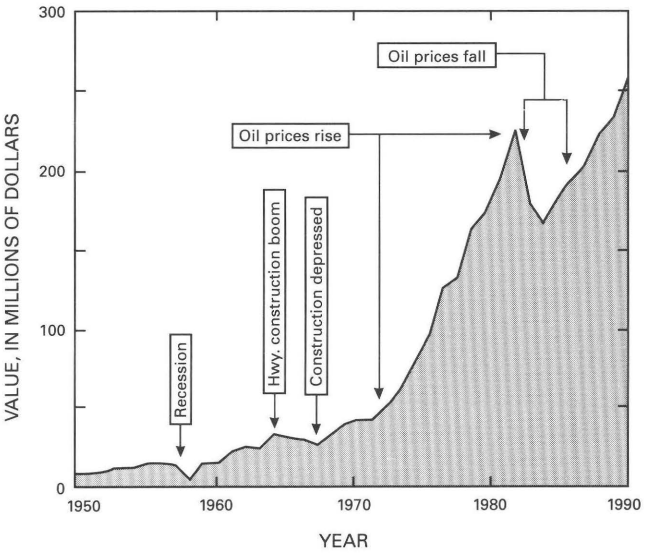

Figure 18. Value of annual production of industrial minerals in Nevada, 1950–90.

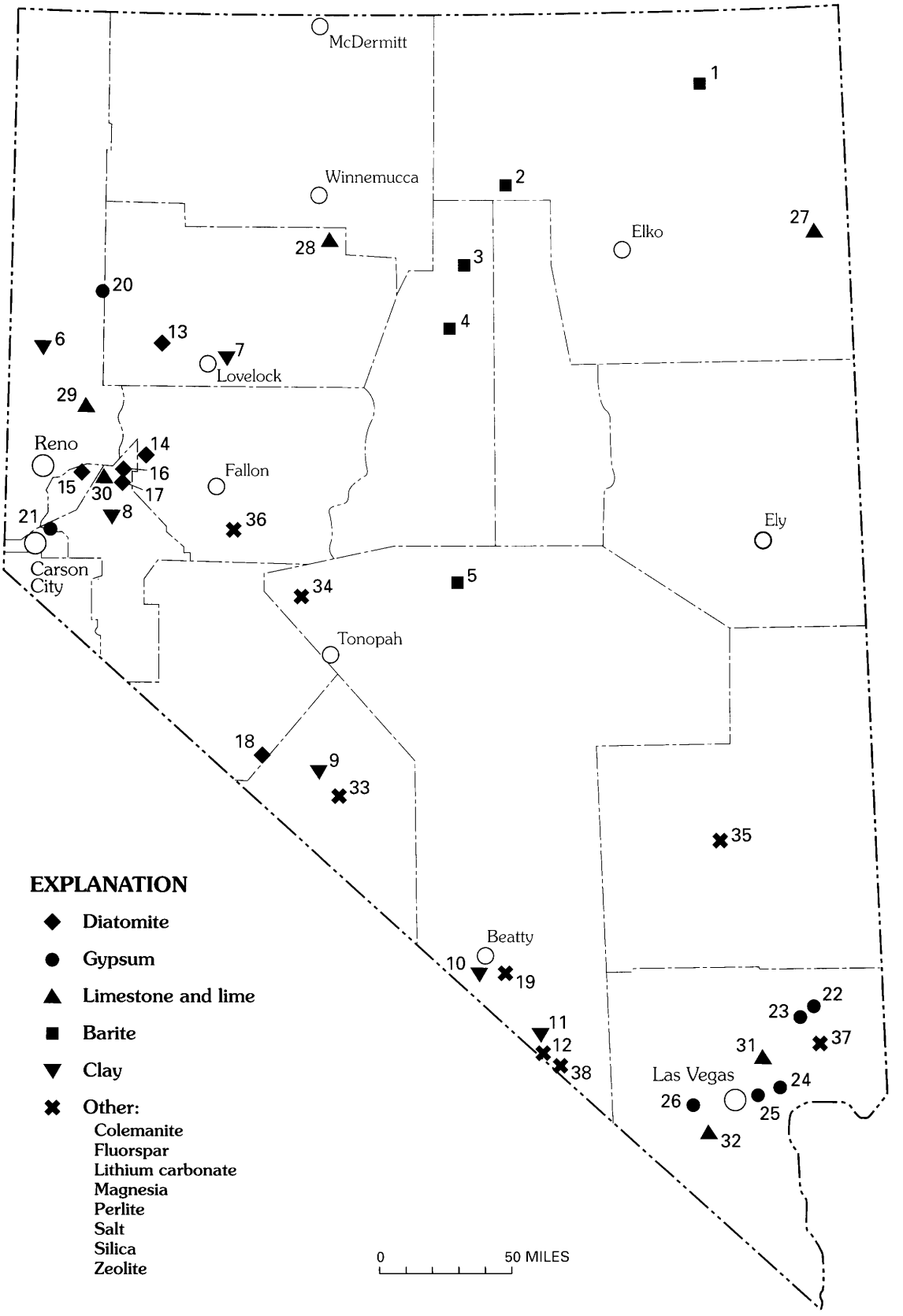

Figure 19. Nevada, showing locations of industrial-mineral operations and production in 1989 and (or) 1990, excluding aggregate producers (see table 6).

Table 6. Industrial-mineral operations, by location and operator, in Nevada with production in 1989 and (or) 1990

[See figure 19 for locations]

Barite

1. Snoose Creek mine; Circle A Construction
2. Rossi mine; N.L. Industries Inc.
3. Argenta mine and mill; Milpark, Inc.
4. Greystone mine and mill; M.I. Drilling Fluids Co.
5. P and S mine; Standard Industrial Minerals, Inc.

Clay

6. Clay mine and shop; Nevada Cement Co.
7. Buff mine; Vanderbilt Minerals Co.
8. Montmorillonite mine; Homestead Minerals, Inc.
9. Blanco mine; Vanderbilt Minerals Co.
10. New Discovery mine and mill; Vanderbilt Minerals Co.
11. Amargosa pit and mill; IMV Division of the Floridin Co.

Colemanite

12. Lathrop mill; American Borate Co.

Diatomite

13. Colado mine and shop; Eagle-Picher Minerals, Inc.
14. Moltan mine and plant; Moltan Co.
15. Clark mine and mill; Eagle-Picher Minerals, Inc.
16. Section 8 mine; Canyon Resources Minerals Corp.
17. Hazen pit; Eagle-Picher Industries, Inc.
18. Dicalite mine; Grefco, Inc.

Fluorspar

19. Daisy mine; J. Irving Crowell, Jr., & SonGyspum
20. Empire mine and mill; U.S. Gypsum Co.
21. Adams mine; Homestead Minerals, Inc.
22. White-Grow Gypsum mine; GKB Nevada Holdings, Inc.
23. Weiser Ridge quarry; Georgia Pacific Corp.
24. North Rainbow pit; Nevada Gypsum & Mining, Inc.
25. Apex mine and plant; Pabco Gypsum
26. Blue Diamond mine and plant; James Hardie Gypsum

Limestone and lime

27. Pilot Peak quarry and plant; Continental Lime, Inc.
28. Dry Creek quarry; Min-Ad, Inc.
29. Marble Hill quarry; Nevada Cement Co.
30. Limestone mine; Nevada Cement Co.
31. Apex quarry and plant; Chemstar, Inc.
32. Sloan quarry and mill; Chemstar, Inc.

Lithium carbonate

33. Silver Peak operations; Cyprus-Foote Minerals, Inc.

Magnesia

34. Gabbs pit and plant; C.E. Basic, Inc.

Perlite

35. Mackie mine; Wilkin Mining & Trucking Co.

Salt

36. Huck salt plant, Huck Salt Co.

Silica

37. Overton pit and mill; Simplot Silica Products

Zeolite

38. Zeolite mine and mill; East West Minerals, Inc.

Aggregate (Sand, Gravel, and Crushed Stone)

In 1989, Nevada's aggregate production was about 20 million tons. The Las Vegas area accounted for more than half of this production, even though some operations were closed for several months, owing to concerns about the impact on the desert-tortoise habitat. More than 98 percent of the production in the Las Vegas area comes from alluvial-fan deposits, which are generally mined to shallow depths and subsequently reclaimed for sale as residential or commercial property. The largest Las Vegas operator, Bonanza Materials, Inc., produced more than 2 million tons in 1989.

Total aggregate production in the Reno-Sparks-Carson City area is less than half that in the Las Vegas area; the largest operator, the Granite Construction Co., produced about 1 million tons in 1989. An estimated 85 percent of the production in the Reno-Sparks-Carson City area is from river gravels, and the rest is from crushed-stone operations.

Aggregate production in Nevada includes increasing amounts of lightweight aggregate consisting mainly of crushed rhyolite. The newest producer, the All-Lite Aggregate Co., expects to mine 500,000 tons of rhyolite in 1990 from its Washington Hill operation east of Sparks.

Barite

Nevada barite production in 1989 was 203,000 tons, less than 10 percent of the production high in 1981 (fig. 20). Only five Nevada barite producers were active in 1989, in comparison with a dozen companies during the boom years of 1973 to 1985. Almost all Nevada barite has been mined from Ordovician and Devonian bedded-barite deposits that are present in a 50-mi-wide belt extending from the southwest State line to the northeast corner of the

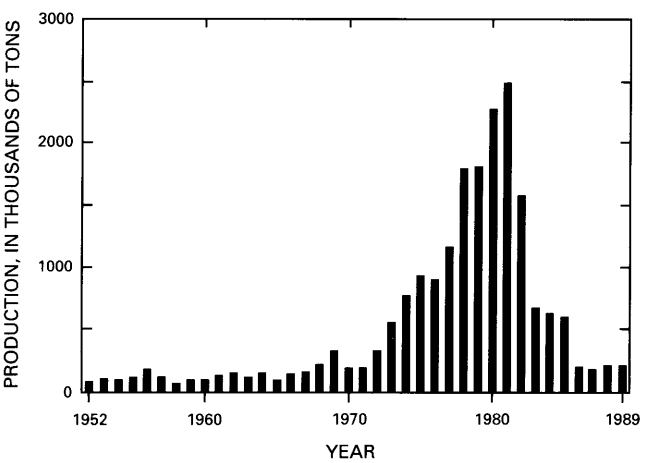

Figure 20. Annual production of barite in Nevada, 1952–90.

State. The largest producers in 1989 were Milpark, Inc., N.L. Baroid, Inc., and the M.I. Drilling Fluids Co. Standard Industrial Minerals, Inc., produces a relatively minor amount of barite from a deposit in central Nevada, which is refined to paint-grade barite and sells for higher prices than barite used for drilling.

Borate

In 1989, minor amounts of colemanite were produced from mill tailings at the American Borate Co.'s plant in southwestern Nevada. This plant, which ceased operations in 1986, originally treated ore from nearby borate deposits in Death Valley, Calif. Because the colemanite was not mined in Nevada, borate was omitted from the estimate of the total value of Nevada's industrial minerals; however, borates were mined in Nevada between 1870 and 1939. Ulexite was harvested from Nevada playas, and colemanite was mined from deposits in Miocene sedimentary rocks near Las Vegas.

Cement

At Fernley, about 30 mi east of Reno, Nevada Cement operates the only cement plant in Nevada, producing about 400,000 TPY. Raw materials are mined locally. Tertiary freshwater limestone comes from a deposit 5 mi south of the plant and is upgraded, when necessary, with high-calcium marble mined 20 mi to the northwest; halloysite clay from a deposit 45 mi northwest and gypsum from 35 mi southwest of the plant are also used.

Clay

The IMV Division of the Floridin Co., the largest producer of clay-mineral products in Nevada, mines sepiolite, saponite, and hectorite from Tertiary sedimentary rocks in the Amargosa Valley of California and Nevada and processes them at a nearby plant in Nevada. The operation produces more than 20 different specialty- and commodity-clay products. Organoclad specialty clays account for less than 10 percent of production by weight at this operation but make up about 70 percent of total revenues.

Small but valuable amounts of montmorillonite used in pharmaceutical and cosmetic products were produced by the Vanderbilt Minerals Co. from operations in Esmeralda, Nye, and Pershing Counties in 1989. The Nevada Department of Industrial Relations also reported montmorillonite mining in Lyon County.

Two major U.S. clay producers, the J.M. Huber Co. and American Colloid, are attempting to develop separate hectorite clay deposits near McDermitt in northwestern Nevada. These developments have been encouraged by increasing consumption and high prices for this lithium-bearing smectite, valued for its ability to form thixotropic gel when added to aqueous solutions in small amounts.

Diatomite

Nevada diatomite production in 1989 was 203,000 tons, approximately the same as in 1988. Diatomite, which is used in filtration, filler, and absorbent products, is Nevada's second most valuable industrial mineral. In general, diatomite market trends have been flat or slightly negative over the past few years because of inroads by perlite in filtration products and by talc in fillers.

In Nevada, diatomite is present in Tertiary lacustrine sedimentary rocks. The largest Nevada producer, Eagle-Picher Minerals, Inc., mines diatomite at three locations in northern Nevada. The company's largest operation is near Lovelock, where diatomaceous earth is mined from a diatomite-bearing sequence as much as 200 ft thick (fig. 21). Three other companies also mined diatomite in Nevada in 1989: Grefco, Inc., produces filler-grade diatomite; Canyon Resources Corp. produces absorbent-grade diatomite; and the Moltan Co. makes cat litter from diatomite.

Fluorspar

The only producing fluorspar mine in the Western United States, operated by J. Irving Crowell, Jr., & Son near Beatty, Nev., was shut down in early 1989. The Crowell operation had been mining high-grade fluorite underground from veins in Paleozoic limestone at the Daisy mine (fig. 22) more or less continuously since the 1920's.

Garnet

A deposit of almandine garnet in the Mount Moriah area of White Pine County, about 15 mi north of Baker, was evaluated in 1988 by a Canadian company, but drilling planned for 1989 was not performed because of environmental concerns. The area contains a placer estimated to contain about 5 volume percent garnet derived from quartz-garnet-biotite-staurolite schist. Demand for garnet abrasives has been spurred by health rulings regarding other abrasive materials, particularly in California.

Gypsum

Gypsum mining in Nevada has grown steadily through the 1980's (fig. 23), owing to vigorous regional construction activity. Production of wallboard from gypsum is an important basic industry in Nevada, particularly in the Las Vegas area.

In 1989, Pabco Gypsum and James Hardie Gypsum were the two largest producers in the Las Vegas area, followed by Georgia Pacific Corp., Nevada Gypsum and Mining, and GKB Nevada Holdings, Inc. Most of the gypsum mined by Pabco is used in a wallboard plant that has an annual capacity of 600 million ft^2. Most of the James Hardie production also goes into wallboard produced at the Blue Diamond plant, which has been in

Figure 21. Diatomaceous-earth mine operated by Eagle-Picher near Lovelock, Nev. White diatomite beds are part of a Tertiary lacustrine sedimentary sequence as thick as 200 ft. Photograph courtesy of NBMG.

Figure 22. Daisy fluorite mine operated by J. Irving Crowell, Jr., and Son near Beatty, Nev. Photograph courtesy of NBMG.

operation since 1941. The Georgia Pacific wallboard plant 15 mi northwest of Las Vegas began production in 1987, with an annual capacity of 175 million ft^2.

U.S. Gypsum Corp., the largest North American gypsum producer, mines gypsum in northern Pershing County and processes it at its wallboard plant, in Empire in Washoe County. In 1989, U.S. Gypsum was the largest gypsum producer in Nevada. Homestead Minerals, Inc., mines gypsum from the Adams mine near Carson City for sales to agricultural users and cement manufacturers.

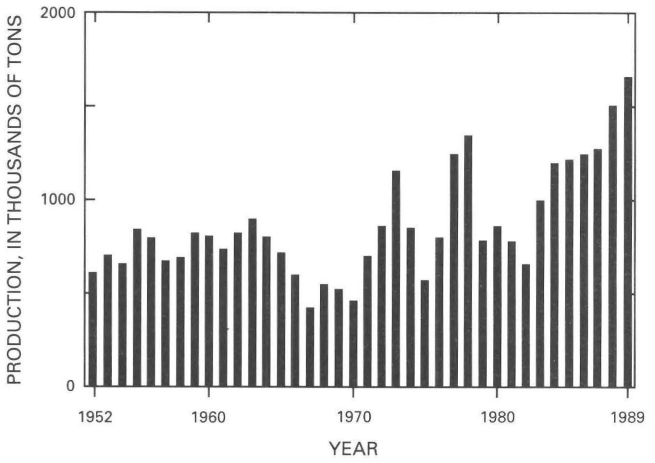

Figure 23. Annual production of gypsum in Nevada 1952–89.

Lime and Limestone

Nevada lime production increased in 1989, partly owing to startup of Continental Lime, Inc.'s Pilot Peak high-calcium lime operation in late 1989 near Wendover in Elko County (fig. 24). However, Chemstar, Inc., is the most important Nevada lime producer. Regional construction remained strong in 1989, and Chemstar operations in southern Nevada, which rely partly on sales of construction lime, were operating at capacity by the end of the year. The company mines and processes both dolomite and high-calcium limestone at operations near Las Vegas. Chemstar is currently exploring for a quality deposit of high-calcium limestone in northern Nevada to meet the increasing lime needs of the gold-mining industry in that area. In 1989, two small companies located near Winnemucca produced relatively small amounts of dolomitic limestone for sale to agricultural users.

Lithium Carbonate

Cyprus-Foote Minerals, Inc.'s production of lithium carbonate from brine at Silver Peak in Esmeralda County increased in 1989 relative to 1988. The company, which is the world's leading lithium producer, is expanding production capacity at a similar operation in Chile; this expansion will lead to lower production rates at Silver Peak in the future.

Figure 24. New lime plant operated by Continental Lime, Inc., near Wendover, Nev. Photograph courtesy of NBMG.

Magnesia

Production at C.E. Basic, Inc.'s magnesite mine and magnesia plant in Gabbs was down slightly in 1989 relative to 1988, owing to slower sales of dead-burned refractory magnesia. However, caustic-magnesia sales were up slightly in 1989.

Perlite

The Wilkin Mining & Trucking Co. mines perlite in Lincoln County and ships both crude and expanded perlite. In 1989, a second furnace was added to the company's popping plant in Caliente, increasing the production of expanded perlite.

Salt

The Huck Salt Co., which harvests salt from a dry lake near Fallon, produced about 13,000 tons in 1989, a 30-percent increase over 1988.

Silica

Simplot Silica Products' operation in Overton produced about 706,000 tons of silica sand in 1989, a 15-percent increase over 1988. Because Simplot's silica sand requires little beneficiation for use in plate glass, it competes strongly with other silica sources in the southern California market. The sand is mined from large reserves in the Cretaceous Baseline Sandstone. Development of similar sandstone in the same unit about 30 mi northeast of Las Vegas is being considered by a Canadian company.

Wollastonite

In late 1989, Sikaman Gold Resources, Ltd., a Toronto, Ontario, Canada-based company, announced the discovery of a major deposit of potential filler-grade wollastonite in Nevada. The deposit, which is in the Gilbert mining district in Esmeralda County about 30 mi west of Tonopah, is said to contain substantial reserves of rock containing more than 50 volume percent wollastonite and high-grade zones containing more than 70 volume percent. Wollastonite, which has never been mined in Nevada, is in demand as a reinforcing filler and an asbestos substitute.

Zeolite

At its Ash Meadows plant in Nye County, East West Minerals, Inc., processed stockpiled clinoptilolite in 1989. Increasing sales to aquaculture users overseas pushed production up by about 60 percent over that in 1988. East West's mordenite operation in Eastgate in Churchill County was idle in 1989. Steelhead Minerals, Inc., was evaluating two Nevada zeolite deposits in Mineral County in 1989.

Table 7. Value of industrial minerals in Idaho

[Sources of data: Bennett (1986), Bennett, and others (1989), O'Driscoll (1989), and McNary and others (in press). All values in thousands of U.S. dollars]

Product	1987	1986
Building stone	15,300	12,700
Cement (limestone)	11,000	11,000
Clay	230	206
Garnet	4,000	3,000
Gem stone	500	500
Perlite	100	100
Phosphate	[1]47,000	82,000
Pumice	213	178
Sand and gravel	12,600	28,000
Total	91,000	138,000
Nonfuel minerals	339,000	269,300
Percentage of industrial minerals	27	51

[1]Decrease in phosphate production in 1987 was due to plant closures.

Industrial Minerals in Idaho

by E.H. Bennett

Idaho is endowed with a wide variety of industrial minerals. The most valuable commodities are phosphate and sand and gravel (table 7). Other industrial rocks and minerals produced in the State include pumice, perlite, garnet, limestone, clay, silica, scoria/volcanic cinder, building stone, gypsum, and zeolites. In 1988, the USBM reported that the value of industrial minerals in Idaho, excluding phosphate, sand and gravel, and crushed stone, was more than $48 million. Idaho also has potentially commercial deposits of diatomite, bentonite, fluorspar, mica, barite, and kyanite; other commodities include manganese, beryllium, thorium, rare earths (black sands), asbestos, feldspar, salt, iron ore, and coal.

The locations of current operations are shown in figure 25, and of potential deposits or occurrences in figure 26. Two of the State's newest industrial-mineral plants are IMSAMET Inc.'s $15 million aluminum-can-recycling plant at Hauser Lake and the new $2.5 million filler-lime plant built by Idaho Lime in Grangeville.

Phosphate

The phosphate industry is the largest contributor to the value of Idaho's non-fuel minerals (table 7). About 10 percent of the Nation's phosphate comes from Idaho. The USBM notes that the 4.7 million tons of phosphate rock mined in Idaho in 1988 was worth more than $81 million. Phosphorus is used in a wide variety of applications, including fertilizer, water softeners, detergents, and food additives. The industry is located in Pocatello and Soda Springs in southeastern Idaho (fig. 27); the various plants and mines employ about 2,500 people, the largest number

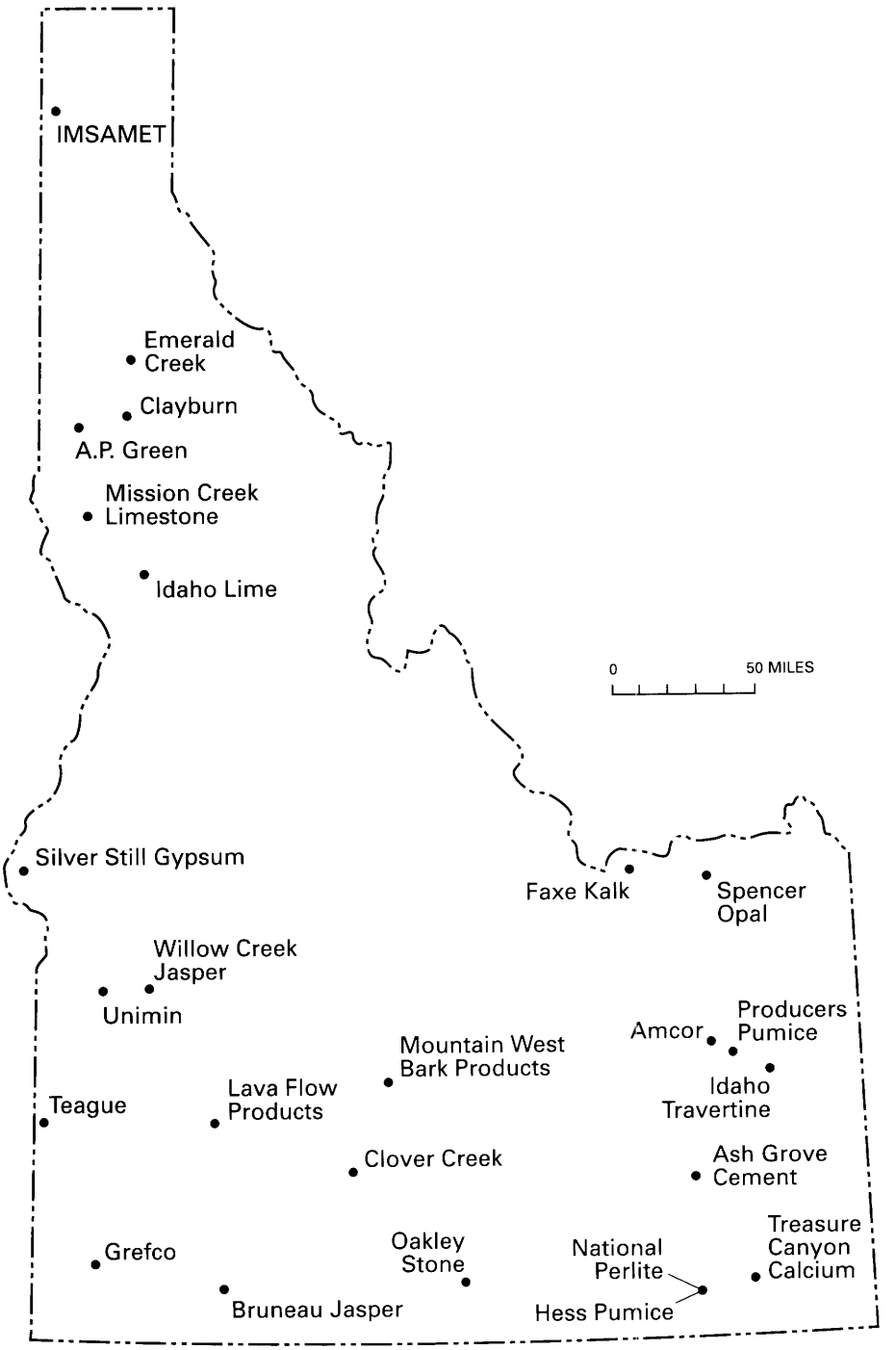

Figure 25. Idaho, showing locations of active industrial-mineral operations in 1989.

of employees in the State's mining sector. The industry is divided into two halves, one producing elemental phosphorus (the Monsanto Co., FMC Corp., and the Rhone-Poulenc Chemical Co.), and the other phosphoric acid (the J.R. Simplot Co. and Nu West Industries, Inc.).

Elemental phosphorus is made by melting phosphate ore in electric furnaces and capturing the volatilized element. FMC operates the largest such plant in the world in Pocatello. Monsanto has an elemental-phosphorus plant at Soda Springs, and Rhone-Poulenc ships ore from Idaho to

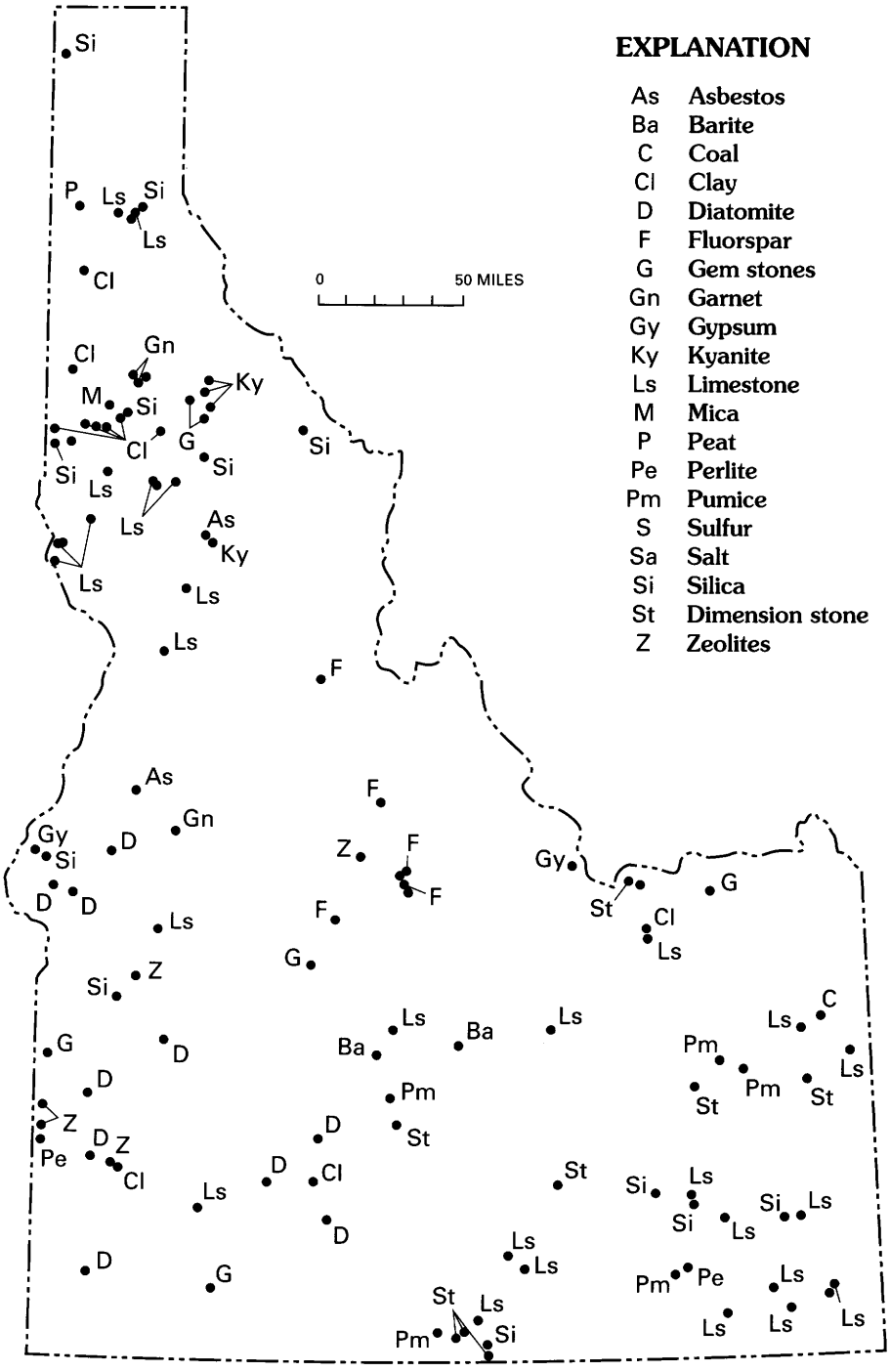

Figure 26. Index map of Idaho, showing locations of potential deposits or occurrences of industrial minerals.

a plant at Silver Bow, Mont. Phosphoric acid is made by combining phosphate ore with sulfuric acid; the acid is then used to make fertilizers. J.R. Simplot operates an acid/fertilizer plant in Pocatello, and Nu West Industries a plant in Conda (just north of Soda Springs).

All of the phosphate ore is mined from open-pit operations in the Phosphoria Formation of Permian age. Monsanto operates the Henry mine. Nu West and the Conda Partnership (a joint venture with Western Cooperative Fertilizer, Ltd.) get ore from the Mountain Fuels lease. Simplot operates the Smoky Canyon mine. FMC currently gets ore from several mines but will soon open a new mine in Dry Valley south of the Wooley Valley mine, from which Rhone-Poulenc gets ore. The ore is transported from the mines to the plants by truck (Monsanto maintains its own road system), by train, or by slurry pipeline (Simplot pumps slurried ore 27 mi from the Smoky Canyon mine to Conda).

Byproducts of the elemental-phosphorus operations are also valuable. Kerr-McGee, which extracts vanadium from ferrophosphorus metal, is the largest producer of vanadium in the country.

N.A. Degerstrom is completing construction of a new plant that will extract gallium and silver from another byproduct, treater dust.

Sand and Gravel

Sand and gravel, as well as crushed stone, have extensive applications in building and construction and are the second most valuable commodities in Idaho after phosphate. More than 40 companies operate sand and gravel or crushed-stone plants, and several hundred quarries or pits are active throughout Idaho. According to the USBM, the value of construction sand and gravel in the State in 1988 was almost $20 million, and crushed stone added another $13 million.

Pumice

Companies mining pumice in Idaho include Hess Pumice (Malad), Amcor, Inc., (Idaho Falls), and Producers Products (Meridian). Pumice, which is a porous volcanic glass, is used as lightweight aggregate for building blocks and other construction materials. Hess Pumice grinds pumice to various sizes and sells its product as an abrasive (used, for example, in Lava handsoap and pencil erasers) and as a polishing medium; the other companies sell pumice for use as an aggregate. In 1988, approximately 57,000 tons of pumice was mined in Idaho.

Perlite

Perlite, another type of volcanic glass, is mined by National Perlite (a division of Oglebay Norton) in Malad. Because perlite contains water, it expands or pops like popcorn when heated. Raw and expanded perlite are used as a fireproofing material, as a filtering medium, and as lightweight aggregate.

Scoria

Scoria also is a type of volcanic glass that is a vesicular cinder material, and generally heavier and darker

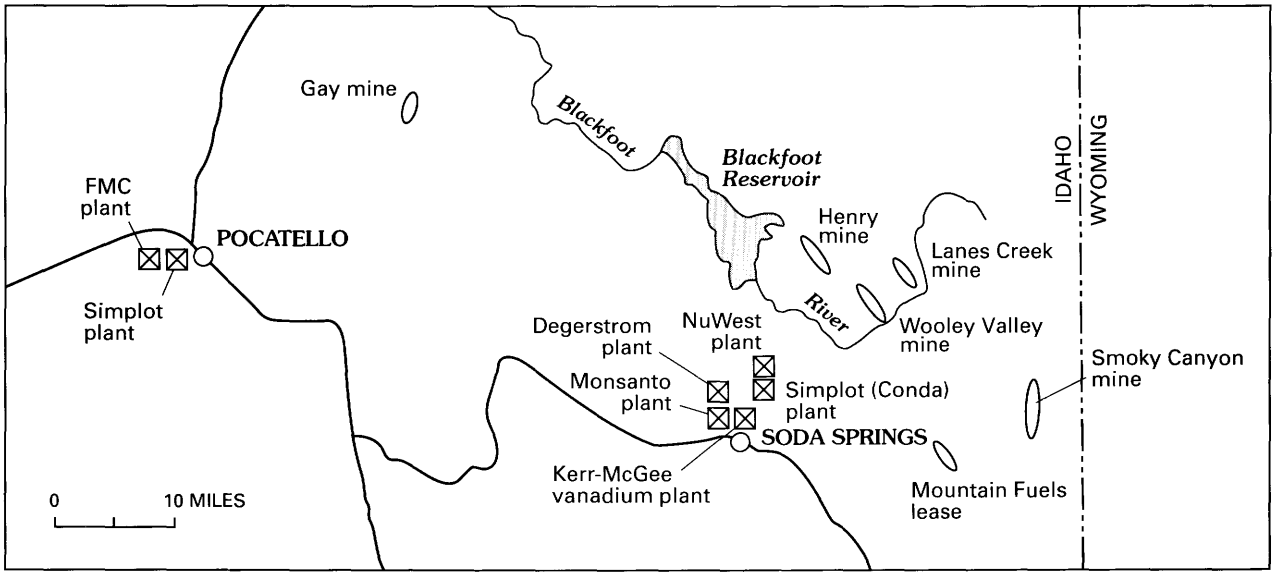

Figure 27. Pocatello, Idaho, area, showing location of the Idaho phosphate district.

than pumice. It is mined by Mountain West Bark Products (Rexburg) and Lava Flow Products (Mountain Home) for use as briquets in gas barbecues, for landscaping, and for aquarium gravel.

Garnet

The Emerald Creek Garnet Milling Co. has the largest garnet operation in the United States, producing more than 25,000 TPY of finished product. The garnets are dredged from Emerald and Carpenter creeks in the State's largest placer operation. Garnet is used as a filtering medium (swimming pool filters), as an abrasive (for example, sandpaper), and for sandblasting.

Limestone and Cement

Limestone is an important ingredient in cement. The sole cement producer in Idaho is Ash Grove Cement, located in Inkom; the company obtains the limestone and silica, the main ingredients for making cement, from pits near its plant. Other limestone companies include Treasure Valley Calcium, which provides limestone for animal-feed supplement and other industrial uses, and the Nez Perce Tribe, which sells limestone to a paper mill in Lewiston. Idaho Travertine in Idaho Falls quarries travertine for use as a decorative building stone.

Recently, the use of limestone as a filler in paper and other products has become important. Clay-based paper is too "acid" and deteriorates relatively quickly, whereas lime-filled paper is more stable and lasts much longer. Two companies, Faxe Kalk and Idaho Limestone, have invested in this market. Idaho Limestone has built a $2.5 million filler-lime plant at Grangeville (figs. 25, 28), and Faxe Kalk has purchased the White Rock lime deposit. Idaho has several limestone deposits that might be commercially developed, only the most important of which are shown in figure 26.

Clay

A high-quality firebrick used by the aluminum and timber industries is produced by A.P. Greene in Troy. Clay used to make the brick is mined near Deary. Clayburn Industries ships clay from this same area to British Columbia, Canada, for making refractories; the companies mined about 23,000 tons of clay in 1988.

Silica

Unimin Corp. is the sole silica producer in Idaho; it obtains pure silica sand from ancient lakebed deposits near Emmett. The silica is sold to companies that make glass bottles and other glass products; it is also used as an abrasive in sandblasting. Monsanto and FMC Corp. quarry quartzite for silica slag in their elemental-phosphorus plants in Soda Springs and Pocatello, respectively.

Building Stone

Several firms quarry and market Oakley stone, a decorative quartzite shipped worldwide as a facing and building stone (fig. 29). These companies obtain their stone from quarries near Oakley; they include Northern Stone Supply, Oakley Valley Stone, Idaho Quartzite Corp., the Star Stone Co., and Ernie Ray Hale Quarries. The S and O Stone Co. quarries quartzite for building stone from near Clayton.

Diatomite

Diatomite is a material consisting of the microscopic skeletons of small animals called diatoms; the skeletons, packed closely together, form a very fine filtering medium, and this is a primary use for the material. The wine and beer industries use diatomite to filter their products. Potentially important deposits are being developed by Grefco in Owyhee County and by American Diatomite north of Gooding (Clover Creek).

Zeolites

Zeolites are a family of minerals that are known as molecular sieves. Most applications use zeolites as very fine filters; the minerals are used for water softeners, in pollution control, as a carrier for fungicides and other products, and as an animal-feed supplement. Large deposits of clinoptilolite, one of the zeolite minerals, are found in southwestern Idaho near the Idaho-Oregon State line, by the old townsite of Sheaville. Teague Mineral Products mines zeolite from these deposits and processes the material at a plant in Adrian, Oreg.; Steelhead Resources also owns large deposits in this area.

Gypsum

Gypsum is quarried from the Iron Mountain deposit near Weiser by the Silver Still Mining Co. All of this material is used for agricultural applications.

Gem Stones

Idaho is known as the Gem State, and for good reason; many beautiful gem stones are found in the State. Active operations include Spencer Opal, near Idaho Falls, which is known for spectacular fire opals. Jasper is mined in Bruneau Canyon and near the old

mining town of Pearl. The famous star-garnet localities are at Emerald Creek and vicinity in northern Idaho. Star garnet is the State stone. The USFS maintains a popular fee-collecting area near Fernwood, and a private company, 3D's Panhandle Gems, markets the stones. Other well-known gem stones in the State include smoky quartz and aquamarine, found primarily in the Sawtooth batholith.

Figure 28. New filler-lime plant operated by the Idaho Limestone Co. at Grangerville, Idaho. Photograph courtesy of IGS.

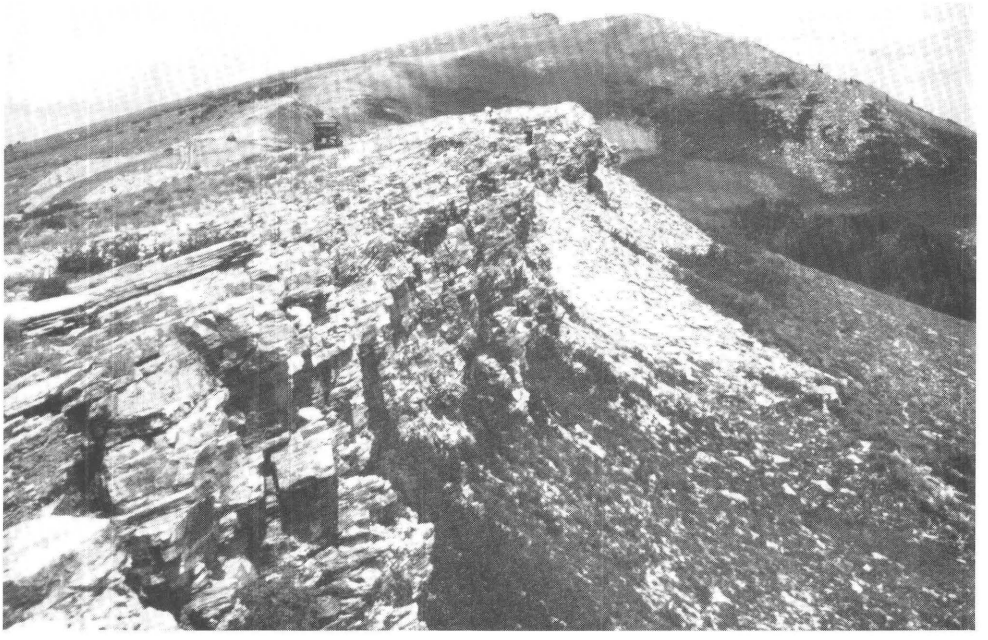

Figure 29. Typical ridgetop outcrops of Idaho quartzite. Photograph courtesy of Don Seehusen, Idaho Quartzite Corp.

Aluminum Recycling

Recently, IMSAMET, Inc., constructed a $15 million aluminum-can-recycling plant at Hauser Lake (figs. 25, 30). This plant will remelt about 80 million lb of aluminum beverage cans per year. The molten aluminum is trucked to Kaiser Aluminum's plant in Spokane, Wash.

Potential Deposits

In the past, mica, fluorspar, barite, and black sands have been mined in Idaho. Deposits of these materials still remain, but they are not commercially valuable at present. However, new products and processes can turn abandoned mines into active properties. For example, recent developments in using rare-earth elements in superconductors has spurred interest in the State's black-sand deposits. These deposits were mined for uranium in the 1950's, but they contain significant reserves of several rare-earth elements that may be useful in making superconducting materials. In the years to come, industrial minerals will continue to play a stable and important role in Idaho's mining industry.

FUTURE NEEDS AND PROBLEMS IN THE BASIN AND RANGE REGION

B.W. Buck, *Moderator*

We now begin a consideration of industrial-mineral problems and some of the numerous challenges facing this industry in the 1990's as it deals with new world markets and additional Federal and State regulations, which are increasingly directed at the mining industry. The industrial-minerals segment of the mining industry faces some challenges that it may not share with many other segments of the mining industry. Among these challenges is the proximity of developed industrial-mineral deposits to urban areas. Some deposit locations are within an urban-suburban environment. This location places the deposit in the unenviable position of being a neighbor to recreational areas or to expensive homes and subdivisions, and it tends to make the permitting of mining operations more difficult.

Industrial-mineral operators have to deal with the socioeconomic constraints of an urbanized or suburban area. Our first panelist, Robert Buchanan, will discuss some of those factors and constraints on the industry. He is currently employed as the principal grants-acquisition agent to the coordinator for Special Development Projects of Salt Lake City Corp.'s Capitol Planning and Programming Division. Previously, he was an environmental planner for the Salt Lake City Planning and Zoning Division, and earlier he was affiliated for 15 years with a consulting firm, Planning and Resource Associates.

The next speaker, James Scherer, has been the EPA's Administrator for Region 8 since 1988; Region 8 covers a large part of the United States and the eastern part of the Basin and Range region. He will discuss some of the Federal policies that affect industrial-mineral operators and their urban neighbors and that constrain and control mineral development, particularly the air-quality/

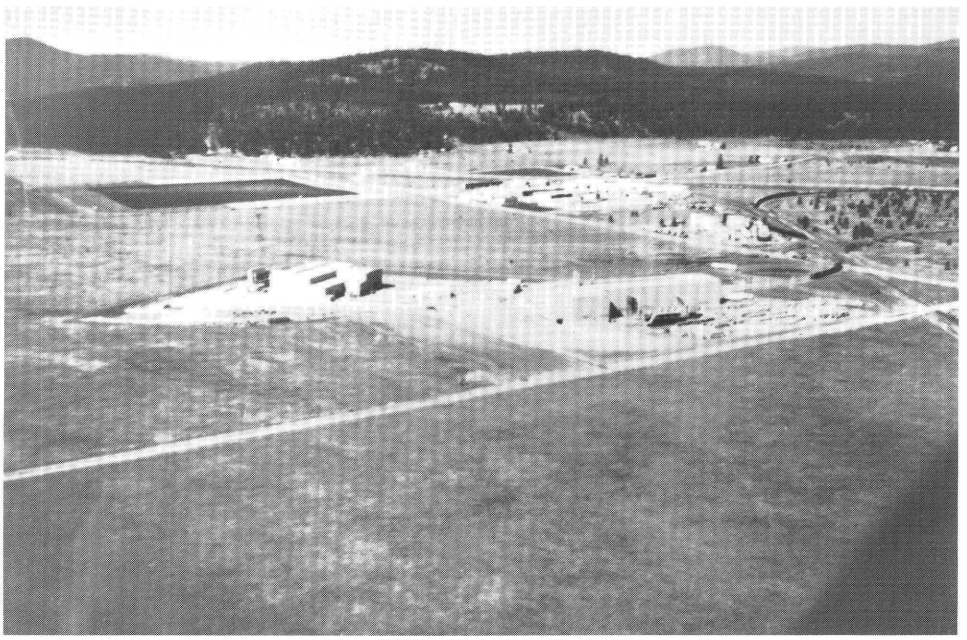

Figure 30. New aluminum-recycling plant operated by International Mill Service Aluminum Metal, Inc. (INSAMET), at Hauser Lake, Idaho. Photograph courtesy of IMSAMET.

wastewater regulations that apply to urbanized areas. After graduating, Mr. Scherer spent 7 years as a business advisor on the Island of Yap in the South Pacific. In 1969, he went into private business in Denver, Colo. He served two terms in the Colorado Legislature and was chairperson of the House Education Committee during 1983–87.

Finally, we examine the problems that the industry faces from State governments, which are taking an increasingly active role in the environmental area, on the impacts of mining operations, and in overall resource management. Dianne R. Nielson, who is the director of the DOGM, the agency that regulates mined-land reclamation in the State, will provide a State perspective. Her experience has been as senior geologist for the UGS's economic geology program, a consulting geologist in uranium and base metals, and geologist for both the Anaconda and Bear Creek Mining Cos.

In the discussions that follow each of the panelists' presentations, participants' questions and comments help clarify the panels' positions or expand the subject area from personal experiences.

Growth of Population and Limitations on Resource Availability

By Robert Buchanan

I'm limiting my remarks to a rather narrow part of the announced topic. You'll note that my technical and professional background is in land-use planning, not natural-resource development. Much of that experience has been in working with local governments, and some of it is related directly to land-use conflicts. From this experience, I've observed that, in many respects, owing to market expansion, it may be more logical to argue that the growth in population in urban areas *enhances* rather than *inhibits* resource development. However, I'll indicate several of the factors that contribute to friction between urban development and the mineral-extraction industry, which, in turn, contributes to limitations on the availability of resources. Although these factors may be confined to only a small part of the mineral-resource business, I think they'll point out the conflicts that typically arise, and they may also apply to other sectors of the industrial-minerals industry. More importantly, I'd like to stress the opportunities to reduce the conflicts that may exist between urban populations and mineral-resource developers.

Shifting Environmental Priorities

I suspect that the vital importance of mineral extraction to local economies in the Western United States has made us so willing to accept the physical changes which mining extraction can bring to the landscape. I've seen a community get much more excited about the height of a building or the availability of a supermarket than about the negative conditions created by an industry. The increased payroll and the infusion of money into a local economy can cover a multitude of sins. This observation is not limited just to changes in the immediate neighborhood. As environmental planner for Salt Lake City, I noted a general absence of concern about the visual impact of the massive Kennecott tailings that were accumulating west of the city, or the gravel excavations and scars that we see on the sides of the mountains north of the city. To emphasize that point, some of you may remember the citizen who regularly posted signs for commuters on Interstate Highway 80, in Salt Lake City near Sugarhouse, complaining about the Federal money being wasted to regrade and landscape the freeway embankment.

Environmental concerns, however, are based on a changing set of priorities that shift in relation to the formation of social objectives. As a local economy diversifies, social priorities almost always change. You can read in the newspaper almost daily of objections to practices that, until recently, would never have been questioned. The challenges by recreationists to cattle grazing on public lands is one example, and to smoke from a coal-fired generating plant 100 mi away is another. Previously, such issues never would have been concerns for urban dwellers.

Factors of Urban Sensitivity

Let me remind you that local government is highly issue oriented and politically responsive, and so city and county governments are best equipped to respond directly to matters that can be confronted at the microlevel. Local complaints about a nuisance chuckhole or a noisy dog will often get more attention from the local government than such issues as air pollution that may affect the health of the whole community. At the same time, local government is highly sensitive to political pressures from a vocal advocacy group or to a well-placed individual who can bring about changes or decisions that may be totally inappropriate in a communitywide context.

It doesn't take a degree in economics to understand that the value of a resource is commonly based on or determined by proximity to its use or the marketplace. Also, note that local government, which commonly has the first line of responsibility on location regulations, usually doesn't benefit directly from any development of mineral deposits. Generally, there are fewer taxes on these commodities than on retail sales. The value to the community comes indirectly through jobs and through the convenience

of having the resource available. These are often hidden benefits, which become even more obscure as an urban economy diversifies and depends less on a limited employment base. Thus, in a diversifying economy, environmental concerns can attain status.

I can account for our passive acceptance of the excavations around the Salt Lake valley only by their necessity. I'm also convinced, however, that such complacency will change as the population continues to grow. Let me cite a couple of examples of the undercurrent of that change.

Beck Street Gravel-Excavation Operation

Several years ago, Salt Lake City began to receive some complaints from a neighborhood group about the gravel-excavation area on Beck Street, which is immediately north of the State Capitol Building, near Interstate Highway 15. There were objections to the dust, the danger from trucks entering and exiting the highway, and the noise from blasting and from operating equipment. Because the complaining group had some political credibility, an assignment was given to appropriate divisions and departments in the city: They were to investigate the complaints and make recommendations to elected officials. Rather than attacking the issue piecemeal, dealing only with such symptoms as noise, dust, and traffic, the question was raised as to the legitimacy of the gravel-excavation operation on Beck Street. Thus, the complaint became the subject of a land-use-regulatory review by the planning and zoning department. As the investigation proceeded, it became obvious that this situation was very complex.

The city proceeded to research the evolution of the land ownership, map the sequential changes in the areas excavated, and note the general purposes for which the material was being used. Distinctions were even made between excavation of material and mining of bedrock, because the zoning ordinance differentiated between mining and excavation. The city's legal office examined aspects of the nonconforming uses and acquired privileges. The initial finding seemed to indicate that much of the Beck Street operation was in violation of city ordinances, with substantial grounds for taking corrective legal action.

It was fortunate for the Beck Street operators that the city took this matter so seriously. First, because serious matters take careful deliberation in a bureaucratic setting, it took a long time to get a clear picture of the situation. By then, the emotionalism that brought the matter to the surface had subsided, and no extreme corrective action was taken by the city. Second, once the problem of being a compatible neighbor had been raised, it provided a forum to begin looking at the problem from a comprehensive point of view. Because it had been 60 years since Salt Lake City adopted its regulatory ordinances, those ordinances have only minimal consideration of mining and excavation in an urban setting. In a broader perspective, however, the situation has spawned a change in the city's regulatory mood, and there will be efforts to close what is perceived by some people to be zoning loopholes.

Developing a Proactive Stance

The point of this example, which affects at least some of the industrial-mineral-mining industry, is to open an opportunity for me to suggest that some kind of *proactive* measures should be taken by the industry in advance of losing its important stance of having resource proximity to urban areas. Let me give you another example to stress this point.

About an hour's drive north of Salt Lake City is a small community that sits on a rather large alluvial fan, which is where we usually build our communities because of the availability of water. In the mountains above this community is a great source of gravel and rock for construction purposes. Not far away is a reclamation project which periodically requires that material. Because of the history of flooding in this community, several years ago the city developed an ordinance that restricted excavations through creation of a *sensitivity zone*, which was tied to a geologic-hazard standard.

Recently, when a request was made to open a new excavation site, the application was denied on the basis of the sensitivity provision of the zoning ordinance. When the community stated that its zoning position was not negotiable, the excavator challenged the validity of the ordinance on the basis of a technicality in the adoption process 20 years previously. The court agreed with the excavator, and he was able to establish his operation in the few weeks that it took to enact a new zoning ordinance. Incidentally, the new regulations are even tighter than the original ordinance. However, I do see an important missed opportunity to form a productive protective relationship between the local community's concerns and the broader community, with its needs for access to the resource, and the industry. All entities would have benefited by resolution of the conflict through negotiation. Ultimately, the battle is always lost to urbanization.

Concluding Recommendation

The recommendation that I'd like to offer at this workshop is for you to find some way to avoid solutions to resource-access problems by direct confrontation. I advocate giving serious consideration to activating an industrywide initiative with a mission of improving the working relationship between local government and the mining industry. I don't know whether such an advocacy

position already exists, but if it does, it has such a low profile as to be virtually invisible. In my experience with local government, I have yet to see it. I believe that a proactive approach has merit, is worth considering, and certainly is needed.

Participants' Discussion and Comments

The following points of discussion and comment on future resource needs and problems centered on three main topics: (1) recommendations for developing a better relationship between industry and government regulators, (2) some positive examples of environmental concern shown by industry reclamation actions, and (3) long-range resource planning. Contributions to these sections have been grouped under each heading.

Recommendations for Better Industry-Government Cooperation

- You're recommending something that we can't directly arrange for here. Some other forum, such as a coalition, which will be considered later on, may be the appropriate venue. Your recommendation, however, is an important contribution toward assuring that resource development can continue to grow in an environmentally responsible manner. I'd be interested to hear from the State representatives and from other agencies how they view this suggestion and how this issue would be perceived in their respective States. What critical issues should be addressed in this regard?

NDM Reply

In Las Vegas, we're growing as rapidly as anywhere else in the Nation. One thing I've seen is that some sand-and-gravel operators in Las Vegas are being squeezed out, owing to a county management plan in concert with the BLM. There'll be some real problems in the next 5 years as even more operators are forced out of the valley. As it is, the areas where the operators would normally be forced to move, some distance away, are probably going to be protected as a desert-tortoise habitat. This situation creates a double-edged problem.

Some of the environmental projects that are being considered in the Las Vegas area actually are rather innovative. The planners and operators are looking at ways in which the sand-and-gravel producers can work together more effectively. The Las Vegas area has a great potential for flash floods, and so they're considering using sand-and-gravel pits, strategically situated, as flood-control basins. Other similar possibilities might be studied, depending on the local environment. As you said, the operators and government agencies need to be more involved in some of the overall planning processes in their areas, and the operators also need to spend a lot more time informing local-government regulators about what's going on, the options, and the impact of the decisions being made.

NBMG Reply

The same thing applies in the Reno area, where there are problems with opening new operations. Reno is heading away from using river gravels toward using crushed stone. Even some of the best attempts to start up crushed-stone operations, which would do away with some of the problems noted earlier, have met with a lot of resistance. Basically, it's the NIMBY syndrome, which also applies 5 mi away from your house, if not next door. One problem in both the Reno and Las Vegas areas, which are rather rapidly expanding urban areas, is the lack of basic data on where resources are located. One thing that needs to be looked at is putting some sort of effort into collecting basic information, as, for example, has been done in the Sacramento, Calif., area under SMARA. I don't see how any planning body can make any rational decisions without having basic geologic data and economic analysis at its fingertips. Therefore, the mining industry must participate in providing such data.

UGS Reply

Along the Wasatch Front and, probably, in other areas in the West, we're living in something of a fool's paradise because, up to this point, we haven't had to worry about sand and gravel; it's so abundant that there hasn't been a supply issue. Thus, we're accumulated very few resource data on these materials; we don't have a GIS data base that county and State planners can use. The turning point is coming when we'll no longer have the luxury of dealing with an abundance of sand and gravel. We can use the experience of people in such areas of the world as southern California, the U.S. east coast, and England to serve as models for what our future is going to be like. They have developed and are developing serious programs for looking at crushed-stone and aggregate resources, and we'll have to follow their lead and collect pertinent data and get them into the hands of decisionmakers.

IGS Comment

One problem I have at these meetings is that we always hear the negative side of how sand-and-gravel operators in and near cities are being shut down. The only way to keep an operation going is to haul everyone into court, which means that the cost of sand and gravel per yard increases dramatically. What about the success

stories? Are there any out there? Are there any sand-and-gravel operators working successfully in urban areas? I have no personal knowledge about sand and gravel, even in Idaho. There must some successes. There are many cities using sand and gravel. How are the operators handling their public relations and the environmental mitigations that are required for them to keep running? Or are we closing up shop everywhere in urban areas? I think this would be the subject for an interesting study. If a consortium is formed, or if the USGS, the USBM, or university researchers want to take a look at some of these problems, they should be considering the positive side of the issue as well as the negative. I have a feeling we're going to keep hearing that New York doesn't have any sand and gravel because they've built over all the sand-and-gravel deposits on Long Island, and Denver is going the same way. This is the standard litany. Where's the other side of the story from which we might learn how better to deal with the problem here in the Basin and Range?

- There are deposit models that we can follow here in the United States in terms of obtaining an adequate data base for decisionmaking. Between 1959 and 1975, the USGS developed a comprehensive mapping program for the Denver-Boulder, Colo., urban corridor (Colton and Fitch, 1974; Crosby, 1976). A resource map was developed as part of that series of maps that not only located but also evaluated industrial-mineral deposits—specifically, sand and gravel and aggregates. What will be required, however, is some sort of funded cooperative effort, probably involving the USGS, the USBM, and the various State geological surveys, to develop exactly that type of data base. Mapping of resource information in urban areas, where such information is necessary for planning, should have top priority.

- There's no reason why the sand-and-gravel industry has to be an adversary to further growth. I'm not saying that it's always been compatible, but I think another problem is the lack of dialogue there. Once you have your community backing, you can make the Beck Street resources available, rather than hauling them from 100 mi out. If not, you pay the price! Somehow the industry manages to find and deliver these materials, which are as valuable as other resources needed by society. We have to advocate the protection of a resource, or we lose it. Thus, the industry must speak out.

Reply: Your point is well taken; it's long been recognized that education of the general population is the real problem. The PR that you have to put forth to try and counteract some of the negative visibility isn't available at present. There've been some programs on PBS, but in general there's no coordinating effort that I'm aware of to try to do this. I think the industrial-mineral commodities would benefit from such a sustained educational effort.

Industry Environmental Concern

- At the California workshop last year, we heard from the southern California sand-and-gravel people that, apparently, there are some good examples of areas where they've excavated river gravels, reclaimed the land, and installed hotels, golf courses, and parklands. The second use of the land was an integral part of the reclamation plans. Another example was the sequential use of some of the deep excavations in Los Angeles as landfill sites, followed eventually by use as industrial-park areas. These examples illustrate good directions to move in, but the type of necessary collaboration required for such good examples of reclamation isn't happening in all areas.

- One success story about the development of an aggregate resource in Virginia was related at the 1990 Industrial Minerals Forum. The process that the operators went through was nearly as follows. First, they identified a market need in the Washington, D.C., area. Second, they looked at the county-board plans and dismissed any area where it was obvious that environmental regulation would cause troubles for development and production. The most favorable political attributes were considered. Then, they went to a geologic map; they found the rock types that they thought would be suitable and tested them. Next, they went to the zoning people and started a proactive process; it wasn't a defensive and antagonistic process. Their approach was couched in terms of, "We want to develop here, and we want to convince you that we're going to be good neighbors, as well as good taxpayers." They went to great lengths to convince people that the development would involve responsible excavation and crushing activities. Within a year, the operators were not only enthusiastic but also optimistic. They planned, when the existing quarrying operation ends, on turning it into water-storage basins or lakefront-property sites, thereby increasing the value of the lands as real estate, greater than for the aggregate that was extracted. We visited their plant, which was beautifully maintained; people could visit it and go away with a feeling that the operators were, in fact, responsible partners. The proactive and "let us cooperate with you" type of role really paid off.

- In my opinion, the answer to the question of access to resources is education of the public and the legislative bodies. In spite of many available data bases, however, the decisionmakers, especially at the county level, are acting without being informed on what resources are available. That type of education should be the responsibility of the national as well as the State trade

associations. In California, mining permits are granted by the counties; the State doesn't have any such power, in spite of SMARA (Beeby, 1988). The State acts only in the capacity of an advisor, but it supplies the counties with a significant amount of unbiased information about the importance of the designated deposits.

We've heard about the successes in Los Angeles, where aggregates are presently being mined, in planning to develop those areas being excavated once the excavation is completed. It's important for the States to learn more about what's available, how important those reserves and resources are, and about the economic and environmental impacts of hauling aggregates into an area from 50 to 100 mi away. The NIMBY syndrome is affecting many areas of the country, especially around airports, where people buy land because it's cheap, build on it, and then 5 to 10 years later try to shut down the airport. There must be balance, and the only hope for achieving it is much more effective education of the public.

- Dresser Industries mined a large fluorspar deposit that started with complete approval of the project before it was begun. It was mined completely and backfilled. The area is now used as an example for company promotion to obtain access to other areas. This operation was in an English park system.

The pleas that I hear for industry and local government getting together aren't easy to respond to. This is America; we in industry are in competition with one another. To ask us to get together with local governments and try to set up working rules without creating a monopoly isn't realistic. You're not going to have one sand-and-gravel outfit help another competing sand-and-gravel outfit. So, the cities themselves must look for where the resource they need is coming from; if they can't obtain it nearby, they'll have to pay more for it. I think any sand-and-gravel operator would be willing to come in and talk with the city council, but if you expect a consortium of sand-and-gravel people to come in and help make laws, you'll be on shaky ground. There's the additional hazard that if one government agency sits down and makes a set of rules, another governmental agency may come around and says this can't be done because of the antitrust law.

Long-Range Resource Planning

- There's an interesting development in the State of Washington, where a bill was passed in the last session of the State Legislature that's effectively a growth-management bill, requiring that mineral-resource lands be designated as such, if they're not already so characterized, in urban-growth areas. Such designated lands will have a long-term significance for the extraction of minerals. Thus, there's an effort at the State level in Washington to look at mineral issues in a long-term plan. That's a direction in which more States and, possibly, local governments should be going.

- The BLM currently is revamping its management plans throughout most of the West. In the Las Vegas area, I understand that, through 1995 or so, all of the BLM's district offices will have reviewed their resource-management plans. This is an ideal time for the industry or its representatives to become involved with the BLM districts. Federal lands will be designated areas for mineral-resource use or other uses. The trend is toward increasing numbers of restrictions on the types of mineral activities permissible on Federal lands. I don't think that trend will slow down, so it's imperative that people from industry and government land-management agencies become involved early in the planning stages. The BLM is involving county agencies, and other State and local government agencies as well, in the revamping process. Joining in may be one of the best ways, at least on Federal lands, to help maintain some areas for mineral entry. Otherwise, we may well have some serious problems if one group or another has undue input to the process. We must face the fact that environmental groups are taking a larger role in developing mandated policies.

- There is some political reality, particularly in the Great Basin, that the States aren't known to be particularly active in statewide land-use planning. In fact, it's considered to be the "P" word in some of these States; you just don't talk about land-use planning. In contrast, in the central and eastern parts of the country, land-use planning is quite common in both local and State legislative bodies. The reality of the situation, however, is that until State governments in the Great Basin can acquire the requisite data—and it might be a while before that happens—you have a major impediment for planning on a statewide basis, particularly when so much of the land is under Federal ownership.

Environmental Concerns for Land, Air, and Water

By James Scherer

EPA Region 8 covers the States of Colorado, Utah, Wyoming, North and South Dakota, and Montana and includes some of the Basin and Range region of interest here. I haven't been much involved with the problems of industrial-mineral mining that you're talking about. More usually, I'm dealing with heavy-metal mining wastes at SFS's, which are extremely difficult to work with. However, I think the problems of SFS's, and some of the environmental concerns that you or we may have with industrial-mineral development in this area, are somewhat similar.

Toxic Waste at Superfund Sites

Let's consider the types of mining situations where we've been heavily involved with toxic wastes and heavy metals, some of them here in Utah. We're actively involved with Kennecott in several areas of concern where ground-water, surface-water, and air-quality problems are being faced. The Sharon Steel site, which isn't far south of here, is an SFS in a previously active development area containing hazardous materials in great tailings piles. These problems epitomize some of the local concerns that you're talking about. We're concerned about how we're going to deal with the environmental problems in esthetic and acceptable ways within a highly urbanized area. As it is, the Sharon Steel site not only has serious environmental problems but also has additional problems of large heavy-lead and arsenic soil concentrations that surround various homes in that area, and of the impact of these metallic materials on the local ground water. The latter may be the biggest concern we have.

Nonetheless, we're often asked to help local economic development by picking up waste-dump materials and moving them somewhere else. That isn't the role of the EPA. We can't spend money in some of the problem areas where the local population might like us to. I've seen several examples of dust and air-quality concerns, particularly when we're dealing with heavy metals, such as those at the Smuggler mine in Aspen, Colo., and at Leadville, Colo. We became deeply involved with these two local communities. I think this aspect of environmental protection may be compared to industrial-minerals operations.

Air Quality and Health Protection

Let me address some of the local concerns for industrial minerals and what their development might be. If you're talking about mining developments near an urban area, you're talking about more than environmental concerns. Air emissions and small particulate matter are major concerns the West. One criterion for the EPA's getting involved, then, is whether it will have to, or need to, protect human health as well as the environment. Most often, human health is one of our immediate concerns. However, if there's no population center nearby, that concern isn't nearly as sensitive as if the operation were in the middle of a population center or close to it. We still have environmental concerns, but, in the case of industrial-mineral production, we find increasingly that these concerns regard some of the urbanized problems, such as PM–10, which are violations in very small particulate matter. In those cases, the State has to come to us with a stated mitigation plan. Commonly, the reentrainment of dust from an operation, such as sand and gravel or some other minable resource materials, could be a problem for that area's meeting its required air-quality attainment. Thus, there'd be an effort to put regulatory controls on the operation, whether for dust control by watering down the area or some more sophisticated method for seeing that the dust doesn't get entrained.

Air Quality and Visibility

We also see that visibility around a national park, which is one place where many of the resource materials we're talking about may well occur, is a new concern of the Congress right now. If new visibility regulations are enacted, it could affect you in your ability to operate as industrial-minerals people, as well as affecting the government people who are responsible for the Federal lands surrounding park areas. Whether we'll be able to use those natural resources or not, and how we'll be able to, will be regulated.

Increasing Future Cost for Mining

No matter which concern we're talking about, it's about a higher cost of doing business in the years to come. The environmental issue will be factored into most everything that we do, whether it's the steel industry or developing industrial-mineral resources, and so all such efforts are going to have an environmental factor included. Personally, I agree with that. I think the general public is willing to pay the price to protect the environment. It'll add an inflationary factor that I think we'll have to live with in this country. Most of the surveys I've seen show that the general public will pay that extra price. We're talking about the purchase of an automobile that's going to have additional equipment on it to cut down on air pollution, or about the additional mitigation that might be necessary on a project that the industry is trying to develop, which will mean that the resource you take out of the ground is becoming increasingly expensive. The consumer will simply have to pay the price for that. Thus, I think that education of the public to that reality is an important item, also.

Water Issues

When you talk about any type of use of water that has to be discharged into U.S. river waters in the processing or reprocessing of minable materials, you again have an environmental problem, and the EPA does get involved. I don't know whether that happens all or only part of the time, but it certainly does occur with acid drainage from a gold mine or something of that sort. We refer again to the heavy-metal content that might be coming out of the workings, but if it's sand and gravel, I'm not so sure. There'd be some water used in processing the resource, and if you have to keep air-quality problems down, you may be compounding a water problem.

One new problem on the horizon, which everyone needs to be aware of, is whether the water is being discharged to a present wastewater-treatment plant, either municipally or privately owned. The States to which the EPA has delegated program oversight are putting down stringent requirements for those municipalities to ensure that anything coming into their plants which may be carrying toxic materials needs to be pretreated. There'll be local pressures to look at the pretreatment of any water that, in the past, had been cleaned up by the treatment plant on its discharge and that now may have to be pretreated before it enters the processing cycle. Now, we're talking about not just meeting State numerical standards but also meeting standards which ensure that what comes out of a plant doesn't kill small minnows and other fish life, so that we can improve the quality of the streams in this country.

I don't know how many mining situations are affected by the wetlands program that we at the EPA have embarked on. This program is much stronger and more visible today than in the past, and it's one I think everyone needs to be aware of. The filling in of any wetlands is being watched carefully. President Bush has talked about a no-net-loss-of-wetlands policy. The EPA has worked out an arrangement with the C of E in an MOU that calls for attempting, first, to avoid any loss of wetlands; second, to minimize the loss of wetlands; and, third, to mitigate any loss. The C of E operated in the past on the assumption that if it could be mitigated, any project could be built or could go forward. I don't know how many of you deal with C of E permits, but I think that, right now, the whole issue is still in a state of flux. I'm trying to bring the Region 8 view back to Washington, D.C., and to inject some degree of sense into this program. We need to look at avoidance as the first criterion in making sure that wetlands aren't disturbed. But if there are strong reasons for the project to be built—and it shouldn't be only that there's additional need—we should allow minimization of that impact or provide a mitigation plan for that wetland. There might be an opportunity for some positive things to be done because, as you begin to talk about some of the developments you're considering, the creation of wetlands might be a real plus in going out to the general public to show what a project can do for the environment. You can have some positive as well as negative effects.

Industrial-Mineral Issues Delegated to the States

Basically, the issue of the EPA's dealing with industrial minerals involves a fairly heavy delegation of responsibility to both State and local governments. We don't get involved unless one of those issues I've just mentioned is involved: wetlands, discharge into U.S. waters, or heavy-metal toxic and polluting air emissions, particularly in a nonattainment area that must reach attainment. Then, the EPA might get involved, but our regulatory responsibilities say that we should mostly allow local governments to make those decisions that they're best equipped to make. We get calls from the public frequently. I've had friends of mine call and say, "They're going to put a sand-and-gravel pit here! Why can't the EPA do something about it?" It can be difficult to explain to them that it's not our role to act in such cases, that really it's a local zoning decision more than anything else.

The EPA'S New Proactive Image

You're going to see the EPA taking a more proactive role, not in a strictly adversarial regulatory sense but, hopefully, in a positive sense. We'll be trying to work with State and local governments on some of the things that you've been discussing here which relate to excavation mining. One way is through public education, which I think is a critical need. Our involvement should also be sought out by developers who want to do something and who want to get an analysis of whether there are some environmental problems that they (or the EPA) might have to deal with. If there are no problems, it's better to get that matter off the table right away. For example, the pollution-prevention direction is one area that the EPA is going into and that I heartily approve of. We should try to do things right to start with, so that we don't create something we have to clean up later. Industry has bought heavily into this philosophy. Certainly, the environmental ethic that we see active around the country today is based on that premise.

Although I can praise that concept, I'm concerned, as many of you are, that we take a balanced approach and that we don't complicate the process so much that nothing can happen. All too often, that does happen, whether it's putting in a solid-waste landfill or any type of mining operation. You were talking about the NIMBY view; I hear it's been replaced by the NOPE syndrome. We have to attack that attitude in a sensible way, not by being defensive and reactionary, but by being up front. Any project that's going to get off the ground should be open for public discussion. If I've seen one thing that the EPA has failed to do, it's going out into a community and discussing matters. I could talk about the Sharon Steel site here in Utah. To make a decision in a vacuum in Denver, getting some input but not putting the decisionmaking process before the public, is a mistake. We tried to do that here; we thought we had a solution for the problem, but the community didn't agree. In this situation, the EPA's case was just poorly done.

I've been trying to stress to my people that we should be completely up front. Spread out all the options; do it very early in the process; get people to understand the difficulty of making a decision about what should be

done. Once that's done, the vast majority will support the decision. You'll always have a few out there with the NIMBY syndrome, who'll try to rabble-rouse, but there also are a lot of sensible people who'll buy into something that's well thought out and that has, in the long run, good environmental impacts. Any project that isn't planned to include that type of input today simply won't get off the ground. *Public education has to be planned.* I hope the EPA can help, along with the local agencies, in trying to improve the planning process.

Planning Avoids Conflict

There are many positive mitigation options that can be taken. When we talk about the additional cost of doing business, it seems appropriate to me that, when you want to develop an area, you looks at purchasing more land than is necessary, so that there can be peripheral buffer zones. If you're looking at having a successful mining project, you'll need to have some way to avoid having the project situated right in somebody's backyard; that's simply unacceptable if he was there first. In the example given of the airport's location, where people moved in later and complained, I agree 100 percent that their beef isn't well substantiated. That was the developer's fault, as well as the local planning division's.

Industry and the Federal Government ought to get more involved up front to help with planning at the local level in this part of the country. We have a few SFS's, as at Brookhurst, Wyo., where housing developments were put in right next to five existing refineries. The development gets built, and a year later the people are saying our drinking water isn't any good! Considering all the territory out there where you could have put a subdivision, why it went into that particular area is the result of just poor planning. If we can use what information the USGS can give us in the way of identifying areas containing resource materials and where they're available, we can do some long-range resource planning. There can be zoning that includes buffers of either light industry or commercial zones bordering these areas. We can do a lot better if we try to restrict residential use next to where some development might be taking place in the future. I think it's incumbent on Federal governmental agencies to be as helpful in that regard as possible.

New Operating Role for the EPA

One exciting thing about my job, after 3 years, is that there've been real changes in the EPA. We've grown from being strictly a regulatory agency, for which we still have some responsibilities. We'll still be the bad guys who, if somebody does something wrong and violates environmental law, will be there to do something about it. However, we're now moving away from duplicating what the States are doing in that regard. We've delegated the monitoring of air, water, and hazardous waste to the States to try to build their capability, so that we can take some of our resources, which have been duplicating theirs, and put them into more positive approaches and be more of a technical assistant to industry, other Federal agencies, the general public, and local government as much as possible.

For just a moment, I'd like to switch back to what we're trying to do with toxic waste from mining sites. We're deeply involved in Region 8 with that issue, and I know you have at least a peripheral understanding and involvement in that problem area. We've been working diligently to provide one staff expert who probably knows more about mining from an environmental point of view than anyone else I've met; he's been working mostly at our Washington, D.C., headquarters and with our Region 8 staff. We've been trying to put together a strategy. Our big concern is that Congress will get worked up about mining wastes; as its next step, it's going to have the RCRA reauthorized. We're concerned that Congress will say that all mining wastes should go under subtitle C and be considered toxic wastes; we think that'd be an absolute nightmare. It already is, as we're trying to get the toxic matter out of the tremendous volumes of waste material that we're currently dealing with. Blanket coverage just doesn't make sense. What we're trying to do is preempt Congress' getting involved in the mining question, and put something into regulations that's workable, that has a buy-in from both the industrial and environmental sides, and from the States and the Federal Government at the EPA level. We just came out in May with our "Strawman II" proposal on how we'd regulate mining wastes, which took 2.5 years' operation to put together. Still, I hear that various people in the industry think it's far too inflexible a plan and isn't going to work. I hear also that various environmental groups think it's giving away the farm. That kind of talk makes me feel good—we must be down the middle, or close, anyway—but there'll be a series of hearings, and a public hearing in Denver is scheduled in June. Then, we'll be going into a final draft sometime next year.

Basically, the approach that we're taking is one that we as Federal agencies need to adopt more often, to build on what the States are already doing: flexibility in dealing with different mining situations in different States. If we get going with national legislation, or national regulations that try to cover phosphate mining in Florida, gold mining in Colorado, and all the other different types of mining operations, we're courting disaster. We've already caused more problems than we've solved with some of our legislation, and some of our regulations just aren't applicable everywhere. These legislated requirements are going to force industry to spend a lot more money than it should

for very little environmental benefit in trying to solve a particular problem. Industry may have another problem that they ought to be doing something about. So, we're trying to build on what the States already have in place in their mining regulations.

What we're proposing is that the States submit a plan to us, which includes their present regulations; the EPA will run it through the Federal Register, and that would constitute the Federal plan for that State. If we saw some problems with a State's plan, we'd go back to the State and try to have it make any necessary changes, so there'd be a good solid-waste plan for that State. About 21 States in which mining is prevalent have regulations already in place. We've been working with the Western Governors' Association and given them a grant to help develop this planning concept (see Nielson, this report). That's the way the Federal Government ought to be operating. We're getting down to a level where we can see that impacts are being analyzed accurately because they're analyzed on the local level. I'm hopeful that this whole process will go forward in the next couple of years and be finalized before Congress gets involved with it. I know what happens with most of the things Congress get involved with! It has to be essentially generic; the power structure for Congress is basically on the east coast and in California. We don't always get a fair shake in Region 8 in the West because we don't have the political power base to get that fair shake. We holler and scream all the way to the end, but we don't always get our terms met. Our new tactic seems like a better way.

Concluding Thoughts on the Future of the EPA

You should now have an idea of where the EPA in Region 8 is going these days. These are exciting times, I think. I know that you're part of a regulated industry, and you may not always think that it's exciting, but if there's anything I've been trying to do these past 3 years, it's to make the EPA a more responsible and responsive organization. In the past, our image has been extremely poor among those in the mining industry, which I think is probably well deserved. I hope that I'm turning that image around somewhat in the Denver office. I deal with 630 employees. It's tough to make cultural changes in people who've been there 18 to 20 years, who've done nothing except write permits and inspect and enforce regulations; that's been their whole life. It's tough to try to turn them around into being educators, technical assistants, and helpers, and to change their mindset so that their role isn't necessarily to be bad guys (or only if that's necessary) but to try increasingly to capitalize on the positive interests in doing things right. We have to do things right, and, hopefully, if we get the whole philosophy in this agency turned around, we can be a lot more positive force.

Participants' Discussion and Comments

- You mentioned USGS information as being helpful. What types of information did you have in mind and, if maps, what scale? How can such data help local-government people?

Reply: I can't give you a precise answer, but I know that we're working very closely with the USGS in Denver, and this work includes mapping. For example, the EPA has provided money for mapping along the Clark Fork in Montana, where we're trying to clean up one of the largest mining-waste sites. I previously mentioned the study in the Denver metropolitan area; that type of information is useful to the EPA. We have a person in our laboratory at the Denver Federal Center who's our coordinator with the USGS. How USGS information can be applied to local-government problems remains to be discovered. The USGS probably has a responsibility in that regard. I don't know how you stay attuned to all the zoning and planning issues that are coming up. The EPA should have an outreach program to find out where decisions are going to be made for which we can provide useful technical expertise; this would be the proactive stance that the EPA should adopt. The local decisionmaker should be given pertinent information before deciding about locating a landfill right over an important ground-water aquifer. Such uninformed decisions have been made in the past, and they've been disastrous. Such types of relevant resource-location information that the EPA can glean from the USGS could be used a lot, particularly in siting landfills and urban expansion in those areas under EPA purview.

- What do you see as the main impact of the CAA on new mining development?

Reply: For the past month or so, I haven't followed the development of that act because it was being changed so much; I decided to wait until it was finalized. I don't know whether it will much affect mining, except that site-specific permitting is going to be a major requirement, and there'll be a fee structure required in every State. Whether that'll be true for mining sites, I don't know. However, if you're in a PM–10 nonattainment area—as for example, Utah and Salt Lake Counties in Utah—there may be added requirements. The State is now putting together its State Implementation Plan to submit for EPA approval. The EPA will be looking at all sites where there are emissions of small particulates, and it will add some type of requirement through the permitting process. I'd say that's the number-one effect on mining. Otherwise, most of the CAA is fuel oil and automobile oriented. In those areas, it will tighten down.

- To follow up on the previous question, will there be any significant changes in air-quality standards that would affect an industry such as oil shale that does put out a lot of combustion products?

Reply: Yes, there will be. I can't tell you exactly what those standards are, but they're being tightened down. In the past week, we've had many discussions with the State of Utah about the revapor standard that the EPA will set through regulation, not in the law itself. Many standards will be changed when the EPA develops its regulations. The EPA is committed by law, over the next 3 years, to come out with specific regulations to actually implement the act; these new regulations will change the standards. In Utah, the refineries have been concerned that the revapor standards for Utah and Arizona were designated at the lowest level, below that for the Los Angeles area. This is hard to believe, so we've persuaded Washington to turn that around as inappropriate. Every time Congress does that for an area like Utah, which feels that there's a real reason for less stringent standards, it has to find another area elsewhere where it can save some of the VOC's, because there've been some ozone violations here in the Salt Lake area. I don't think the numbers are going to be tightened down a whole lot, but there'll be many more requirements that must be met and a lot more difficult local decisions to be made in most cases. State decisions will also be required.

The real success story in such endeavors has been in Denver, and the EPA was deeply involved in that success. Some people still consider that Denver has a real air-quality problem, but it doesn't. A serious problem has been almost licked in the past 6 to 7 years. Just 6 years ago, there were 161 violations for excess carbon monoxide in Denver; this past season, there were 2. The number of violations came down dramatically to 80, then to 25, 16, 9, and then 2. A lot of this success has to be credited to the technology of new automobiles and the fact that new automobiles have taken the place of old ones. I'm not trying to say that what's been done locally does 100 percent of the job, but there've been wood-burning bans, and the city council met last night and will eliminate leaded fuel in Denver beginning in January 1991. At the same time, they passed several other strict pollution-mitigation ordinances. I think a good job of cleaning up that area has been done. That's the kind of program that's going to be required of local governments. The EPA will be the catalyst to get them to do many more tough things. For mining, however, it's in the particulate and dust area that the CAA will have its greatest effect.

- In the mining industry in the future, if you have a particulate source, will you be able to go on stream if you mitigate another or lessen another particulate source? I recently heard of a powerplant in southern California that was expanding, and to get its air-quality permit, it had to buy 150 old cars a year and destroy them. Is this the wave of the future?

Reply: Yes, I think the act does call for a credit system whereby mitigations can be traded or sold. This mostly concerns SO_2, but there are several other pollution areas where I think the free-market approach of trying a different approach from the established one is a big part of what the administration has been asking for in, and is a part of, the CAA. So, yes, you can solve your problem in other ways, but it has to be handled, tested, documented, and proved to be successful. The EPA always takes a pretty stiff look at those tradeoffs to make sure that they work. In the case of wetlands mitigation, with which I'm most familiar, you'd better be sure you can prove that the wetland can be restored or built and will succeed beyond a year or two and not fail. Past history has shown that we need some tough requirements. Yes, mitigation and the whole free-market approach is a good way to move, and it'll be a part of the way we at the EPA are going.

Interstate Activity in the Formulation of Regulations Governing Mine Waste

By D.R. Nielson

During this workshop, there will be discussions of the problems that are limiting an operator's ability to locate, develop, and market industrial-mineral deposits. Working through an interstate coalition is one option for approaching these problems. I'm going to concentrate on the efforts of several States to work with the EPA in establishing a regulatory program that will safeguard the environment while maintaining a workable framework for mineral-resource development. That program involves mine wastes, not industrial minerals, but the issues are similar.

The focus is on a case study of States' input into the EPA's development of a program to regulate mine wastes under subtitle D of the RCRA. The coalition that was formed was the MWTF of the WGA. Let me state at the outset that I'm speaking as an active member of that task force, but I'm not acting as a representative or spokesperson for either the WGA or the MWTF. Historical background data and figures were prepared by the MWTF.

The proposed regulatory program is complex. It's important to bear in mind that, with the possible exception of phosphate operations, the major waste streams which are targeted in the RCRA, those of base and precious metals, are more complex and potentially toxic than in most operations associated with industrial minerals.

Background—The Problem

To begin, let's consider the problem, the basis for establishing the MWTF.

1. Wastes from mining, as well as from extraction and processing, including some from industrial-mineral

operations, are significant contributors to the overall problem of solid-waste management, especially in those States and communities with significant levels of mining. According to Coppa's (1984) estimates, a total of 50 billion tons of mine wastes was produced through 1980 from all mining, coal and noncoal, in the United States. Furthermore, mine wastes are projected to increase by an additional 5.8 billion tons through the year 2000. To put it in a different perspective, albeit one that's not directly related to industrial minerals, in the period between 1910 and 1980, mill tailings from base- and precious-metal operations increased from 46 million to approximately 300 million TPY. Much of this total represents an effective increase in precious -metals exploration and development, including a dramatic increase in the number of precious-metal heap-leach operations. However, the significant growth in precious-metals operations over the past 10 years isn't even a large part of those numbers. More pertinent to this workshop, consider that the mining segments which generated the largest volumes of waste, as of 1980, were copper- and phosphate-mining operations (U.S. Environmental Protection Agency, 1985).

2. Increasingly, mining wastes that once accumulated in areas remote from human population centers are now located in the midst of population growth. This congestion is creating new concerns for protecting human health and the environment. As noted during other presentations at this workshop, the problem goes beyond the issue of management of mine waste to include issues of dust and noise pollution, preservation of scenic vistas, planning and zoning of residential versus industrial areas, and prioritizing of mineral- and environmental-resource protection, conservation, and development. It's all the baggage that goes along with the NIMBY syndrome or, if you prefer, NOPE. It's the issue that causes residents along the Wasatch Front to focus on development and continued mining of rock aggregate north of Salt Lake City. It's the issue in your communities that might cause you to ask whether planning occurred before the location of new housing or commercial developments. How much of the development in your community is on top of valuable sand-and-gravel or industrial-mineral crushed-rock deposits? Consider, for example, that, because of restrictions against new quarries along the Front Range, the new Denver International Airport may be built with sand and gravel imported from Wyoming. These are the types of situations encountered every day.
3. The Congress, through the RCRA, EPA regulations, and other laws, has federalized the regulation of the mining industry. Heretofore, that regulation had been largely within the authority of the individual States. When the RCRA was enacted in 1976, Congress made a distinction between high-volume, low-hazard solid wastes, such as municipal waste, which they placed under subtitle D, and hazardous wastes, which they placed under subtitle C. In 1980, the Bevill amendment specifically excluded mining wastes from regulation under subtitle C until further studies were conducted by the EPA. In 1986, the EPA published a regulatory determination that certain solid wastes should be regulated under subtitle D, including base and precious metals, phosphate, oil shale, asbestos, and overburden from uranium mining. In the new regulatory proposal, which has just been released by the EPA, the proposed scope of the regulation has been expanded to include heap- and dump-leach waste units and materials that are contaminated by regulated waste material.

The States' Response

The States have played and continue to play significant roles in terms of regulation, regardless of what the Federal Government has been doing. Furthermore, the States have specific interests and concerns in the development of any Federal regulation. The EPA's mission is to protect the environment; a State's mission is to promote prudent development of its resources in a manner that protects the environment. That distinction, that added aspect of the State's mission, makes a big difference in the way a State deals with its industries. From that perspective, I think the direction that the States took was clear:

- Protect human health and the environment.
- Ensure compliance with sound mine-waste-management practices.
- Utilize relevant, site-specific information in regulatory decisions and actions. For example, recognize that the phosphate operations in eastern Utah are distinct from, and ought to be regulated somewhat differently from, phosphate operations along the coast of Florida.
- Promulgate effective and nondiscriminatory regulations.
- Enable continued mining-industry activity within the State. Workability and consistency of regulation are an essential component of the mining operation. The uncertainties of the RCRA and of the regulations under subtitle D were not conducive to planning and carrying out mining operations. Regulatory requirements and related costs need to be clear, reasonable, and consistently applied.

Formation of the MWTF

The WGA passed a resolution in 1988 in response to the EPA's draft regulations. Given that the EPA had determined that mining waste should be regulated under the RCRA, the EPA should:

- Expeditiously develop a mine-waste-regulatory program.
- Base the program on RCRA subtitle D, as opposed to subtitle C.
- Allow for meaningful State input before proposing regulations.
- Establish a State-based program.
- Protect public health and the environment.
- Account for site-specific, waste-specific, and waste-management-specific practices that could be adapted within the States and for operations in those States.
- Maximize reliance on existing State regulatory programs without creating a new Federal program to handle the issue of regulation. This resolution basically set the tone for the MWTF.

The MWTF was formed by the WGA to provide guidance to the EPA as the regulatory management framework and program were developed. A total of 21 States across the country participated in the MWTF.[1] In addition, we had the advantage of advice and input from the Western Interstate Energy Board, which is a coalition of Western States, and from the IMCC, which provided a perspective on the Eastern States.

This program of proactive participation by the States in drafting and evaluating a regulatory framework is a new approach for the EPA, as well as for some of the States. Furthermore, drafting of the proposed regulatory framework before reauthorization of the RCRA provides an opportunity for statutory changes that will reflect workable regulations.

The MWTF's objectives were to:

- Bring the States' perspectives to the EPA and enable the EPA to understand how the States currently are regulating mine wastes and what unique characteristics justify establishing a program at the State level.
- Survey State regulatory programs to provide the EPA with an updated and complete summary of State programs. This document has been prepared and will soon be released by the MWTF.
- Recommend a regulatory, not just a Federal, framework that would be imposed on the States, but one that would be workable within the States' programs. The EPA drafted "Strawman I," which was their initial draft of regulatory-program concepts, and the MWFT reviewed it. "Strawman II" has now been released. Many of the MWTF's recommendations, however, were not accepted by the EPA.
- Advise the EPA on implementation to establish State-based, State-controlled regulatory programs. This work is being evaluated by individual States in the coalition.
- Identify the cost and manpower resources needed to implement and maintain a program of regulation for mine waste.

Regulatory-Program Position—a Solution

Through the discussions with the States and in response to the EPA's 1988 "Strawman I" draft of Federal-program concepts, the MWTF established a regulatory-program position that was clear and probably not unexpected. A regulatory program must:

- Recognize State primacy and maximize existing programs—no omnibus permits.
- Avoid regulatory duplication on any level; ensure clear lines of responsibility and clearly defined lead agencies where there is potential duplication.
- Establish a performance-standard-based program that is site and State specific, that has flexible application to recognize the differences between conducting mining operations in Minnesota and Nevada, for example, and that is multimedia based (soils, water, air, stability).
- Provide Federal financial and technical support and enforcement in nonprimacy States.

Each State, at its election, will establish a mine-waste-management plan that includes the following elements: (1) scope of coverage, (2) implementation and enforcement, (3) standards of performance, (4) design and operating criteria, (5) performance monitoring, (6) corrective action, (7) closure or reclamation, and (8) financial responsibility, surety, or bonding. Aspects of these elements already exist, to one degree or another, either in mining-regulatory programs or in programs implementing the CWA and the CAA, in the 21 States that participated in the MWTF.

Last week, "Strawman II," the second and, presumably, last of the EPA's draft program concept and discussion documents, was released for public comment and review. This document includes many, but not all, of the MWFT's recommendations. In some cases, the MWFT's recommendations have been incorporated within a strong Federal role, one that was neither anticipated nor supported by the coalition.

What the Process Cannot Do

In consideration of this process as a model for the work of an industrial-minerals coalition, we must also recognize the MWFT's limitations.

1. The process of interstate coordination is only as effective as the ability to reach some common perspectives and positions on issues. For example, there are no

[1]The State members of the MWTF include Alaska, Arizona, California, Colorado, Florida, Idaho, Michigan, Minnesota, Missouri, Montana, Nevada, New Mexico, North Carolina, Oregon, South Carolina, South Dakota, Texas, Utah, Washington, Wisconsin, and Wyoming.

guarantees that the EPA will adopt a position supported by the MWFT. The final call, in fact, lies with the EPA and with the Congress. "Strawman II" did not incorporate all of our recommendations, and some of those changes are significant. We may, to the extent that we can't work through an interstate task force, move on to other options in addressing those issues.

2. There's a risk that, by taking a proactive position initially, the States will be perceived as supporting any regulation of mine waste through subtitle D of the RCRA. As noted earlier, what we've done, essentially, is draft, not implement, a regulatory program before the authorizing law, reauthorization of the RCRA, is in place. The counter to this concern is that, as States, we've tried it the other way. We attempted to influence how a program would be structured after the act was in place in the SMCRCA, the CAA, the CWA, and countless other Federal environmental laws. That process didn't work; we hope this one will. We've dealt with various environmental laws on the Federal level after they were enacted and after the regulations had gone forward. We've been fairly ineffective in convincing Federal regulators of the direction that should be taken by the States.
3. The proposed waste-management program doesn't resolve the significant problem of inactive and abandoned mines, the group of mines that the environmental community holds up as the failures of the industry and the regulatory agencies, and they're absolutely right. Furthermore, no matter how effectively active sites are regulated, the problems associated with inactive/abandoned sites won't be resolved. All the States recognize the need for reclamation of these sites. However, the RCRA is not the process or forum for addressing these issues because it doesn't accommodate reclamation or remining/reclamation of inactive/abandoned sites. Reclamation options must be flexible, site specific, and State based. The work must be on-the-ground reclamation, not expensive studies and litigation of responsibility.
4. Finally, we recognize that the solution to the problems of mine-waste management or, for that matter, industrial-minerals development isn't any new national program, Federal or State law, or regulatory program. The solution really lies in how industry operates on the ground. Safe, responsible, nonpolluting mining operations occur where the operator, whether it's a multi-million-dollar consortium or a "mom and pop" operation, has the knowledge and forethought to avoid environmental problems and to clean up any accidents promptly. It means that the operators and their suppliers need to consider the hazards as well as the benefits of the products they use and the process or environment in which they use them. It means that regulatory agencies are staffed with trained individuals who know and can evaluate state-of-the-art mining and waste-management practices. Regulatory staffs know how mines and processing facilities work, on site, and understand that their primary responsibility is to make sure the facility can work effectively as permitted.

The objective is to internalize environmentally sound management practices in the permit and in the operator's work under that permit on site. It means recognizing the limits of the operation and the environment. It means support from the local community, not just because the operation employs 50 percent of its residents but because the company is running an environmentally responsible operation. That's the challenge before us.

Participants' Discussion and Comments

- Are there EIS's for development wherein you evaluate what the denial of a local source of industrial minerals might mean in terms of having to transport industrial minerals, let's say, from Wyoming to the Denver Airport site? That option has a certain environmental cost to it, also. In addition to increasing the cost of materials due to transportation, increases in air and noise pollution and highway congestion must be considered. Are there ways to weigh these environmental costs?

Reply: One way that's been suggested and that was discussed earlier is through planning. Admittedly, we don't do much of this type of planning in many of the Western States. We've shied away from it, but more and more we're learning, particularly in States with large percentages of Federal lands, that if we don't proactively plan on a State level, we're going to get *de facto* planning from the Federal Government. I think the planning process is a good place to start. This planning may be in terms of new developments or in terms of basic allocation of land use and what areas will be allowable for mineral development. There's an opportunity within the planning process, whether it's on a general scoping level or right down to the public-comment period.

Generally, we don't hear much about whether there's going to be participation and concern or whether potential conflicts will be discussed in consideration of the general mine-plan level in Utah. Most operations in which there's potential conflict have already been in existence, or they may be modifying operating plans, but they're not establishing new plans. We see this happening in some other resource areas, such as coal in southern Utah. Such questions are legitimate in the planning process. What are the actual costs? They may be difficult to ascertain. The more you can say about the cost of importing sand and gravel or crushed rock adding X number of dollars to the cost per ton, and the more you

can say about importing or bringing materials from another county up to the Salt Lake City-Wasatch Front area adding X number of trucks to the interstate system over a period of time, the more people can put these costs into solid concepts and visualize the full effect of the decision. Then, those issues *will* be discussed. Until you can view that part of the problem, the issues won't come up.

- What do you mean by your statement that if the States aren't going to plan, the Federal Government is going to plan for them in the West?

Reply: The BLM and USFS are both required under Federal law to have land-management plans in place for their specific districts. There's been a lot of discussion, particularly in terms of oil-and-gas exploration and development, as to whether those plans are current enough and whether the agencies have a significant and reliable data base. For the oil-and-gas industry, these conflicts are coming in all the sensitive environmental areas you'd expect, like the Rocky Mountains grizzly-bear habitat and operations adjacent to national parks. However, the bottom line is that each of those Federal agencies which have responsibility for managing Federal lands is required by law to have a current resource-management plan in place and to operate in accordance with that plan. If there're going to be deviations from it—for example, to construct a major road for access to a mine or a pipeline to transport minerals—the BLM and (or) USFS will have to amend the plan. Those plans are going to dictate what you can or cannot do on those lands without additional public comment.

In the Western States, State lands are interspersed within larger blocks of Federal lands. When the States received school-trust lands, they received them as interspersed sections within townships and ranges, for the purpose of providing a source of income for school systems in the States. Consider managing 32 sections in the township and range in one manner with four additional State sections in the middle of that, surrounded by Federal lands. It's next to impossible to perceive that mines or other major land-intensive operations located on State lands are going to go forward in conflict with major Federal land-management policy within the area. That's the basic issue.

A PERSPECTIVE ON REGIONAL INDUSTRIAL-MINERAL PROBLEMS

J.E. Christensen, *Moderator*

The two main industry problem areas to be considered by panel experts include the economic and environmental spheres of activity. The first panel, convened by C.W. Berry, professor of mining engineering at the University of Utah in Salt Lake City, will examine some of the primary economic problems for the mining industry, including the development of an industrial-mineral-marketing strategy for a specialty mineral material, Gilsonite; the problems of financing a mineral enterprise in the present economic and environmental climate; and the art of making business deals, dealing with taxes, and tips on making an economic analysis of a mining project. The second panel, convened by B.W. Buck of the J.B.R. Consultants Group in Salt Lake City, will discuss the environmental problems facing the industrial-mineral industry in the Basin and Range region from the perspectives of a government regulator and an industry environmental-affairs coordinator. Finally, the critical support systems required in the Basin and Range region are reviewed. Discussion and comments by the participants and panelists follow the panel presentations.

Economic Problems of Industrial-Mineral Mining

C.W. Berry, *Convenor*

During this session, we'll discuss some industry problems, such as marketing, financing, taxes, and royalties, and some aspects of the economic analysis of an operation. The first panelist is L.I. Weiner, manager of development and planning for the American Gilsonite Co., a division of Chevron Resources in Salt Lake City. He'll describe the new marketing directions that his company has taken in recent years. Mr. Weiner is a graduate mechanical engineer; previously, he was affiliated with the aerospace industry and the Gulf Oil Co.'s Colorado oil-shale program. The second subject for this panel is the all-important financing of industrial-mineral enterprises. R.W. Bernick, now retired from First Interstate Bank, has had much experience in mineral financing. For 20 years, he was business editor for the Salt Lake *Tribune*. Thus, he's familiar with the business and financial side of financing a mining project. I'll complete the panel's economic considerations of deals and taxes and conclude with an economic analysis for the State of Utah.

Industrial-Mineral Marketing

By L.I. Weiner

New and innovative marketing strategies have become important factors for survival in the competitive industrial-minerals business. The American Gilsonite Co., a wholly owned subsidiary of Chevron, provides an example of what one industrial-mineral firm has been doing in recent years through development of a focused and aggressive marketing program. The company has modified its objectives and developed new products for new markets.

But first, let's look at what Gilsonite® resin[2] is and what it's used for. Then, we'll consider the company's marketing responsibilities, the several controlling marketing factors that are evident, and, finally, current marketing experience and product development.

Occurrence of Gilsonite

The American Gilsonite Co.'s mine area in the Uinta Basin in northeastern Utah is located 35 mi southeast of Vernal and nearly due west of Rangely, Colo. Gilsonite itself is a naturally occurring asphaltite or saturated hydrocarbon, 98 to 99.9 percent pure, with a specific gravity of about 1 and a melting point of 230 to 400°F. The mineral is black and shiny, like obsidian. The material occurs in parallel, almost-vertical, northeast-trending veins, from 22 in. to 6 ft wide, which may extend for 8 to 30 mi. The veins are found in Tertiary limestone and shale and are believed to have been derived by distillation from oily material in the underlying Green River Formation.

Mining and Marketing of Gilsonite

Many veins of Gilsonite occur in the region. Each vein has a slightly different grade; the grades are differentiated on the basis of the softening point of the material. Softening point, which is similar to melting point, is the temperature at which Gilsonite becomes soft; this temperature ranges from 300 to 400°F. The difference in its softening point is one of the key characteristics that makes Gilsonite usable in different industries. The mine is developed by inclined shafts and intersecting tunnels. The veins are mined by hand, using an air chipping hammer; the Gilsonite is airlifted into a holding bin, using a vacuum, and then is dumped into trucks and taken to the processing plant. The plant has three major functions: to size, dry, and package the Gilsonite before it goes to the customer. Gilsonite is packaged in 50-lb bags for the United States, and 25-kg bags for the rest of the world. Some of our customers are now getting the material in bulk bags, and the export foundry industry sometimes receives it in open-top containers.

American Gilsonite is the largest exporter (on a volume basis) in the State of Utah. Exports are measured by the shipping companies in what they call a TEU container. Last year, approximately 1,400 TEU's were shipped to 40 countries around the world.

Industrial Uses for Gilsonite

Gilsonite is used primarily in four basic industries. (1) The foundry industry uses Gilsonite as a greensand additive. The hydrocarbon vaporizes and provides fine casting surfaces. It's used in Germany for casting Mercedes and BMW automobile engines. (2) Gilsonite is used as a modifier of bitumen or asphalt in road paving, roofing, and emulsions; it adds strength characteristics to the asphalt or hot mix that is put down. (3) Gilsonite is used in the oilfield industry in two different applications. Adding it to oil-well cement reduces slurry weight without loss of compressive strength to the cement. It's also used as a drilling-mud additive for plugging depleted sandstone formations and to prevent drilling-fluid loss. (4) Gilsonite is used in the printing-ink industry. Conventionally, it's used as a carbon-black dispersant; it forms a film around the carbon black and helps it to disperse. Gilsonite is not used *per se* for its resin component in higher quality black inks because of natural variations in the Gilsonite; it's used as a resin in less expensive ink formulations, such as newspaper inks.

Marketing Factors

As a part of Chevron Corp., American Gilsonite is financially responsible to and dependent on Chevron. The cash flows both to and from Chevron; however, American Gilsonite is operationally independent. At the minesites, we make our own decisions. We're independent marketing-wise; we make our own marketing decisions. Chevron Corp. and Chevron Resources do not interfere with our plans as long as they see them progressing well and money resulting from our production and marketing activities. We have a product-development laboratory here in Salt Lake City. It's not an R&D facility, because we don't do pure research; we conduct applied research to develop new valuable products from Gilsonite.

The company operation at Bonanza, Utah, has been in continuous production for more than 102 years. As you can imagine, Gilsonite is a fairly low cost commodity by itself. Transportation costs are a significant part of the cost to the customer. When you consider U.S. freight rates, overseas shipping rates, and unloading at Rotterdam or another port, there are many costs in transporting Gilsonite to the country of use. Because of the weak dollar overseas, currently, customers also have a currency-adjustment-cost factor added to the ocean freight cost.

Our sales policy is to sell directly to customers or through distributors both domestically and around the world on a spot basis. We have 18 distributors worldwide, and they, in turn, sell to their customers. At American Gilsonite we don't have a contract with any customer. If you were to ask me today what our sales would be like in the future, I'd only be able to make an educated guess. We have to wait for a telex, a fax, or a telephone call to come in from overseas or domestically.

[2]Gilsonite® is a registered trademark of the American Gilsonite Co.

The American Gilsonite Co. competes with other Gilsonite producers, of which there are three in the Uinta Basin. We're the largest producer, but the Ziegler Chemical and Mineral Co., headquartered in New York, and the Lexco Co., headquartered in Utah, are also in production. Other countries claim to have Gilsonite. The Chinese call their product rock asphalt, but it's a different material. The same is true for the materials occurring in Argentina and Estonia, which have oil-shale deposits. Thus, Gilsonite, with its high softening point, extremely high purity, and unique chemical composition, is unique to the Uinta Basin as far as is known.

Gilsonite also competes with other materials. For asphalt modification, there are 35 other modifiers. In the foundry industry, we compete with seacoal. Other materials are used in the oil-field industry. We also have competitors in the ink industry, primarily hydrocarbon resins. So, the competition of Gilsonite with other products will determine its market price.

Early Marketing Experience

Gilsonite has had numerous diverse end uses. We've made clay pigeons for skeet shooting and nuclear rods, and it's been used to make explosives. The American Gilsonite Co. built and operated an oil refinery near Grand Junction, Colo., from 1958 to 1973; we produced gasoline and made coke. Gilsonite has also been marketed as a product to melt snow because of its black color.

Current Marketing Efforts

The company is now concentrating on the four basic industries that I mentioned earlier—oil fields, inks (including paints and coatings), foundries, and asphalt-modification applications—for its development or marketing strategy before trying to market something new. Moving away from the commodity aspect of Gilsonite marketing, the new area of company interest is value-added products. The marketing philosophy for these new efforts is as follows:

- *Establish a strategic reason for success.* The company must attempt to find a long-term need and to make sure that this new product will fit and have synergy with the current business. We found out that one of our overseas foundry customers used half the Gilsonite purchased for the foundry business and the other half for a kitty-litter enterprise. However, kitty litter just wouldn't fit into Chevron's overall image or strategy.
- *Establish a competitive advantage.* We also have to make sure that any new product we develop has a competitive advantage (by "competitive" I mean either in price or in function). In looking at our new marketing, we want to develop value-added products, for example, using Gilsonite as a feed stock instead of as an end-use commodity. That would be a big departure from the way the product was viewed in the past.
- *Pursue a few advanced programs.* The new business program has to be the proper size—not too big, like the refinery, which was a huge monster that just didn't fit in comparison with other refineries or into our own operations, and not too small, because we want to carry it through to completion. A few years ago, our product-development laboratory was working on about 20 different products, and it took each one to about 60 percent of completion but none to final completion. We've changed that and are now concentrating on a few highly likely best products, and we want to go to market early for evaluation. We started off with laboratory studies; next, we developed a pilot plant, which we ran last year; now, we have a toll production where we get our marketing analysis done.

New Marketable Products

One development program that we have going on now for value-added products is called the ER-resin. ER-resin is a purified resin. Effectively, we're purifying Gilsonite by taking out the high-molecular-weight portion and any ash and grit. We're left with the lower-temperature stable resin, which has a stable viscosity. One past problem with Gilsonite used in the ink industry is that, over a period of time, the viscosity rises. That can be a difficult problem for an ink producer: He measures the viscosity one day, and a week later it's just double, triple, or maybe an order of magnitude higher. That's the inherent nature of a Gilsonite solution. By eliminating the high-end, high-molecular-weight portion, the so-called asphaltenes, and leaving the maltene part, you have a stable, lower-viscosity, lower-softening-point material that also retains its carbon-wetting attributes, which is useful in the ink industry. This process drastically affects the way an inkmaker looks at the material. With Gilsonite as a carbon-black dispersant, the product is of relatively low value and represents about 2 to 3 percent of the total formulation. With ER-resin, the value of the product—now competing with hydrocarbon resins—increases twofold to threefold, and the percentage that can be used in the formulation increases by a factor of as much as 10. The marketing implications of the success of this program would be of tremendous significance to American Gilsonite.

Gilsonite can also be considered for use as a resin in asphalt modification. Adding Gilsonite to the blacktop used for road paving, which is made up of about 5 percent AC and 95 percent aggregate, results in a higher strength material. It's been successfully used to decrease the amount of deformation caused by heavy traffic stressing the highways. For example, it's been used at the entrance to the Lincoln Tunnel in New York City, where all the

trucks are approaching and stopping and starting as they edge forward into the tunnel. We have test strips in the United States and all over the world, at interchanges of the interstate highways and at crossroads where there's a lot of traffic. In certain cases, when you use unmodified asphalt, you can get what's called a "rutting and shoving" effect when the pavement is overstressed. Gilsonite can help mitigate that situation. In high-stress areas, many modifiers (I mentioned before that we're competing with about 35 different modifiers, including all types of polymers, sulfur, ground-up tires, and other materials) each claim to do this job, but Gilsonite is a low-cost modifier, adding one of the lowest costs per ton. Modifiers are being used on only about 1 percent of roads, but we believe that about 10 percent of roads or interchanges are amenable to their use. So, there's a big market out there. We have a marketing program going on that's very costly. Every State and every county has its own way of getting a product specified. You've to make numerous visits to numerous agencies, and if you don't have the staying power, you're not going to make it. So, mostly, it's the larger companies that are in this marketing business.

We also have proprietary oil-well products. We've developed what we call a borehole stabilizer. In drilling for oil in a depleted sandstone reservoir, the circulating fluid that contains the muds would ooze out. The Gilsonite in there helps plug pores in the borehole walls, so you don't have a loss of circulation. We developed our own proprietary materials that work either at low or at high temperatures. It's given us a competitive advantage in the industry against the leader, which was a Philips Oil product. The main thing about this material is that it's water dispersible. It is environmentally unacceptable now to continue using oil-based derivatives for drilling; these materials are being phased out in the North Sea and California oil fields, so water-based systems are the only way to go.

We are also conducting research on an advanced emulsion project, which is probably the coming thing in the ink industry. Right now, many inks are based on solvents, which are becoming environmentally unacceptable. In California and, increasingly, in other States and counties, there are VOC limitations. Water-based systems are going to be the wave of the future.

Marketing Matrix

Henry Romagosa, business development manager of the American Gilsonite Co., has made up a matrix to show where our products fit in (fig. 31). Existing and new products are shown at the top, and existing and new markets on the side. The existing market in the upper left-hand corner represents the commodity sales that we currently have. Our new products, such as the resins that we are test marketing or the new oil-well-type materials that are going into existing markets, are shown. Emulsions and dispersants, which we're working on, are not yet on line for those markets; these products will become new market areas. Gilsonite-modified asphalt was an existing market, but in the asphalt industry, there's a new market to use the modified Gilsonite resin. These are four new ways in which Gilsonite can be used in the marketplace. The company is at work on additional marketable products from this unique hydrocarbon material.

Summary

The marketing strategy that we've taken on to change from the old way we did business to our new way has been developed in recent years. Whereas once we had many projects, now we're focusing on a few projects. We used to be production driven—can we make it, and can we mine it? Now, we're market driven—can we market it, and can we sell it at a profit? We used to be volume driven—the more sales, the better. Now, we're value driven; if we have to give up a market, raise our price, or lose that market share because we feel that we're not making sufficient money to cover our costs, so be it!

Might there be philosophic opportunities for you there, too? In the old business strategy, we looked for the short-term gain; now, it's the long-term gain, to a degree. When we project 10 years ahead, we're looking for long-term opportunities. But Chevron is still stock-owner driven, and when we tell them this is our 10-year plan, they say, "What are you going to look like next year? What's your cash-flow, and what's your profit?" Thus, this long-range plan has to be moderated to a degree by the fact that we're financially responsible to Chevron. In our old way of doing business, we wanted to be big; now, we just want to be profitable! We're an old-time Utah company hopefully gaining a new lease on life.

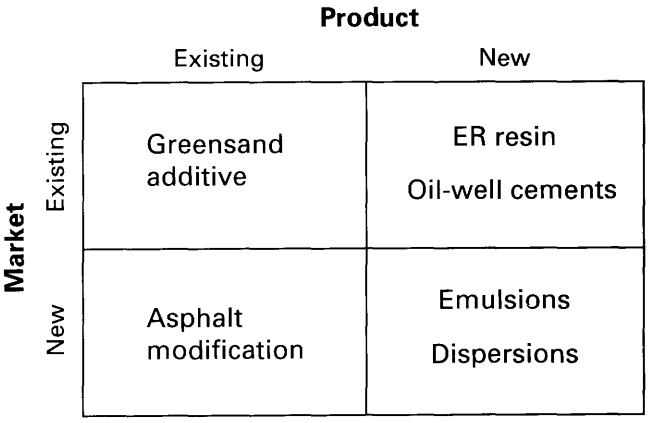

Figure 31. American Gilsonite Co.'s market-development product matrix.

Participant's Comment

• I'm sort of a "drucker," a follower of Peter Drucker (1973), the management guru. He addresses American business' transnational activities and some of the things that Mr. Weiner was talking about, particularly that we're market driven. This, of course, is the basic problem that we all face in the mineral industry and the banking business. These types of activities on a transnational scale are going to drive our future for the next 50 to 60 years.

The Art of Financing an Industrial-Mineral Enterprise

By R.W. Bernick, Sr.

I've been asked to discuss the problems of dealing with lending, and I refer not just to banks but also to all sorts of lending sources available to the industrial-minerals part of the mining industry. I covered this subject in greater detail in a talk at AIME (Bernick, 1981), but for the present discussion and limiting ourselves only to industrial minerals, I'd say that in today's atmosphere of tight credit, lenders will be looking primarily at the highest possible equity contributions; under ordinary circumstances, they'll be avoiding highly leveraged project financing. For the purposes of your discussion today, therefore, I suggest that we take as a model a relatively modest-size mine for which the operator would be seeking a production-loan type of credit. Production lending is common in the oil-and-gas industry, where you'd assume there's a semideveloped or known deposit and you have certain market situations confirmed. We won't go into project financing, which had a disastrous record during the Depression in the mineral industry, particularly in the taconite business, when a lot of big companies went broke and disappeared.

Typical Loan Requirements

A small industrial-mineral project would have to present solid market contracts. The American Gilsonite Co. is an example of a specialty-mineral company. However, here we're talking about arranging a loan for normal or conventional types of industrial minerals, such as a barite company with a modest market position. (1) Such a company would have to verify to the banker that it has market contracts for the product to cover the term of the loan. (2) Its management must have a good track record and experience in the mineral field. (3) The equity contribution required at the time of my earlier speech a few years ago was 20 to 25 percent. Now, as an approximate estimate, there would have to be at least a 35-, 40-, to as much as a 50-percent equity contribution. These are tough conditions, but there are other opportunities for financing, besides bank lending or borrowing from an established institution, that have to meet the regulations of the Federal Deposit Insurance Corporation, the Federal Reserve, the Controller of Currency, and whatever else is required. (4) For such loans, the company must also demonstrate that it has met all the environmental risks; I emphasize the word *all.* Bankers don't want any surprises in lending; they're controlled by risk factors, just like an insurance company. They don't want to approve a loan only to find out later, "Oh, I forgot to tell you that we have to set aside 10 percent of the cash-flow for waste management and disposal and things we didn't think about up front." (5) You have to demonstrate your land-ownership or control situations because industrial minerals are particularly vulnerable to problems in banking. Under the U.S. Federal Mineral Leasing Act or other types of leasing of mineral rights, increasingly, the Federal, State, county, and city governments are all writing new leases with more restrictive operating conditions in response to pressure from environmental groups. These leases consume a great deal of legal time in the perfection effort, and, even now, many of them haven't been tested under administrative-law procedures. These are headaches for financing. I'm not trying to discourage you; I'm simply telling you that these are obstacles to overcome.

Beyond these constraints are the additional considerations of depletion and royalties. (6) We have to pay attention to what the depletion allowances are, because depletion plays an important role in cash-flow. (7) We have to figure out what the royalties are going to be and what the royalty factors are. Personally, I believe that, for the average industrial mineral (I know the State and Federal Governments wouldn't agree!), the less royalties, the better off you are. These royalties are controlled by the State and Federal Governments or Indian tribes, and so on, and aren't subject to negotiations. If anything, royalties tend to go up, not down, but if you're looking at a development on fee lands or properties subject to royalty negotiations, they could be converted to an equity position. One of our customers did this when it took its silver-mine royalties and traded them for common stock of the operating company, permitting income to them from dividends declared by the operating company. This arrangement also gave the royalty owner access to the American Stock Exchange for sale of some of the shares, providing a liquidity dimension to the former royalty holding. Furthermore, the operating company that had the bank loan was provided an enhanced cash-flow, enabling it to reduce bank debt, and so on.

Cash-Flow Considerations

Generally, the purpose of loans is to meet working-capital requirements, and repayment is from cash-flow

generated by the mining, processing, and sale of industrial-mineral products. "Cash-flow" is defined as the amount of money available for loan retirement from net profits plus depreciation, amortization, depletion, and mine-development deductions.

CPA Assistance Needed

Where such mine-development deductions are available and permitted by the taxing authority, I also recommend that you employ a highly experienced CPA. A CPA will be required by a bank lender; they lend money only to people who have CPA-approved statements.

Security for the Lender

The lender may well seek a secured position in the lease and the lease-operating rights, the security being the stockpile of raw materials available for processing, the final product itself, and the equipment owned by the operator. Among the reasons for this seemingly stringent requirement is that, if the operator fails in performance under the terms of the loan contract, another operator can supplant him, and the market contracts can be completed to the satisfaction of both the purchaser of the product and the lender. The lender will see that the purchaser of the product is protected. A satisfied purchaser is the only way the lender gets his money back. The lender will question the borrower about the mineral resource and verification of its reserves, both proven and probable; proof of ownership; his operating rights; environmental health hazards that the mining processing may engender; transportation availability; and proof of all costs, including labor, energy, transportation, rents, royalties, water availability (especially in the Basin and Range, where it may be scarce) of the type and quality necessary to perfect the product. The operator has a real problem without that assurance of water availability. There are potential gold mines that haven't been brought into production because no water was available, and transportation restrictions were such that you couldn't haul the ore materials to a place for processing. The plant has to be built in certain areas near the mine. Availability of waste-disposal sites is essential, also. Access to properties, easements granted by others, insurance, and a management track record on mine safety are considered. In other words, you must prove that the project will generate the cash-flow necessary to repay the loan within the time period agreed upon without cost overruns and unsatisfied risk. Because industrial minerals are labor and energy intensive, in comparison with some other minerals (gold, silver, oil, and so on), the discussion of lenders and borrowers will center largely on cost, cost, and more cost—including, thanks to D.R. Nielson's comments, the cost of regulation. In fact, I suggest that the financial profile for a loan application be constructed, in the case of industrial-minerals lending, from a compilation of all costs, because normally such minerals do not lend themselves to generate wide margins of profit, such as the value-added consideration for a specialty industrial mineral.

Value Added and Other Considerations

The more you can demonstrate that you can add value to your mineral product, as discussed earlier by L.I. Weiner, the more the bankers will be interested in lending you money. For such metals as gold, you get a large swing in commodity prices, and you can structure your loan so as to use commodities' "forward hedging," as is common in financing sales of precious metals, and so on.

There is now available a veritable treasure trove of contributions, through use of computerized profile development, and so on, to help make it much easier to prepare the required documentation. In sitting down with your lender, who also has computers, you can figure out many of these factors if you set them up right and have the right software. Such services are now available to the mining industries.

I might say that I'm not trying to be particularly negative, but this is a highly competitive period that the world finds itself in. Persistence is a virtue. I wish you good luck.

Problems of Business Deals, Taxes, and Economic Analysis

By C.W. Berry

My objective is to highlight some of the complex problems that mining operators must become involved with as modern entrepreneurs. First, we consider how business deals are best made. Next, we consider the problems that industrial-mineral operators have with leasing a mineral deposit, evaluating tax consequences, and other operational and regulatory factors. Finally, we consider the advisability and advantages of making an economic analysis, with an example of the benefits accruing to Utah from the Utah minerals industry.

Business Deals

Successful business arrangements require that you define your business wants and then your needs; they can be different. Also, when dealing with other people or organizations, you should define their wants and their needs. I've been in situations where entrepreneurs claim they want something but, actually, they need something else. As an entrepreneur, you can help yourself in dealing with others by showing that a particular deal is better suited to

their needs. You want to avoid commitments, if possible avoid production commitments or financial commitments, in the event of unforeseen problems.

I'm sure most of you are familiar with the preferred negotiating posture in which you want to get into a win-win situation, in which you both win. You can do this by tax advantages or by different commercial advantages that you bring to the table, and they bring something else to the table. In the less desirable win-lose situation, where you win and they lose, the problem is that, in many cases, it deteriorates into a lose-lose situation. Normally, the win-win situation is a much better posture.

Joint participation has the advantage that you share the risk. You lessen the capital requirements of each participant, which is especially advantageous if you're new in the business. You can take advantage of each side's strengths. For example, one side may be strong in operations, the other side in marketing or in financial backing, so you try to bring the two joint venturers to the table with complementing strengths. The disadvantage is that you have to share the rewards. The objectives of each party may differ or may become different; the financial strength of each party may differ or may become different. These are some of the disadvantages of joint participation.

Mineral-Leasing Problems

It's common in the petroleum business to have a bonus payment (a front-end payment) or a complete bonus payment, which is a buyout. Then, you get into the royalty situation. In sand and gravel, for example, it might be common to have a royalty of so many cents per ton or cubic yard of product, or maybe a percentage of revenue; or you can have a percentage of net-profits interest, with or without land rentals. The advantage of the net-profits interest is that it's more risk sharing. In the percentage-of-revenue scenario, you can actually operate at a loss and still have to pay royalties; the same is true with the dollars or cents per ton of product. Also, you have minimum royalties, and if you're the lessee, the operator will want those minimum royalties advanced or creditable against operating (earned) royalties.

Basically, in an analysis of mineral leasing there are two questions: (1) What are the economic impacts of the deal, both from your standpoint and from the other side's? It's a good idea to do the economics not only for your side but also for the other side. In some cases, it might even be advantageous, for negotiating purposes, to show the other side the economic advantages of a particular deal when you want to get into a win-win situation. (2) What are the risks, both for the deal and for financing? These risks are broken down into three categories—political, business, and technical. One important thing is that risks can go up or down. In exploration, there's an important word—serendipity. Everyone wants that in exploration.

Tax Considerations

Tax changes occur. For example, in the United States, we've gone from a corporate tax rate of 46 to 34 percent; that's a positive change. There are many types of taxes that you have to consider other than income tax. At the local level, there are property taxes on plant and equipment and, possibly, on ore reserves, using either the present-value approach or the production basis. There may be other local taxes, such as a State severance and income tax. You have to be careful as far as the income-tax rate is concerned because it's a percentage of what? In some States, you're allowed a percentage depletion allowance per the Federal tax; in other States, you're not. So, it's a percentage of what? Also, your severance tax can be pretty stiff in some States. Another factor is sales and use taxes. As far as U.S. operations are concerned, the percentage depletion allowance, depreciation, methods of depreciation, exploration versus development in terms of expensing, and corporate structure can have a bearing on your taxes. For foreign operations, the royalties, severance tax, income tax, and the creditability of foreign taxes paid against U.S. taxes are important to understand. Your depletion allowance, which I think most of you are familiar with, depends on two things: (1) It varies with the commodity (for sand and gravel it's only 5 percent, whereas for phosphate it's 14 percent); and (2) it's levied only on your mining activity, so you have to determine where mining stops and nonmining starts from a tax standpoint. One test is that if there's a chemical change to the product, mining stops. Once you have a chemical change, you don't get any further depletion allowance.

Other Cost Factors

Several other widely varying factors should be considered. Community relations can be good or bad. Government regulations, such as D.R. Nielson discussed, can affect business. Especially in overseas operations, possibilities for expropriation, riots, war, production problems, and import/export trade restrictions must be considered. I'm sure that the American Gilsonite Co. is concerned about these factors. Government support or its absence, business risk, union-labor practices, the loss of key personnel, the need to renegotiate business arrangements, and the processing of contract changes provide additional uncertainties. If the value added is done by a custom process, the processor might change the charges. Certainly, transportation problems in the high-volume, low-value industrial minerals are significant. The market, prices, quality, volume, and interest rates are factors that you may not be able to control. Capital availability, possible litigation, changing infrastructure requirements, and currency exchanges, as, for example, with the Gilsonite business overseas, can affect your operation. The technical risks, such

Table 8. Potential political, business, and technical risks affecting a mining operation

Political risks
Tax changes
Community relations
Government-regulation changes, for example, environmental, safety
Expropriation
Riots, war
Halts in production
Import, export, trade restrictions
Business risks
Union-labor problems
Loss of key personnel
Renegotiation of business arrangement(s)
Processing-contract changes
Transportation problems
Market: price(s), quality, volume
Interest rates
Capital availability
Possible litigation
Infrastructure requirements
Currency exchange
Technical risks
Ore grade: inplace and minable, variation
Ore tonnage, geometry, depth
Processing recoveries, mineralogy
Efficiency
Geotechnical
Cost changes: operating and capital
Bench test/pilot test/prototype
Earthquakes, storms
Retrofitting

as ore grade in place, ease of mining, and variations in the ore—its quality, tonnage, geometry (reserve), and the depth of mining—figure into the business economics. Certainly, the American Gilsonite Co.'s mining costs would be much lower if the deposit were massive instead of occurring in thin, steeply dipping veins. Geotechnical costs, bench tests, power tests, prototypes, earthquake and storm damage, and retrofitting are some additional factors, as listed table 8.

Economic Analysis

Let's consider some of the problems that we've seen in economic analysis. One question is whether you use uninflated or inflated dollars. Uninflated dollars are so-called constant or real dollars; inflated dollars are nominal or current dollars. In terms of the interest rate used to get the present value, what's the value of something if you want to buy or sell it? Most operations have a relatively long lifetime, and so the time value of money becomes important. Let's say, for example, we have a nominal interest rate of 15 percent with inflation; the calculations are shown in table 9. Let's also say that our inflation rate is 5.5 percent. That would give us a real interest rate, without inflation, of 9 percent; but in determining the present value, if you do it correctly, you'll come out with the same percentage in constant dollars. Let's say that we have a cash-flow at the end of each of 4 years of $100; undiscounted, that has a value of $400. If we discount that at the uninflated rate—or at the real rate, which is 9 percent—we come up with a present value of $323.97. Let's say we have the inflated dollars at the 5.5-percent inflation

Table 9. Calculation of present value using constant money and current (inflated) cash-flow

[Given: nominal interest rate, 15 percent; inflation rate, 5.5 percent; annual constant cash-flows, $100 for 4 years]

Solution:
Let real interest rate=r:
$1+r=(1+0.15)/(1+0.055)=1.09$; r=9 percent
Discount factor $1=(1+0.09)^{-n}$
Discount factor $2=(1+0.15)^{-n}$
where n=year

Year	Constant cash-flow per year	Discount factor 1	Present value	Current cash-flow per year	Discount factor 2	Present value
1	100	0.9174	91.74	105.50	0.8696	91.74
2	100	.8417	84.17	111.31	.7561	84.17
3	100	.7722	77.22	117.43	.6575	77.22
4	100	.7084	70.84	123.89	.5718	70.84
Total -----	400		323.97	458.13		323.97

.rate, and we have the current cash-flow dollars, which are more in terms of numbers of dollars but which don't have the same purchasing power. Then, we'd use the discount at the nominal or inflated interest rate of 15 percent, and we'd come out with the same present value. I've seen some situations where companies do the analysis, let's say, using 10 percent in constant or uninflated dollars. They then say, "Let's look at it with inflation at 5 to 6 percent," but they use the same 10 percent. They'd get a higher present value, but it'd be fallacious. So, you have to be careful to match apples with apples rather than oranges.

I'd like to make just one final comment on economic analysis. I've found in my industry experience and consulting work that a project can be helped by showing the economic advantages to the community. I once was involved in making such an analysis for a project in which both the environmental impact and the economic impact were important.

Economic Analysis for the State of Utah

I'd like to go through an analysis that I did for the State of Utah for the year 1990 to show the benefits that the Utah mineral industry provides the State. This analysis includes metals and industrial minerals (beryllium and magnesium are included with the metals in this analysis), coal, and oil and gas at the wellhead. In 1990, my estimate is that the total value of metals will be a little more than $1 billion. Industrial minerals, which include Gilsonite, phosphate, coal resin, Kennecott's smelter sulfuric acid, cement, clays, gypsum, lime, salts, and sand and gravel, will total about $400 million. The coal mined in the State amounts to 21 million tons, or about $500 million, and petroleum about $750 million. These commodities will total about $2.7 billion in 1990.

However, what also is probably important to the State is the employment in these industries, which translates into income, sales, and other taxes. For employment we have the direct number of 8,600 employees, an addition to mining of 2,300 employees.

One problem you'll have, if you go looking at the importance of mining in any particular economic sector, is that the SIC system is used, which is now administered by the OMB; it sets up the classification, sends out the forms, and tries to keep the forms simple. Thus, many activities that are mining related are actually considered by OMB to be manufacturing. In Utah, for example, all of the mineral-brine operations are considered industrial chemicals; Kennecott's smelter and refining are considered manufacturing, not mining. Thus, you have to be careful when you use the SIC numbers.

Normally, mining is a good multiplier in terms of job creation. For example, if there's a multiplier of 3.3, that means that for every job in mining, you create 2.3 jobs in supporting industries or employees support. In mining, much of the maintenance is done by contract; the employees themselves need clothing, food supplies, and entertainment. I try to estimate the population that depends on mining. Some people have said that my estimate is slightly high, but I use a multiplier of 4.2. For each job, both direct and indirect in mining, you have a 3.2 dependence. If you remember, total employment in Utah is 69,000 people, but for many of those jobs, if a person is paid $50 in a quarter (3 months), that person is considered employed. Thus, many of those people who are employed, such as teenagers at McDonald's, are dependents. Note that in mining, the average work week is 42.3 hours, whereas overall the average is 34.8 hours; in fact, in the service industries, it's less than 30 hours. My end result of this analysis is that the proportion of all wages in Utah gained in minerals is 11.2 percent. The proportion of people who depend on minerals, again including all mining plus oil and gas at the wellhead, is 13 percent.

For taxes, I've tried to estimate the taxes that are paid by the mining corporations, taxes paid by the employees, and taxes paid by the service industries, plus mineral royalties. One important thing in terms of Federal royalties is that all the States get 50 percent of the amount collected. For example, in Utah, the Federal mineral-leasing income for 1990 is estimated at $106 million, of which the State of Utah will get $53 million. Then, I include property taxes, severance taxes, and all the other related taxes that corporations pay. The individuals who depend on the industry pay taxes that include State income tax, sales tax on cars, property tax on houses, and other miscellaneous taxes that aggregate $137 million. The bottom line is that the State realizes a total of $423 million in tax and royalty payments. The total 1990 tax revenue for the State is estimated at $1.847 billion. Local taxes amount to $968 million. I add in the mineral-leasing revenues. So, we have a total for Utah tax and mineral-leasing revenues of $2.873 billion, of which mining represents 14.7 percent. One thing you might say is that these numbers for the State are too low; the State budget might be about $3.5 billion. That's true, but the makeup of that difference (about $1.6 billion) is from U.S Government grants to the State and revenues that the State collects from different sources for services rendered, such as driver and hunting licences.

I think these percentages are fairly significant for the industry, and they show that the mining and oil-and-gas industries are quite important to Utah. The classification of what constitutes mining has to be adjusted to take into account all of mining, not just that accounted for by SIC.

Participants' Discussion and Comments

- You mentioned that you estimate the total mineral production in Utah at about $2.7 billion for 1990. What

percentage of that total is actually leaving the State as a profit for the companies, from the value of materials sold? This is a question we hear voiced in Nevada quite frequently. The criticism comes that foreign companies (British, Australian, and Canadian) come in and take ore out of the State and their profits with it. We have a payroll of about $485 million for the mining industries in Nevada. If you go through a similar economic analysis, you can come up with various figures, depending on how you view it. It would be instructive to State officials to see just how much of that profit is actually feeding back into the State's economy.

Reply: I don't know. I didn't address the question directly as to profit, because I don't know company costs. If you could get tax records and other records from the companies to arrive at a cost figure, maybe that type of analysis could be done. Realistically, many of those records wouldn't be available.

Foreign investors were willing to put up their capital, so they should get a reasonable return. The higher the risk, the more the return. Maybe there's economic rent there, and it's excessive. Then, you can do it by having an excess-profits tax. If you go that route, you'll scare away future investors. It's a problem. You want to attract investors, but they have to be able to make an adequate profit. In Utah and, probably, in Nevada, more than 65 percent of products are exported out of the State. If you export, then you import economic activity into the State. Certainly in Nevada, just about all the gold that's produced is exported from the State.

- You mentioned royalties assessed under the Mining Law of 1872. There are no royalties on Mining Law minerals on public lands. Under the Mineral Leasing Act, a fixed cost, a fixed-sum additional royalty, has been allowed in the past. For example, under a standard oil-and-gas lease, I believe that in the 1950's, the lease owner got 5 percent and was permitted to add another 1 percent. You're referring to a private royalty in which someone has a lease and subleases it to someone else.

- There are different rules for minerals taken off Federal lands. There are three categories of minerals: locatable, leasable, and salable. Locatable minerals fall under the 1872 Mining Law and include such metals as silver, gold, copper, and certain industrial minerals. Leasable materials would have a royalty associated for oil and gas, coal, Gilsonite, trona, and so on. Salable materials don't require a royalty. There's one point that I wanted to make, relevant to the economic analysis: Bonding has become quite an issue with mining companies. Even though they can go through the analysis and find that they can mine a certain product at a profit, they have to go and get a bond for the BLM to cover environmental reclamation.

- Bonding used to be common in the coal industry, but there are many problems associated with it. Many of the bond brokers went broke. Bonding is an additional insurance cost. It's OK to sell bonds, but trying to collect on them can be a problem.

- I made a survey in Utah last year and found that there are no surety companies within Salt Lake City which hold bonds on a mining operation. We're requiring operators to come in with a bond in order to operate. We'll have to devise a policy to allow them different ways to hold bonds.

The Director of the BLM has announced recently (American Mining Congress Journal, 1990) that the BLM is implementing its mandatory bonding policy for exploration and mining plans, following instructions released on June 27, 1990. The goal of the new policy, which is similar to that for management of coal-mining operations under the surface-mining law, is to encourage the States to run their own programs. Bonds will be required for all plans of operations, unless the operators can demonstrate the existence of a State bond within 75 percent of the BLM's estimated bond amount or ceiling. Operations using cyanide leaching and operators with a record of noncompliance must be bonded at 100 percent of the BLM's reclamation-cost estimate. The ceiling amounts for BLM bonds are $1,000 per acre for exploration and $2,000 per acre for mining operations. The new policy will remain in effect until the BLM completes rulemaking addressing all issues associated with bonding and mining operations. It will be a costly requirement for the industry to bear.

Environmental and Support-System Problems for Industrial-Mineral Mining

B.W. Buck, *Convenor*

We now move into more detailed discussions of environmental constraints and problems that face the industrial-minerals industry. So far, we've have addressed many of these issues in general—those constraints caused by Federal Government policies and regulations, limitations caused by local planning and zoning authorities, and various regulations by State governments. The industrial-minerals industry has to work within these land-management rules. We now want to examining the issues further from a different, possibly more detailed perspective. We'll be looking at land-access problems and controls from a Federal perspective; then, we'll move on to a case-history study of environmental permitting and environmental-baseline studies from an industry perspective, in which we'll demonstrate the types of permits and programs necessary in Utah but which would be generally applicable to most of the States in the Great Basin.

We then will discuss the difficulties in providing support systems. The Great Basin is aptly named; there are

lots of open spaces out there. It's difficult, frankly, and a major limitation on mining development to get such support services as water and power to mining facilities. I'd guess that most of the industry representatives here have some personal experience with one or more of these topics and should be able to add their comments about their past problems during the discussion period.

The panelists, who will present some practical experiences, include S.J. Brooks, a geologist in the BLM's Salt Lake District office, who will address land-access issues from the Federal perspective. Mr. Brooks began his professional career logging soils for the Alaska Pipeline Construction Project, then moved on to the USFS in California and to BLM projects in Nevada and Utah. G.M. Eurick has been environmental-affairs coordinator for American Barrick Resources Corp., located in the Mercur mining district, Utah, since 1982, where he's had various positions in environmental and occupational health. Previously, he was operations environmental health officer for the Anaconda Minerals Co. at the Carr Fork mine in Tooele, Utah, and was in the environmental-affairs department of the Minnesota Power and Light Co. Mr. Eurick will discuss land-permitting issues in Utah. Finally, C.L. Smith, who is the director of environmental services and senior project manager in the Salt Lake City offices of Dames and Moore, a geotechnical and environmental engineering firm, will consider mining-support-service problems. Previously, Ms. Smith was consultant for support services to the DOE's Western Area Power Administration and had experience in environmental-project management, data management, and cultural resources for Worth Associates in San Diego, Phoenix, and Denver.

Land-Access Issues from the Federal Perspective

By S.J. Brooks

I'm going to focus on issues affecting access to public lands and how access limitations arise; I'll also summarize some of the industrial-mineral activities on the Salt Lake District's public lands in the Western Desert and how legal access differs for locatable, salable, and leasable minerals. Environmental issues and concerns have increased significantly in recent years; regulation is proliferating. At the regional and State levels, major environmental legislation is being revised and developed. In the U.S. Congress, the 1872 Mining Law and the BLM's Service Management Program for mining activities are undergoing intense scrutiny; the GAO and environmental groups are also studying them. We can expect to see more concern in the years ahead about mineral operations.

Industrial minerals are commonly overlooked by the public, as well as by the BLM, where funding in salable-mineral programs could be called the "Rodney Dangerfield" of mineral programs. Funding has never been adequate to ensure timely responses to public needs and environmental concerns or to management goals. These signs of the times involving ever-increasing demands on the public lands, along with public interest in such nonconsumptive land uses as recreation and wildlife habitat, make it imperative that industry improve mining practices and its image, so that mineral development by the mining industry is more compatible with the activities of other user groups. The current climate is a result of past abuses. There's a need on the part of industry to accept a role as a steward of the public lands.

There are many well-publicized examples of public lands that cannot be accessed owing to private inholdings. The BLM has an easement-acquisition program driven by the land-use-planning process that may, in certain circumstances, be of assistance in obtaining such access. Access has been acquired for recreation uses, but no one from the mining industry has asked for such assistance.

Use of Industrial-Mineral Resources in the Salt Lake District

Some of the industrial-minerals activities in the Salt Lake District include the following. Magnesium Corp. of America uses oolites from the shores of the Great Salt Lake to remove sulfate from brines and to scrub chlorine from their waste stream. Large amounts of Lake Bonneville muds have been used to form dikes around evaporation ponds for this corporation. We sell large volumes of Lake Bonneville aggregate deposits for roadbase materials. Diatomaceous marl is used by U.S. PCI, Inc., to stabilize hazardous wastes and for construction purposes. Elba Quartzite is used for building stone and has been obtained from numerous pits in the district. Potash is recovered from brines near Wendover, Utah. We sell some topsoil for landscaping, and clay from beds in the Manning Canyon Shale is used to make bricks. I think these examples illustrate some of the great variety of uses and the need for availability of industrial minerals located on public lands.

Access to Locatable-, Leasable-, and Salable-Mineral Lands

The resources in the Salt Lake District include minerals that are locatable, leasable, or salable. Access rights to these minerals vary. Nonexclusive access across Federal lands to projects for locatable minerals is specifically granted in the 1872 Mining Law and is included in the submission of a plan of operations. Access to leasable-mineral operations is by ROW offlease; it's also included as a part of the operating plan. For salable minerals, which form the bulk of industrial-minerals operations, ROW's are not required; access is implicit in the contract. The

BLM doesn't guarantee access across private lands, but we'll alert potential permittees as to the requirements to obtain such access.

Concluding Remarks

In conclusion, I'd like to mention that participation by an informed and knowledgeable public is important in the BLM planning process. We're now completing a planning amendment for the Pony Express Resource Area, which covers a large part of the Western Desert, for use by offroad vehicles. This plan, which will soon be released for public review, proposes some significant restrictions on offroad-vehicle use. To date, there has been very little feedback from the mining industry. A copy of this document is available for your comment.

Problems of Mine Permitting in the Great Basin

By G.M. Eurick

American Barrick Resources Corp., headquartered in Toronto, Ontario, Canada, is a major North American gold producer with operations in the United States (Nevada and Utah). The difficulties encountered in environmental permitting of these operations are not unlike those encountered by industrial-mineral producers in these States. My presentation will focus on our mining operations at the Mercur mine in Tooele County, Utah, located about 65 mi southwest of Salt Lake City.

The Mercur operation employs 230 personnel and operates on a year-round basis. Ore production is nominally 5,000 tons per day from four active mining sites, with an ultimate bonded disturbance area of more than 1,000 acres. The gold-recovery mechanisms utilized at Mercur include the conventional carbon-in-leach circuit, the alkaline pressure-oxidation circuit (or autoclave system), and three valley-fill leaching operations. Annual production at Mercur is expected to exceed 100,000 troy oz Au throughout its remaining lifetime.

Mining-Regulation Actions at Mercur, Utah

To date, a total of 45 regulatory actions have been necessary to permit and continue to operate the Mercur mine. The bulk of these actions have been by the State; there have also been some significant Federal actions and, on a lesser scale, some local or county actions. The regulatory overview that I'll describe, though directed at such locatable minerals as gold, could apply to just about any other salable or leasable material produced in Utah.

Federal Actions

The significant Federal environmental determinations at the Mercur project were done initially. The most significant issue, listed in table 10, concerns the BLM plan-of-operations permit that was obtained before operations began. I believe we have less than 500 acres of BLM property involved at Mercur. This district is also a historical mining area, and most of the land is privately held. The BLM-land part is limited but required a plan, nevertheless. The significant issues are land use, private versus State versus Federal ownership, and land access, such as how to afford adjacent landowners or royalty holders access and involvement in the operations. The BLM also delves into revegetation extensively, and the goal of concurrent reclamation is desirable, though not always achievable, in an open-pit hard-rock-mining operation like that at Mercur. Also of significance in table 10 is the EPA's mine-waste exclusion, which was promulgated in 1989. This regulatory determination essentially excluded numerous mining-waste streams from protection by the Bevill amendment. Industry must now seriously evaluate its mine-waste streams to determine hazardous versus nonhazardous characteristics. Also significant is the T&E-species review, which was done early in the project.

Table 10. Federal-agency environmental regulatory determinations for the Mercur mine, Tooele and Utah Counties, Utah

[Do., ditto]

Agency	Issue/action
EPA	PSD/review.
Do[1]	NPDES/permit.
Do[1]	RCRA/notification.
Do	Mine-waste exclusion.
BLM	Drilling/permits.
Do	ROW/permits.
Do	Plan of operations/permit.
Do	CERCLA/review (EPA).
Mine Safety and Health Administration.	Plan of operations/permit.
National Institute for Occupational Safety and Health.	Facility health/review.
Bureau of Alcohol, Tobacco, and Firearms.	Explosives/permit.
Nuclear Regulatory Commission.[1]	Radioactive devices/permit.
DOD	Water monitoring/agreement.
Fish and Wildlife Service	T&E/review.
USBM	Statistics/reporting.
C of E	Non-Federal dams/review.

[1]Subsequent State adoption.

State Actions

The State's involvement at Mercur has been extensive and is ongoing. As noted in table 11, the DOGM

Table 11. State-agency environmental regulatory determinations for the Mercur mine, Tooele and Utah Counties, Utah

[Do., ditto]

Agency	Issue/action
DNR, Division of Oil, Gas, and Mining.	Minerals reclamation/permit.
DOH, Bureau of Water Pollution Control.	Construction/permit.
Do	UPDES/permit.
Do	UIC/permit.
Do	Ground-water discharge/permit.
DNR, State Engineer	Water supply/appropriation.
Do	Dam construction/permit.
DOH, Bureau of Air Quality	Air operating/permit.
DOH, Bureau of Drinking Water and Sanitation.	Facility construction/permit.
Do	Potable water/approval.
DOH, Bureau of Solid and Hazardous Waste.	Facility construction/permit.
Do	UST program/notification.
Do	RCRA/administration.
DNR, Division of State Lands and Forestry.	Mineral leases/approval.
Do	Exploration/permits.
Do	Land-use lease/approval.
DOT	ROW/permit.
DCED, Division of State History.	Historic and cultural/review.
DNR, Division of Wildlife Resources.	Wildlife impact/approval.
DOH, Bureau of Radiation Control.	Radioactive devices/permit.
DPS, Division of Comprehensive EmergencyManagement.	EPCRA/notification.

permit is the primary State action. This permit has been modified numerous times and currently is under review for ultimate perceived expansion of the operations. In my opinion, the important issues of concern to the DOGM are (1) drainage and how it affects ongoing operations; (2) ultimate closure; (3) postclosure monitoring and reclamation, how it is achieved, and how it will stabilize the ultimate configuration of the property; and (4) bonding. The Mercur operations currently are self-bonded on the basis of Barrick's financial strength. We're thankful that self-bonding is a continuing practice in the State of Utah. Also significant, as listed in table 11, is the BWPC's Division of Environmental Health permit sequence. Construction, UPDES, and ground-water discharge all can be applied to any particular facility or component within the facility at Mercur. The ground-water-discharge permit is most recent, promulgated in August 1989. Our industry is currently dealing with the BWPC on implementation of these regulations and application procedures for new ground-water-discharge permits.

Table 12. Local-agency environmental regulatory determinations for the Mercur mine, Tooele and Utah Counties, Utah

[Do., ditto]

Agency	Issue/action
Tooele County	Conditional land use/permit.
Do	Zoning/permit.
Do	ROW/permit.
Do	Access corridor/permit.
Do	Building code/permits.
Do	Solid-waste disposal/permit.
Do	Public health/review.
Do	EPCRA/notification.
Utah County	Facility construction/permit.

A most significant item in table 11 is the Bureau of Air Quality's operating permit, which requires the monitoring and recordkeeping of pollution incidents, pollution-control-equipment data, and processing-facility statistics. The implications here clearly are that, with the anticipated reauthorization of the CAA and the work the State of Utah is doing on its implementation plans for Utah and Salt Lake Counties, more attention will be directed to mining operations. The mining industry should maintain a proactive position in these discussions.

Another noteworthy State regulatory action is the Division of Wildlife Resources' wildlife-impact-mitigation program. This aspect of our operation is important to Barrick and involves close cooperation with the DOGM, as well as with Tooele County.

County Actions

We've dealt with the local county agencies for the permits listed in table 12. The mine is located primarily in Tooele County, but it crosses over into Utah County. Tooele County is our primary contact and will follow the permitting leads of the BWPC and DOGM. However, the county has some unique concerns, in (1) what the ultimate land use will be as the county reinherits the properties, and (2) how the designated lands will be used to support wildlife-habitat and recreational purposes, as they were before mining.

Pending Environmental Regulatory Activity

I'd like to discuss a few of the more pertinent pending Federal environmental regulations or regulatory developments. (1) The mine-waste-regulatory development program of the EPA, referred to as "Strawman I," was released for public review a few years ago and strongly criticized. "Strawman II" was released for public review last week, and it'll probably get similar treatment. The mining industry

is heavily involved with the implementation of this process. (2) The CAA reauthorization bill has passed both the House of Representatives and the Senate; final passage is anticipated this year. That bill probably will affect mining mostly in terms of offroad-vehicle emissions from our large industrial equipment. Also, fugitive-dust monitoring for PM–10 and TSP's and an increase in the hazardous-emission-mitigation effort will require that the mining industry put forth greater effort to comply. (3) There is probably no hope that the RCRA reauthorization will be passed during this Congressional session; however, it's anticipated to have a top priority for next year, once the CAA is out of the way in the Congress.

From the State regulatory perspective, we also expect some actions. (1) The regulations governing extraction of metals by heap leaching are in draft form now and under review by a technical advisory committee; they're due to be re-released to that committee by June. This will become an additional permitting program, as we understand it, to be applied to the heap-leaching industry generally, not specifically for gold. (2) The wellhead-protection regulations have now been released for public review. Hearings are scheduled in June, and they could strongly affect mining operations in proximity to a community's or an individual's water supply.

Conclusions

In conclusion, I think it's important to understand and convey to the general public the fact that mining, any type of mining—metal or nonmetal, locatable, leasable, or salable—currently is heavily regulated from an environmental standpoint. In my position as an environmental coordinator, I believe that any additional environmental regulatory programs should be focused on realized, not on perceived, environmental impacts.

Environmental Problems in Planning Mining-Support Systems

By C.L. Smith

I was asked to prepare a brief presentation about the support systems associated with industrial-mining operations, which would include the needs for power, water, transportation, and labor, consideration of regional socioeconomics, and so on, and the problems encountered in establishing such infrastructure. The needs and permits required depend on many factors, such as the type of industry, its location, and the size of the facility. To address the need of each of these factors in detail is impractical and most appropriately would require the expertise of a design engineer.

As an environmental planner who's had the opportunity to participate in projects from the preliminary planning stage through construction and monitoring during operation, I'll address these issues from my experience in the development of a project in environmental planning. I'll start by providing an overview that illustrates the complexity of project development, briefly describe infrastructure, and then provide an example of support-system planning within the environmental-planning process from a project in which I recently participated.

Legislation

A word is needed about legislation. Although we understand and agree with the importance of environmental legislation (for example, NEPA, CEQ regulations for implementing NEPA, and resource-specific regulations), one difficulty has been and will continue to be the interpretation and implementation of regulations. Unfortunately, but necessarily, each agency interprets the regulations and guidelines in accordance with its own legal mandate. For example, the BLM interprets the guidelines differently from the USFS; both are land-managing agencies, but their respective responsibilities are different. Not only that, but the regulations change, seemingly often to you in industry, I'm sure.

With the number of requirements that exist and the number of agencies that potentially can be involved in a project, it can easily become a confusing situation. The environmental-planning process suffers from a widespread lack of understanding. As you've most likely experienced, the process can be burdensome, costly, and time consuming. I've heard that the environmental-planning process has three distinct parts: a beginning, a muddle, and no end.

We (companies, agencies, and consultants) are faced with identifying ways to place the project-development and environmental-planning process in the proper perspective and balance all the issues. Such success has been repeatedly accomplished, but only with persistence and a concerted effort in planning and coordination.

Company Economic Benefits

When a company considers the development of a facility for mining an industrial mineral(s), it's an understatement to say there are numerous issues that must be addressed in detail if that business is going to yield a profitable product. Selection of a location or expansion at an existing facility requires tradeoffs among economic return, amenity benefits, and environmental costs.

There are several reasons why a company may decide to locate at a particular site, and as many reasons for

government agencies or the community to support or oppose a company's decision. The company's management wishes to be close to its market and raw resources, at a location that provides a reliable and inexpensive labor force, proximity to reasonable transportation and communication networks, and sufficient supplies of energy and water. Also, management is attracted to communities that offer financial incentives and (or) deferred taxes and local financial support.

As a result of a heightened consciousness of human welfare and the environment through the 1960's, 1970's, and 1980's, companies need to consider locations where the lives of their employees and employees' families are perceived to be attractive, consisting of available quality housing, shopping, entertainment, education, esthetic surroundings, outdoor recreation, and community services.

Public Involvement

Also, in recent years (approx 8–10 years), companies have had to become more sensitive to citizen and agency perspectives, issues, and concerns. The perspectives are diverse. The populations of certain geographic areas may consider equally income and benefits and impacts to the environment, whereas the populations of other areas may focus on one or the other.

Regional Socioeconomics

Economic benefits from a development within a region begin with increased employment during construction of the facility and continue during the operation of the facility. This employment produces increasing regional income with the purchase of goods and services, which leads to increasing tax revenues. Increasing tax revenue and community wealth may lead to community growth, expansion of community services, and improved amenities.

However, the proposed facility also may create some short- and (or) long-term costs to the region, such as displacement and relocation of some residents; increasing activities (for example, traffic) during construction; need for additional housing (temporary or permanent), materials and space in schools, and other public services; loss of land for other beneficial uses; and loss of attractiveness due to environmental degradation.

Project Development and the Environmental-Planning Process

Generally, there are four levels of project design and planning: (1) preliminary planning; (2) initial identification of potential sites and comparison of site options (or a regional siting study); (3) evaluation of process-design options, or development of the project description with site-specific considerations in mind; and (4) detailed assessment of the consequences at the selected site or at all alternative sites. Environmental planning essentially is a process of arbitration, of choosing between often mutually exclusive uses of land, and of ensuring that a new land use proceeds only with an acceptable level of impact. The process is complex, involving an assessment of the proposal and the development site and a prediction of the impact of the new development on the natural, human, and (or) cultural environment.

Infrastructure, or Support Systems

The infrastructure, or support systems, are the auxiliary or contributory facilities that are needed or required for the construction and (or) operation of a mine. The need for and extent of these facilities depends on the location of the facility, the type and size of the operation, and regulatory requirements. One of the most common problems that I've seen in the past has been the focus on permitting the mine and directly associated mine operations and neglecting plans for support systems. Fewer problems arise if the entire proposed action is carefully planned and addressed simultaneously. The lack of planning does not occur as much now as in the past—agencies, companies, and consultants are now much more aware of project-development requirements.

Support Systems

The proposed mining operation will need several support systems that may include the following:

- public access to the facility
- hauling by access road, rail, or pipeline
- use of public highways if hauling long distances by truck
- labor (temporary construction personnel, permanent operations and maintenance personnel)
- solid-waste disposal.

Some of the support systems that I will discuss here are linear facilities, such as roads, rail lines, pipelines, and powerlines, which will vary in length, depending on the distance of the facility from the closest highway, water source, or power source. Linear facilities may be included in the facility permit in some cases, or a separate permit may be required, depending on the land use or jurisdiction (for example, the mine may be on private land, and the linear facility may cross land that is administered by the BLM). Much of the time, a single corridor may be used for all the linear facilities needed (for example, the overhead powerline and communication line will parallel the access road, under which is buried a water pipeline).

Water

The two primary considerations are (1) demand for water and (2) water discharge. In most cases, both considerations require permitting. Industrial- and potable-water supplies must be sufficient in both quantity and quality. Sources of water could include surface-water bodies (natural or artificial), ground water, municipal supplies, or a combination of sources, but whatever the source, usage should not interfere with existing regional uses.

Because of local variations in the availability of water from season to season and from year to year, many operators have chosen to construct a reservoir(s) to assist in ensuring that a constant water supply is available. Generally, this may entail calculation of:

- surface inflow and outflow
- water imports and exports
- precipitation
- consumptive use (processes or evapotranspiration)
- changes in ground and surface water storage
- subsurface inflow and outflow.

If the water is used from off site, transporting the water could require hauling by tank truck or siting and construction of an aboveground or underground pipeline. An underground pipeline is normally preferable—it costs more to install, but it generally doesn't interfere with surface land uses and isn't vulnerable to vandalism, as is an aboveground pipeline.

Water-Discharge Systems

As most of you are aware, discharge of wastewater is heavily regulated and is evaluated and monitored on a case-by-case basis, and so designs of water-discharge systems are site specific.

Electrical Power

The company must determine the amount of electricity that will be required for the industrial operation and employee workspace. Also, the company must consider whether power will be generated on site or provided by a commercial source, or both. Generating power on site may require permitting, depending on the fuel used and potential emissions. Use of a commercial source will require a contractual agreement with the local electrical-utility company and siting and constructing a powerline, which may require permitting. The amount of power will dictate the size of the powerline (for example, 12, 48, 160, or 230 kV, single wood pole, H-frame wood pole, steel-lattice tower). A powerline (most often an overhead line) may interfere with adjacent land uses (for example, airspace, radio transmission, agricultural practices).

Energy Fuels

Similarly, the company must determine whether or not energy fuels, such as natural gas, will be used at the facility. The company must consider the quantity to be consumed and the method of delivery, for example, by pipeline or tanks.

Communication

Several modes of communication are available—traditional telephone lines, which would have similar problems to those described for transmission lines; microwave for operation signaling or voice, which must be strategically placed for sending and receiving; and (or) fiber optics, which can be buried and typically create fewer impacts than a pipeline.

Transportation

Modes of transportation include roads, railroad, conveyance systems (mechanized belt or pressurized pipeline), and, in very rare cases, air transport (for example, in a remote area during disruption of normal transport service). A road(s) is usually needed to access the mine for transportation of personnel, delivering supplies, and hauling (for example, raw materials, product, waste). Railroad spurs are commonly constructed from a main track to the facility for hauling raw materials and (or) product. Conveyance systems can be used both on and off site for transporting the mined materials. Roads should be well planned and engineered. Direct impacts that typically can be caused by the construction of roads include erosion, segmentation or fragmentation of wildlife or plant habitat, interference with land uses, and intrusion on the visual characteristics of an area viewable to the public. Also, the construction of a road in a remote area, if not barricaded by a gate or other means, allows the public access that may result in damage to natural resources or disturbance to prehistoric or historical archeologic sites. Railroads should be well planned and engineered for similar reasons.

Conveyance systems, such as mechanized belts, are usually constructed above ground. Although physical impact to the environment can be minimized, segmentation to habitat, interference with land uses, and intrusion on the visual characteristics of an area can occur.

Pressurized pipelines for transporting materials are not yet common. A pipeline constructed to transport phosphate slurry will be described later as an example, so I won't provide any details about the system here.

Labor

There are many factors to consider with regard to the temporary or permanent labor force:

- How many individuals will be required temporarily and (or) permanently?
- Will the work force be hired from the local communities or outside the region?
- Is there adequate temporary housing for the nonlocal construction workers?
- Is there adequate housing for the incoming permanent employees?
- Will there be a need for transportation of the work force to and from the jobsite?
- Are there adequate goods and services for temporary or permanent employees and the families of the employees (for example, food, schools, churches, law enforcement, fire protection, medical, and so on)?

Other Socioeconomic Considerations

The following items add to the considerations that effective support systems require:

- economic analyses, as discussed here earlier by C.W. Berry
- effects on commerce and industrial levels (community and regional)
- availability of public utilities
- effects on community and social structure
- effects on land values
- tax benefits to the community
- effects on rent structure
- effects on local government.

Example of the Conda-to-Pocatello, Idaho, Phosphate-Slurry Pipeline Project

A recently completed project provides a positive example of careful and coordinated planning. Sincere and concerted cooperation among the agencies, the company, and the consultant resulted in a successful project that proceeded without major problems or disagreements. Last year, I was Dames and Moore's project manager to conduct environmental-planning studies and prepare the required environmental document for the J.R. Simplot Co.'s 60-mi-long, buried phosphate-slurry pipeline from Simplot's facility at Conda to its manufacturing plant at Pocatello, Idaho. The pipeline was to be an expansion of a 27-mi-long pipeline that has been operating since 1984. The primary purpose of this pipeline was to eliminate hauling the phosphate ore by rail, thereby eventually reducing the costs of transportation and allowing for a more consistent supply of ore (that is, the pipeline would operate 24 hours a day, whereas the railroad operates within the regular work week). A notably positive consequence of the pipeline is the fact that all outdoor handling and storage of the ore could be eliminated, thereby reducing the amount of fugitive dust. Air quality is a problem in that area, so, from that perspective, the project was welcome.

Before the award of the environmental-studies contract, Simplot engineers had considered both the engineering and major environmental constraints of various alternative corridors and selected a preferred route for the pipeline. The BLM and USFS, however, were somewhat concerned about the appearance to the public of having a route "predetermined" before an objective study, so we designed and conducted a rigorous environmental overview of the region to identify all potential, feasible alternative corridors.

Early in the project, as part of the "scoping" process and the public-involvement program, we prepared and distributed a project newsletter to relevant agencies and the interested public to inform them of the project and to solicit comments. The comments indicated concerns about:

- water demand (amount needed, interbasin transfer)
- wastewater discharge
- effects on trout fisheries at stream crossings
- water quality at stream crossings
- access roads allowing/inviting unwanted traffic into remote areas
- effects of construction on the visual characteristics of the area (land scars and tree removal)
- regional socioeconomic effects (reduction of jobs at Simplot, the railroad, and others within the region).

Water Demand

Water for operation of the pipeline would originate from a ground-water source at Simplot's mine facility. Use of the water had been permitted since 1981, and normal usage for the new section of pipeline would not exceed what was already permitted.

Wastewater Discharge

The water present in the slurry mixture would be used directly in the production process at the Pocatello facility, thereby reducing the amount of water extracted for the process from wells at the Pocatello facility. The water from the slurry would become part of the liquid-fertilizer product or would be evaporated from dryers in the production of dry-fertilizer products; no water would be discharged into streams, ponds, or reservoirs.

Fisheries

The potential impact on trout fisheries and concerns about water quality at stream crossings were reduced by committing to use a special construction technique. A metal culvert would be placed in the stream along its flow. The stream would then be diverted through the culvert with the use of sandbags and hay bales. Then, the trench would be excavated perpendicular to and under the culvert,

the pipe installed, and the streambed reclaimed. Some sedimentation was expected, but not nearly as much as if the streambed were trenched with no precautions.

Access Roads

First, the alternative corridors were sited to take advantage of existing roads for access—construction costs would be lower, and fewer impacts would be introduced. In one remote area, an existing dirt road would have to be widened during construction, and the agencies were concerned that the widened road would be more inviting to more traffic, which was undesirable. Simplot committed to returning the road to its original width after construction through that area was completed. In construction areas where no roads exist or are wanted, Simplot committed to constructing no access roads, and all vehicles would drive overland. Vegetation above ground would be crushed during construction activities but would regenerate from the roots. Also, bare soils would be reclaimed immediately.

Visual Characteristics

A swath for the pipeline would have to be cut through a few stands of trees. The USFS was concerned that the obvious, visible swath would invite recreationists to create a new offroad-vehicle corridor through the forest. Trees cannot be planted over the pipeline, but Simplot committed to coordinate with the USFS to selectively cut trees, so that the swath would not be so obvious, and to plant trees strategically to screen the ROW swath from view.

Socioeconomics

Reduction in labor was a concern. The new operation would require fewer Simplot employees; however, transfers and natural attrition of workers were expected to accommodate much of the reduction. Toward the end of the project, a rather interesting concern arose from the railroad union. The use of the slurry pipeline to replace rail transportation might have affected employment with the railroad. However, the railroad would continue to serve other mines in the area, and we were able to demonstrate that any reduced rail-transport volume was likely to be offset by ore shipments from a proposed mine, which would eventually ship more ore than the Simplot Co. had.

Coincidentally, as the environmental document was distributed for review, the Kraft Co. announced that it would be closing its plant in Pocatello, which employed about 400 people at the time. We were concerned that this announcement might affect the decision on the pipeline project. Though not directly related to the Simplot project, it could have been perceived as a cumulative effect in the region; however, the issue did not arise as part of this project.

Conclusion

This has been only a brief and cursory overview of the support systems that may be needed for a mine operation, with some examples of the environmental problems encountered in developing such systems for a new project or expansion of an existing project. Both foreseen and unforeseen environmental problems occur in nearly every project, but through understanding and careful coordination between the agencies and companies, and with the assistance of a competent environmental-planning consultant, as well as an effective public-involvement program, most of these problems can be resolved.

Participants' Discussion and Comments

- How long would it take to get a typical medium-size aggregate operation going in the Basin and Range region?

Reply: It would, of course, depend on the location. If on public lands, it would depend on the administrative agency, such as the BLM or USFS. The USFS may require more time to permit because it tends to have more restrictions. It's difficult to say what the total time for project development would be. If an EA or EIS is prepared, it's been our experience that an EA process can take anywhere from 3 to 16 or 24 months, and an EIS can take 18 to 24 months; if it's a major project, it could require 36 months or more. For a medium-size project, it could take 18 months just for the EIS, not including permitting or all the project development. A minimum schedule could be at least 6 months if the project is well planned and organized, the designs are ready, and no problems with permitting or environmental assessment are pending. Much depends on the issues, concerns, and controversy associated with the project.

- How do you determine whether you need an EA or EIS? Is it true that a lot of that's purely political?

Reply: First of all, it may be more appropriate for the representative from the BLM to tell you what the requirements are. There are three types of documentation in the Federal system: categorical solution, EA, and EIS. Selection of the type of document is both objective and subjective; there are regulations that guide the decision, but it also requires professional judgment. If, after the project is reviewed and no potential or significant impacts are found, the type of project fits an established list of projects for which effects are known to be minimal, the agency may prepare a brief document, a categorical solution. That isn't the usual process. An EA is the "first look" at the affected environment, the first step in determining whether or not an EIS is warranted. If it's demonstrated that the project will have little or no "significant" effect, then an EA may be adequate. If more potentially serious effects are identified in preparing the EA, an EIS may be required; an EIS

is based on a more detailed, rigorous analysis. Public involvement and review are required, which lengthen the project schedule. In the beginning, if the agency identifies a potentially heavy impact for a project, the agency may decide to forego preparation of an EA and begin the environmental-planning process by requiring an EIS. Usually, the agency is able to determine the type of document at the beginning. The agency uses the regulations as a guide but must also use its knowledge of all the environmental resources and consider the concerns of interest groups and citizenry. Is it controversial? There may not be many environmental problems, but there may be controversy associated with a project in the public's eyes. In that case, an agency may choose to complete an EIS just to make sure that all "bases are covered," and assure to satisfy itself that the public is satisfied.

The answer to the second question is "Yes"; in some cases it's highly political. In other cases, it can be straightforward and smooth as silk. It can't be predetermined. Knowing the area, the community, and the agencies is helpful in determining the climate. Does the region you'll be working in typically demonstrate opposition to that type of project? If the communities have strong feelings about one aspect of the environment, they may oppose the project; or the agency may have strong feelings about the sensitivity of a particular resource. It's difficult to say without referring to a particular project.

At the beginning of the environmental-planning process, an agency is required to identify the range or scope of issues, concerns, and opportunities to be addressed in the studies and, subsequently, in the environmental document. If some impacts are anticipated to be significant at that time, the decision will be made to do an EA or EIS.

In addition, some agencies I've worked with begin with an EA, complete all the inventory studies and the impact assessment, and then conclude at that point, if significant problems exist, to proceed with an EIS. When we conduct the studies for an EA, we try to do it in the detail required for an EIS, just in case. If the analyses are adequate, then all the agency has to do is change the cover, more or less. Most of the projects we're contracted to do are major and (or) controversial, so beginning with a detailed EA is warranted, although such thoroughness isn't always warranted.

- In making an EA or EIS, how important is the socioeconomic evaluation or study?

Reply: That can be highly important; it alone can trigger the document into an EIS or EA containing a more detailed socioeconomic study. It depends on the particular issue. Once again, it comes down to a determination of importance. If you're evaluating a large mine near a small town that doesn't have the infrastructure to support the intended new employment in the area, that may trigger the need for an EIS. Conversely, if you have a large operation at some distance from an area with a large population, it will have a different level of impact, and an EA may be adequate.

All of those environmental resources that are variables discussed earlier are addressed to some appropriate extent, and most of them are addressed adequately in the initial study. Then, you know the seriousness of the problems, and in some cases socioeconomics may not be a problem. The impacts identified may be entirely beneficial to the region. In an example of a 100-mi-long transmission line that was constructed across several counties, the economic benefits are both short and long term. The community is going to gain from goods and services during construction and obtain revenues from the long-term presence of that transmission line.

Whether the impact is beneficial or adverse, it's addressed in the analysis. In fact, most agencies and developers want those positive elements included in the document to help offset the negative.

- Do you have any idea what percentage of the startup costs at Mercur were related to environmental concerns or regulations? How about ongoing operating costs?

Reply by G.M. Eurick: Mr. Buck can best answer the first part of your question because he was involved in making most of the startup permitting studies for Getty, which was the original developer. Ongoing costs for environmental concerns are less than 1 percent of the current operating costs. The cost to permit the new dump-leach area 3 project will be substantially higher than it was to permit dump-leach areas 1 and 2. The cost to continue to operate our containings department will go up at some increment because we have to get a ground-water-discharge permit for tailings containment for the lifetime of the property. Those associated costs for ongoing operations will go up, but overall it's insignificant.

Reply by B.W. Buck: For the Mercur operation, the percentage of total capital invested for environmental baseline studies, consultants, lawyers, and so on, was about 0.15 percent of the total. By the time we were done, the capital investment was close to $100 million.

- When you made the regional analysis, you considered quality. What factor determines the quality of the material?

Reply: That was primarily the opportunity for the industry engineers. They may have a particular grade of mineral in mind when they process and sell. If they specify grades 1, 2, or 3 and they need grade 2 and we can find only grades 1 and 3, then those site locations aren't going to do them any good.

- You're saying that the proponent is defining quality?

Reply: Yes; it's not necessarily a part of the environmental analysis. What I was showing in the regional versus site-specific analysis is that we can help as a part of

the project development. We can, along with a company's engineers and geologists, help determine site locations by identifying that, for example, there are five sites which are suitable for mining from an engineering point of view; however, one is a known wilderness study area, and another is adjacent to a Native American sacred site. Those two sites are eliminated. So, environmental planning can assist in conjunction with the proponent's work. It's not necessarily part of an EA or EIS; it's part of the proponent's planning process and helps him get a step ahead. Whenever we do regional environmental analysis, we include it in the description in the EA or EIS to help substantiate and strengthen the producer's planning. It's just another positive aspect to show the public and the agency that the proponents have looked at a lot of aspects, and the agencies appreciate this effort.

- Do you evaluate need as part of your analysis?

Reply: Yes; that's a requirement of the CEQ guidelines. The first chapter of the environmental report is usually a description of the project, its purpose, and the need for it. The next chapter is usually a description of all the alternatives that were considered. The next chapter is a description of the existing environment, as it is right now. The next chapter is a description of the impact that's been predicted and a discussion of the mitigation measures. Some agencies may arrange it a little differently, but essentially that's what ends up in the document.

- Let me rephrase the question. Who defines the need for the product and determines whether, in fact, that should be a factor, assuming that the environmental option essentially describes the environment and is, indeed, a part of the environment?

Reply: There are certain procedural requirements authorized by NEPA that call for an evaluation of need. For locatable minerals, we have to address the means that meet the NEPA requirement.

- How do you define need? What facts are going to define need? Is it the fact that the economy of the area which that material is going to serve isn't served by a sufficient amount of that type of material? Do you just go out in a free market?

Reply: Frequently, that's the case. As a consultant, I can't define a need for a material; the owner defines that need. I'm simply writing a document on behalf of the lead agency, which has complete responsibility for the content of the document and the content of the studies leading to it. The agency isn't going to allow a company to have as its purpose the need for a project just to make money. Of course, that's part of it; they want to mine something or develop something for a profit. However, there has to be a (societal) need for it. There has to be a demand; that's the basis for need. It's up to the agency to consider it. We've helped the developers establish their basis of need in terms of the community, the region, the Nation, and even internationally.

- Assuming that a feasibility study is done for a company or that the company did one, are you involved at that point? Are you involved after the study is done? Are you talking about bringing about the decision that the company wants to go forward with, for example, their decision to invest?

Reply: It varies from project to project. In one case, I was involved with the company from the very beginning of the project and later monitored the operation. In other projects, because consultants cost the company money, the company will develop the feasibility, complete all the preliminary engineering and planning, and then go to the agency to apply for the permit. A lot of work still remains, but once the company goes to the agency and the agency says, "Well, you have to do an EA or EIS," that's when the consultant usually enters the picture; we usually prepare the EA or EIS. Sometimes followup work, such as on cultural resources, is required. We could be contracted to do the excavation and testing of those sites and assist in making recommendations for treating the sites or for conducting a biologic assessment, and so on. In most cases, because of the cost involved, we primarily conduct the studies and prepare the documents. We prefer being involved in the upfront work because it helps the company's credibility with the agency.

Reply by B.W. Buck: Let me add that the environmental resources and EIS and permitting issues are typically addressed in a feasibility investigation, but feasibility studies are more focused on whether there are any fatal flaws regarding the environmental issues, which could make the project too expensive to construct because of environmental constraints. For example, you may need to have a waste-disposal site, and there's no way you can get approval for the waste-disposal site where you need it; it may have to be in the next county. That makes the operation uneconomic; we need to know that in a feasibility study. However, you wouldn't go into that in the permitting and baseline studies; instead, you'd make what we call a fatal-flaw analysis, which typically is part of the feasibility study.

- I think I know what Mr. Harper was getting at in his reference to specific aggregate sources, where you might have several choices in a metropolitan area. A new company comes in with an EA that's perfectly fine and has no problem, but to go into business, this new company has to put somebody else out of business; or maybe he thinks he's going to get all the business. Well, he might not, and he might be shut down, and then you'd have an inactive operation. The bonding requirements may be such that he can't reclaim the operation adequately. I think that's a quandary with local governments: There may be too many of one type of operation out there, and somebody won't live up to the expectations of the local government.

Reply: These issues come before us now in the permitting process. What's the need for the product? You can do the environmental-impact analysis until every item is taken care of. The bottom line is that if you have a powerful-enough interest group out there arguing about the need or defining needs, these groups may interpret their solution irrespective of the information available. That's the kind of major issue facing the mining profession. We have now, in my opinion, the situation where no one makes a decision based on socioeconomics anymore. It's based on environment as a whole, and unless your EA is clean, no one will make a decision to overturn what someone may consider a less than adequate environmental study because of the socioeconomic demands for it. You can have a problematic project, but it creates socioeconomic benefit; I've never seen a project in all the years I've prepared EIS's and EA's ever try to prove that.

- For most aggregate (sand and gravel) socioeconomics under Federal law, salable minerals are an entirely discretionary action on the part of the BLM. We try to emphasize the free-market availability of the material. One example we worked on out in the Dugway area involved a new gravel pit. We took a look around and found a couple of pits on private land. The operator would've had to open up his new pit on public land, so we denied the application.
- That comes to the crux of the problem: It depends on the kind of mineral and what the owner's rights are. If the mineral is locatable and the owner has claims under the 1872 Mining Law, he has the right to develop that resource. He could develop it and go broke because there's no market for it, but he doesn't have to show a need to the Federal Government, for example, because he has vested rights under that law to develop it. However, if the mineral commodity is leasable or salable, one which the proponent of the project doesn't have a vested interest in or a property right to, the denial of developing that deposit wouldn't be unconstitutional; it wouldn't be taking away his property rights. The agencies that control the property can make a decision based on need, whether or not they can prove it. So, it depends on the type of commodity.
- Yes; for locatable minerals, as long as the proposal doesn't involve undue and unnecessary risk, as defined in the regulations, we (BLM) have no discretion involved. For leasable minerals, if we've developed an area open for lease process and someone has a lease, it's hard to deny a proposal.
- Every mining operation in our county, even those that are close to land administered by the BLM or USFS, involves public hearings. For most of the mining operations in my county, in my opinion, there's no longer a desire to accept the owner's need. The property owner, the lessee, has the admonition that, yes, we have a need—and he can prove it. Has anyone done anything about—or are there organizations out there that are looking at—the idea of defining "need" in terms of factors, so that, in fact, the environmental issues don't become the only controlling items in permitting for or disapproving of that type of use? This is a problem that should be looked at. Companies need to start helping to *find* the need. It's in their enlightened best interest to do so.

INDUSTRIAL MINERALS FROM THE PERSPECTIVE OF GOVERNMENT

M.L. Allison, *Moderator*

It is my pleasure to introduce our speaker, Scott M. Matheson, Governor of Utah from 1977 through 1984, to talk about "Politics and Industrial Minerals." Governor Matheson is uniquely qualified to address this subject, because he was governor at the time of (1) the proposal to deploy the MX missile system in Utah and Nevada, (2) the confrontations over the "Sagebrush Rebellion," and (3) the negotiations with President Reagan over the "New Federalism." He also brought an intimate working knowledge of the mineral industry and mineral issues to the State Capitol in Utah. Not content just to respond to issues that were affecting this State and the other States in the Rocky Mountains region, he actually set the agenda that we're continuing, empowering State officials in Utah and giving the State a mindset that it should be in charge of its own destiny and not rely on the central government to run its affairs. There is recognition among the people in Utah with whom I talked that, owing to his efforts and attitudes, the mineral industry in the State is now in much better shape, as a whole, than before he came into office.

Gov. Matheson received a political-science degree from the University of Utah and went on to get a law degree from Stanford University. Before his election as Governor in 1976, he worked as counsel for the Union Pacific Railroad and the Anaconda Co., among others. He also worked as a city and county attorney in various parts of the State. In 1968, he became the youngest president of the Utah Bar Association. He served as chairman of the National Governors' Association in 1982 and 1983, and he has subsequently been a leader for Western water policy. After leaving the governorship in 1985, having served two terms, he joined the law firm of Parson, Bailey, and Latimer in Salt Lake City, and presently he is on the board of directors of that firm. He practices primarily in the areas of natural resources, railroad, and corporate law. In 1985, he was appointed the chairman of the Democratic National Policy Commission, and he continues to serve on the boards of several corporations, including such resource companies as the Williams Co. and Bonneville Pacific Corp. He is the author of the book "Out of Balance" (Matheson and Kee, 1986). I'd like to quote a remark about the contents of that

book and his work from the back cover by a nationally known commentator: "Scott Matheson is universally considered by political observers to have been one of the outstanding governors produced by any American State in modern times. This book helps to show why."

Politics and Industrial Minerals

By Gov. Scott M. Matheson

One thing that's important to me, because I happen to think that natural resources are absolutely indispensable to the future of public and private life in our State and the Nation, is *the need to recognize that need.* You're part of an industry that does know. Frankly, I don't know anything about the technical subjects of this workshop, but I do know how the current political situation affects your industry. I'll get to that in a minute, but first let me thank you for your invitation to spend a brief time tonight talking to you about the importance of your efforts here. I met earlier with the Utah State geologist and his staff, and we tried to think of a simple title for my comments as a nonprofessional in the area of industrial minerals, but as one who understands the political realities of our society. We decided that an appropriate title would be "Politics and Industrial Minerals."

I'm aware now, after meeting with M.L. Allison and his staff of experts in the minerals field, that this workshop is covering the current status, projected needs, and future plans for industrial minerals in the Basin and Range region, with the objective of fostering cooperation between the industry, on the one hand, and government, on the other, in the discovery, extraction, and utilization of industrial minerals. Those of you with professional and technical backgrounds already understand the nature and scope of the subject of industrial minerals, as well as the public responsibility associated with the industry; but what I want to tell you is something you don't already know, I suspect. For the average citizen of Utah and the surrounding States from which you come who, like me, is not a part of the inner sanctum of industrial minerals, the industrial-minerals category of the Great Basin extractive-mineral industry is a complete mystery. You should know that your knowledge is not shared by the public at large; the subject matter is the biggest secret in town! I conducted a little survey by telephoning several people in the natural-resources industry with whom I practice law every day and asking, "What do you know about this industrial-minerals component of the extractive industry?" They responded, "We don't know what you're talking about. We're in the copper, iron, uranium, or coal business. We're not familiar with the sand-and-gravel, phosphate, or clay business. We know almost nothing about those activities."

What I now know is that this workshop is dealing with a big mystery. The public doesn't really know what you do, and neither do the hardrock and coal mineral-industry people. They don't know what you're trying to accomplish in terms of making your part of our economy a valuable and productive part of society. So, I'd like to begin my comments tonight by introducing a subject about which you know a great deal, though not from your own perspective.

Public Recognition Through Education

I'd like you to think about industrial minerals as something that individuals from another perspective know very little about. It's absolutely essential, therefore, to take from this workshop a crystal-clear understanding that its subject matter isn't well known to the average citizen, or maybe to only a very few citizens. If that's true—and this is my thesis tonight—it's also a fact that those who earn their living from the industrial-minerals industry probably aren't recognized in the economic community of Utah and the surrounding States as major economic producers in the natural-resource industry. The natural-resource-extraction industry is big business in Utah—well over $1 billion last year. However, if you sat down and talked to people who don't know anything about it, very few would know that the industrial-minerals section had much to do with that performance. I suspect that we'd first think of hardrock minerals and coal when we talk about the natural-resources business in Utah, or whatever State we come from. Accordingly, one perspective I hope to leave with you tonight is that the subject matter desperately needs public education, and it needs ongoing public discussion to give it sufficient emphasis if this industry wishes to grow and develop in what I consider to be a new, competitive environment involving other natural-resource-extraction industries.

Let me talk about the public image and the economics of industrial-mineral commodities in Utah and elsewhere. The primary problem with the industrial-minerals industry is that we basically take it for granted. The group of commodities that make up industrial-minerals production, in my view, holds our vital public infrastructure together. How do you build the bridges and roads and dams that keep our society functioning if you don't go to this particular industry to provide the resources and the components to do it? I wonder, though, whether we as citizens really think about it. I can assure you that, when I talked to my wife about this assignment, she had no idea what I was talking about. When I telephoned several people, they didn't know either. Now, this isn't scientific, but anecdotal, evidence; my thesis is that this industry is the big undiscovered business in our State, performing a valuable, absolutely necessary, service of providing the basic

components—and nobody really knows what you're doing! So, my first point is that we take you for granted.

One interesting thing that I've found is that sand, gravel, and cement provide the basic building blocks of society. As Governor, I understood that we don't deal in specifics but in philosophical points of view about how society can succeed in a competitive environment. We have to build highways, dams, and foundations; we have to pave roads; we have to provide runways for airports; we have to provide for general construction of buildings, and so on. Phosphate, limestone, clays, and other miscellaneous commodities all penetrate the entire fabric of modern industrialized society, but most people don't recognize that. They build our communities and our society, and each, in his or her own way, much too often thinks only in terms of the ultimate economic benefits to the local community, as well as the appropriate and suitable management of the environment in which we use them. However, the industry is hardly the shining star of the economic vitality of the State of Utah. I suspect that's true in other States as well. The industrial-minerals industry fails miserably to stir emotion over its role in the economic vitality of our community and how it can continue to grow and be vibrant.

There's an increasing use of the commodities of which I speak in the Great Basin, and as a matter of fact, as the world population increases, so does the demand for the Earth's minerals. Industrial commodities come from all parts of the globe. Today, as never before, the producers, processors, and consumers of industrial minerals operate on a worldwide scene, as they continue to more heavily influence our worldwide industrial society. What does that mean in Utah? How is that affecting our economy? How many of these basic materials are being imported into this State that might just as well be produced here? Well, industrial-mineral production in 1989, including uranium, geothermal, and saline resources, generated $390 million in revenues, 21 percent of the mineral business in Utah. That's pretty good! Utah continued as a significant producer of cement, lime, phosphate, potash, salt, gypsum, clays, sand and gravel, and crushed stone. All of that production indicates to me that the business is rocking down the track, doing the best it can. However, I wonder whether or not it knows where it's going and who's deciding the policy of whether it succeeds or not. Therefore, the first point I've made to you tonight is that we in Utah certainly take this industry for granted.

An Industry Identity Gap

The second point is a little more subtle—the industry suffers from a lack of identity. When I think of the great diversity of industrial minerals in the field, I think there's an acute problem of identity. The perlite "institute" may speak for perlite, and the national sand-and-gravel association speaks for the producers of sand and gravel, but I know of no agency that speaks for the entire field of industrial minerals. For example, the mineral industries have traditionally meant metal mining, and economic geology has been equated with metallic ore deposits. Many of the universities from which some of you come are dominated by what's been called the "metallic mentality." And the image of the immense field of industrial minerals seems destined to continue to be somewhat vague and unfocused. It sometimes helps to be reminded that the value of the industrial minerals consumed annually in the United States is twice that of the metallic minerals.

Can the Industry Survive and Prosper?

Let me turn now to the question of how the industry under this set of circumstances can survive and prosper. How does anybody make a living in this business? If its importance to us is only infrastructure oriented, how do we make the business succeed? I can tell you, much of the statistical information shows a decline in the production of industrial minerals in Utah. Utah presently is on the downside, not the upside; this statement is also true in the surrounding areas. The increase in regulatory requirements on the part of Federal, State, and local governments upon the extraction process has become a real burden. It's an insidious trend that's creeping up on the outside of this process, and no one I'm aware of has really quantified it in a way to make sufficient sense, so that this industry can react positively and in our best interest. The matter is further compounded, if I may say so, by the mom-and-pop nature of many industrial-mineral-extraction efforts. Competition with large businesses, which normally are hardrock metals and related corporations, is difficult because the industrial-minerals industry operates basically as small operations in scattered geographic locations, although this situation hasn't prevented governmental processes at all levels from imposing supervisory controls in the areas of tax. I'm sure you've all read about the problem in connection with severance taxes for industrial minerals. Economic problems and environmental concerns are hurting this industry.

The trend in recent years has been to impose greater burdens on those operations and to increase environmental costs, all in the name of improving public health, public safety, and the way our society lives. All of that is good! Philosophically, I doubt whether anyone here would disagree with that, because it makes sense and it's in the public interest. We need to provide a healthy, safe environment in which industrial minerals are produced. At the same time, however, the industry hasn't developed sufficient political size or visibility. It certainly doesn't have much political clout in Utah to make certain that it receives a fair policymaking

commitment from every level of government in changing how people in that industry make their living and meet the public policy; it seems to be the forgotten end of the mineral business, something that's there but which nobody thinks about or cares much about.

Industry's Dependence on Government

About 10 or even 12 years ago, it may not have made any difference, but today the industrial-minerals industry totally depends for its success on the processes of the Federal, State, and local governments. I want to emphasize the local. You may think that the Feds and States control everything. Not so—the people who run local government have as much influence over the success of the industrial-minerals industry as the State and Federal Governments. But all levels of government are important for you to know, if success is your objective.

The problem is not only from the top, where Federal and State governments impose regulations. I've followed the legislative process for many years. Let me tell you, the world of doing business is related not to the company boardroom but to the Federal, State, and local government boardrooms. That's where policy is made, and business reacts to their decisions. Businesses don't decide how to make a profit on the basis of philosophical business decisions anymore, but on the basis of public policy set by the legislature, the executive branch, and the regulatory agencies of government. Whatever these agencies decide, business responds; it's a reactive relationship. This isn't just true for the industrial minerals, but basically it's also how we do business across the board. We do business on the basis of the Internal Revenue Act of 1986, as amended. Isn't that a nice way to go out and "do the right thing" about serving the needs of the public? But that's a given these days.

As I see it, the industry hasn't developed sufficient size and clout to make its issues and concerns and its impact known. Local government has a big role in regulation. We always think of the Federal and State governments as deciding everything for these extractive industries, but you know, there's as much control over the success of the sand-and-gravel industry from local urbanization and the zoning capability of local governments as there is at the higher levels. It's true that you have to take into consideration the Feds, the State, and the local municipal group, but if you've ever driven around the corner up in North Salt Lake, you can see the sand-and-gravel operations by the scarring on the hillside. People in that neighborhood are getting quite upset about the scars, traffic, and dust. The net effect at the local level is to reduce the number of areas where deposits can be mined. We zone away where you can mine, and, even where you can, we put conditions on an operation, and your ability to operate is foreclosed because those conditions commonly are so burdensome that the economics of the process won't allow the business to flourish—in fact, you can't even proceed in the business. It becomes essential under those circumstances to provide some resource protection in local planning and zoning regulations. I wonder how many of you participate in planning and zoning meetings to protect your opportunities to develop those resources locally.

Options for Success

It's even more important that the industry have something to say about its own future at the State and national levels. Wouldn't it be fair to have the industry sit down and help decide what public policy is before public policy is made and before industry has to spend dollars to meet that policy? What are we going to do about that? I've done some more telephoning and found out that there's no industrial-mineral association in Utah—in fact, I don't think there's any such association in the Western States—organized to cope with the overall public-policy concerns of this industry. My point tonight is that, if this industry is worthy of support, shouldn't it have an opportunity to participate effectively in the government side of its existence, which controls the economics and future of its success? How do you do all that? Let me give you a couple of suggestions. The closest organization to fill that need in Utah is not the industrial-minerals industry at large but the UMA, which at the moment basically looks after hardrock metals and coal. Did you know that the coal people weren't even in that organization 10 years ago? But coal and hardrock metals have since joined to work together; they needed each other to make sure that that particular set of industries had an opportunity to survive in the governmental policymaking process. It's fair to say that industrial minerals do not command a large membership in the UMA; there may be one or two members at best. I deal with a few major oil companies that are in the resource business, and they do have a big impact. This is an exception, simply not the rule. In addition, there's no single organized committee or subgroup assigned to watch out for the industrial-minerals industry in the UMA. The net effect is that the UMA, which incidentally is highly supportive of the industrial-minerals industry, looks out for you on an *ad hoc* basis. I'll tell you, *ad hoc* isn't a good way to look out for an industry in the legislative, executive, and regulatory processes of government. I've been there, and I can tell you that you lose when you go at it by that approach.

Thus, my own conclusion is that the industrial-minerals industry is, at this point in time, at a high political risk for its economic future at all levels of government. Even though the industry provides the basic bedrock of sustenance to our American society, I'm not sure anybody really cares, because I'm not sure anyone understands

what the industry does. If that's true, it seems to me that we have both an opportunity and an obligation to do something about it, and so this workshop may be such an opportunity to, at least, expose that concept here and later in the public sector. Because no other better organization exists in Utah and the intermountain West, I'd suggest that a beginning would be to sit down with the UMA and see whether they'd be willing (I've already called them, and they're willing) to take in the industrial-minerals industry. They'd like to be helpful; they need your support, and your industry needs their support.

It's important, however, that the industry maintain a separate identity with a separate agenda, with the ability to maintain independent influence over the public process that affects it. That, in my opinion, is a worthwhile thing to do. Initially, face the fact that nobody knows about you. You need an educational program; the public needs to know how important this industry is, what it does for society and for the vast infrastructure. When I was Governor, I spent a year of my life as chairman of the National Governors' Association, fighting for improvements in the public infrastructure. We're letting this infrastructure deteriorate before our very eyes in the United States of America, and we don't seem to be concerned that we're not doing much about it. It has no "sex appeal." The industrial-minerals industry doesn't, either. The fact that this industry is necessary isn't enough; it has to be more than necessary. The UMA, in my view, is a good ally to look to. They have experts in the fields of taxation, economics, wage relations, regulation, and all the other issues that affect this industry. I'd suggest that the industry put a small committee together and go sit down with Jack Christensen, president of the UMA, asking the UMA to evaluate the overall needs of the industry as part of an educational process.

Second, the regulatory world is upon us. Environmental issues are a part of the present equation. The nature of the public process from the regulatory point of view is that the environmental side of this equation is becoming largely a way of life. We might as well face up to the fact that we're not going to go out and destroy our environment for the sake of what we want to gain; we're going to go out and cope with the environment as a part of economic gain. I'll tell you, this is the name of the game in the 1990's in the United States of America. We're going to have to realize that economic viability must be attained. If we're not smart enough to find a way to do that, we're all going to be losers, and not just on the industrial-minerals side—the economy of the entire Nation will be at risk.

Finally, the organization of small lobbying groups or coalitions makes a lot of sense to me. However, I wonder whether the industrial-minerals business knows how to lobby. It's not easy; you have to know what to do. The UMA is pretty smart in this area. I must confess that my law firm represents that association, but, as a result, I know what kind of job they can do. It represents the industry, but at present the industrial-minerals part isn't getting a fair shake in the front lines. It's time that you people organize and put together a small group to learn the lobbying game, and dedicate yourselves to political agendas and face up to the realities of the lobbying process. Let me tell you something: The legislative leaders will welcome your input to explain where you're coming from and to educate them. They'd be willing to participate cooperatively for the benefit of the industry. If you're not present before legislative committees and the legislature passes a law, and you come up later and try to right a wrong, it's too late. The money is all on the table, and the policies are in place. You'd have to go back to the beginning of the process to change the rules. So, you need to get there before the policy is fixed.

That's nothing new to most of you, and I apologize for repeating the obvious. But you know something—I've been in politics for a long time, and I've found that *you have to repeat the obvious a lot.* This industry needs to have the obvious repeated. It's time to start sitting down and doing the practical, commonsense things that all of you can think of and know are needed.

Let me conclude with this final comment. In the past generation, the problems of the natural-resource industries, particularly those associated with mining and extraction, have gradually moved away from business- and financial- and technical-problem decisionmaking to regulatory government and political processes. More often than not, the success of the business depends more on the political process than on the usual business process. It's not how smart are the lawyers or the chief executive officer or whoever in the company is the defending individual; thus, individuals have to know the political process. If political processes are ignored, the business will be in deep trouble. More often than not, that's what happens, and that same trend will continue in the 1990's. If you've followed public policy, think of any social problem that's come up in the past generation. Let's take *Brown* v. *Board of Education*; let's talk about education. How do you think the problem of access of minorities to the schools was solved? That's a social problem. It wasn't solved in the business environment; it wasn't solved in the schools; it was solved in the public arena and in the courts. The truth of the matter is, that's where public problems are being solved these days. The legislatures, the governors, the regulatory process, and the courts are solving more problems, or attempting to, than the business people are able to solve all by themselves. That trend will continue. An environmental concern took me to Washington a couple of weeks ago, and a U.S. Senator said we can protect the environment by the acid-rain bill, the CAA, and so on. That's true. It's now a new ballgame; the environmental concern continues to demand more management of our

resources to the exclusion of the traditional methods of extracting and processing industrial minerals. Anyone who wishes to succeed in this industry will simply have to join in and compete according to the new rules and new facts of life. The sexual facts of life haven't changed, but the political and business facts of life have really changed.

That's the point that we all have to know and understand tonight: Recognition that the government is there and that the political aspects of the industrial-minerals industry aren't going to go away. You must provide a strategic game plan to deal with the political situation in an effective way, so as to allow continued growth and success of the industry. May I conclude by saying that's a worthy objective, and I wish you great success for the good of all Utahns.

EXPANDING INDUSTRIAL-MINERAL OPPORTUNITIES IN THE BASIN AND RANGE REGION

R.C. Bradt, *Moderator*

The expansion of opportunities for the development of industrial minerals in the Basin and Range is a timely and far-reaching topic, for which the organizers have assembled a worthy group of experts. We begin with a consideration of the expanding development of advanced materials, which will require broadening the search for industrial minerals used as primary constituents or filler materials, as well as expanding industrial-mineral production through research by State and Federal Government agencies and academia. We next consider examples of new industrial-mineral market development of high- and low-value materials. Finally, we examine the successful use of PR techniques to educate the public in support of industry expansion.

Our first speaker, G.R. Hyde, who comes to us from Washington, D.C, is a staff physical scientist in the USBM's Minerals and Materials Division and manages its substitute-materials research program. He will discuss advanced-material potential and research in the USBM. M.P. Foose, Associate Chief for Development of Assessment Technology in the USGS' Office of Mineral Resources in Reston, Va., will describe research activities in the USGS. Representing research programs in the State geological surveys and universities is J.G. Price, director of the NBMG and the Nevada State Geologist.

Potential for the Use of Industrial Minerals in Advanced-Material Applications

By G.R. Hyde

The wide range of advanced materials requires virtually every stable element in the periodic table and includes many of the industrial minerals. I hope to explore with you the potential use of industrial minerals in advanced materials and to impress upon you the importance of determining the domestic availability of these minerals. We will also talk about advanced materials and identify some of the properties that make them "advanced." Then, we'll look at some examples; you'll recognize that industrial minerals are used in many of those examples. The bottom line is that we need to find out just what minerals will be needed and where they're located, because advanced materials are going to be important to the Nation's economy in this and the coming decades.

We've arrived at a situation today in which the materials picture has changed. There's a new relation between materials and society. Historically, we've taken natural materials, such as wood, stone, iron, and copper, and made things out of them. Then, we began to take rocks and extract the metallic values from them. Today, we start with a societal need and, essentially, put together a material, atom by atom, molecule by molecule, to get the special physical properties that we require. The new high-temperature superconductors are a typical example of such activity: Yttrium, barium, copper, and oxygen are combined to obtain a specific physical property—superconductivity.

The key to the importance of advanced materials is the fact that they're an *enabling* technology—they create economic opportunities. The President's Council of Economic Advisors has recently cited three potential areas for economic growth in the United States: information processing, biotechnology, and materials. Information processing and biotechnology, however, depend on our ability to develop materials with particular properties. Advanced materials are an enabling technology—they enable many other things to happen. For example, our whole information-processing industry is based on the transistor, which derives its utility from the unique solid-state electronic property of a junction between two types of semiconducting materials.

Because materials are an enabling technology, they're high on the agendas of every advanced nation. These nations see materials as keys to economic growth and competitiveness. Materials are getting a lot of attention, even at the White House level today. That fact is exemplified by the positive executive-branch response to a recent study by the National Research Council, "Materials Science and Engineering for the 1990's—Maintaining Competitiveness in the Age of Materials." Advanced materials are extremely important in shaping the global economy.

What Are Advanced Materials?

I asked our director that question, and he said, "That's simple—titanium 20 years ago." He was correct.

As an advanced material becomes more widely used and standardized, it will ultimately become a commodity.

Many of today's advanced materials are not really "materials" but an engineering concept. A schematic diagram (fig. 32) shows the basic difference between conventional and advanced materials. If you look at conventional commodity materials, they're obtained by digging ore out of the ground, extracting the metal (or nonmetal), and using that material to make various products. You can look at advanced materials as the result, essentially, of taking components from many different ores (several different metals, possibly some nonmetals) and combining them by a unique processing technology to make a single product with particular required properties. Advanced materials are an engineering step in the development of a device; they're much more intimately related to the product than are conventional materials.

Special Properties and Types of Advanced Materials

Industrial minerals play an important part in achieving some of the desired properties of such advanced materials as polymers, composites, optics, electronics, and ceramics. Polymers are certainly one of the most widely used advanced materials. Most plastics have industrial minerals as fillers; in fact, it's a large market, I understand. These plastics include the polyethylenes; some of the more expensive materials like Teflon and Kevlar, which is as strong as steel at one-third the weight; and Vespel, which is a high-temperature plastic that's not cheap at $2,700 per pound. USBM research at the Idaho National Engineering Laboratory has produced a polyphosphazine material—a high-temperature plastic that retains its properties from cold temperatures to as high as 250°C. That material is based not on hydrocarbons or petroleum but on phosphorus. Polymers are important in the upcoming picture of advanced materials; clearly, industrial minerals will play a major role.

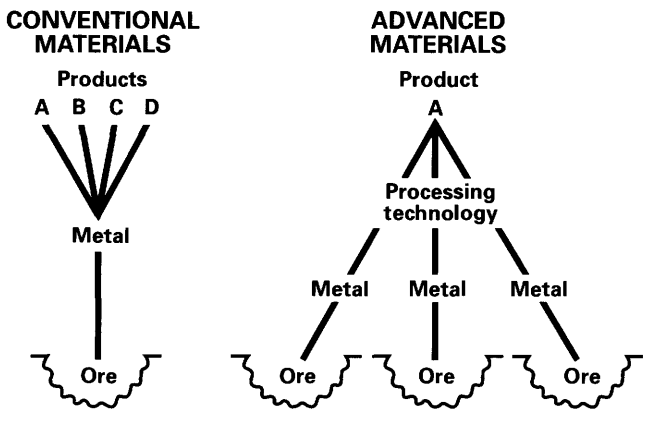

Figure 32. Relation between conventional and advanced materials.

Composites are materials that give a very high stiffness, very high strength, and very light weight. Carbon-fiber epoxies may be the most widely known composites; they were the primary material of construction for *Voyager*, the aircraft that Dick Rutan and Jena Yeager piloted around the globe without refueling. Boron-fiber epoxies, silicon carbide/metal-matrix composites, and aluminum-matrix/silicon carbide fiber materials are providing increased strength and stiffness-to-weight ratios. These properties are important because every pound of weight you save in aircraft construction represents a savings of $1,000 over the life of the airplane, so if you can take a few thousand pounds off the weight of the aircraft, you've saved quite a bit of money over a 20-year aircraft lifetime. Structural properties are clearly important, and materials research is continually trying to achieve light weight and high strength.

Optical and electronic materials also are extremely important. I don't need to repeat the example of high-temperature superconductors that have attracted so much attention recently, particularly in the computer field, but optical materials are becoming more interesting for future-generation computers. We're reaching the point where, rather than switch electrons around, we want to switch light around—it's faster. The field of photonics is growing. Both people and computers talk to each other now by means of fiber optics, and with optical devices in the near future, we'll be switching those light beams around without having to translate them first into electrical signals. For that, we need indium phosphide and gallium arsenide-phosphide emitters and detectors; these three-five semiconductor materials are important. Silicon, by the way, won't work in this application because its optical-transmission band is in the infrared part of spectrum; it transmits heat rather than light. Lithium-niobium trioxide doped with titanium is presently used as an optical switch; by applying an electrical field, a beam of light can be switched from one side of the device to the other.

Most of us are familiar with the term "rare earth" materials. Neodymium is one of the rare-earth elements used for very strong permanent magnets. If you own an automobile that was built since 1986, chances are that the starter has such a magnet. Neodymium magnets allow you to build a motor that's one-third the physical size and get the same power out of it.

We now come to the corrosion and thermal properties of materials. Let's consider jet-engine turbine blades. When you stop to realize that those blades operate at about 1,200°C and spin around anywhere from 20,000 to 50,000 rpm, you can see the problems faced by the design engineer. The pull on the white-hot blades by centrifugal force at those speeds is tremendous. Under such conditions, tremendous stresses

are exerted on blade materials. We want to make engines operate even hotter, and, to get more efficiency out of them, we want to maintain light weight and try to minimize friction. We want our airplanes to fly higher and faster.

We're pushing conventional materials to the point where we can't get the properties we need from conventional cast-metal alloys; we have to go to unique processing technology to achieve nonequilibrium material structures and compositions. This processing technology uses rapid solidification to freeze under nonequilibrium conditions. For example, you quench in an excess number of atom vacancies, which then undergo reactions during cooling to the point where they tend to disperse and strengthen the material. We're making such things as shape-memory alloys, which can be deformed and then, on applying a small amount of heat, will come back to their original shape again.

Ceramics also have a lot of promise as advanced materials, particularly ceramic-matrix composites. Ceramics have one fatal flaw, however: They're subject to catastrophic failure. There's been talk about using ceramics in aircraft, but an employee of one aircraft manufacturer said, clearly, that he'd never fly on an aircraft which has ceramic structural parts in it! Ceramic composites—maybe. The fracture-toughness problem still exists for ceramics, but ceramic materials like beryllium oxide are used in the heat shield for the space shuttle. We have silicon carbide and silicon nitride ceramic materials for rotors in turbochargers and heat exchangers. Then, there's the family of piezoelectric ceramics and the whole family of refractories, which are used a lot in furnaces and are made from such clays as aluminum oxide, magnesium oxide, and magnesium silicate.

Quantities of Component Materials Required

Because raw-materials costs are generally only a few percent of the cost of an advanced material, many people fall into the trap of neglecting raw-material-supply issues. We talk about advanced materials, and people say, "Yes, but you don't need a large quantity of them. You're talking about high value but small quantities. It's really the processing technology that's important." This isn't always the case. Consider, for example, the superconducting supercollider. It takes about 2 million lb of niobium and titanium, each, just to make the superconductors for the magnets in that device, not to mention the specialized structural materials needed to support those magnets. As you can imagine, the forces from these strong fields tend to make the magnets try to fly apart or collapse on one another. The large structures needed to support such magnets must be made from materials that can provide the strength and yet be nonmagnetic. Such structures may well require sizable quantities of exotic materials.

Let me attempt to quantify some requirements. If you took all the electric motors produced annually in the world today and substituted neodymium permanent-magnet motors, a recent study by the European Economic Community found that you'd use about 4 times the present world production capacity for that element. If you built a 600-mi superconducting transmission line with existing low-temperature superconductor technology, using, for example, Nb_3Sn, it would take about 10,000 tons. We have about 250,000 mi of electrical-transmission lines in the country today, and if you ascribe to the theory that nobody wants a powerplant in their own backyard, then you begin to realize the magnitude of materials requirements for power transmission.

Also, there's the metal scandium, which we don't hear much about. It turns out that if you take scandium, for which I think the production capacity is measured in kilograms per year, and put about 0.5 percent into aluminum, you can make that aluminum superplastic. In other words, you can stretch the new aluminum alloy about 200 or 300 percent when you form it. This new property opens up a whole new area for the manufacturing technology of aircraft parts. If you look at the million or so tons of aluminum that might be affected by that and you put 0.5 percent scandium in it, you can see how the market for scandium is likely to increase. As advanced materials become parts of consumer products, we're no longer talking about small quantities of the constituent elements—we're talking about very large amounts or very large increases in raw-materials requirements. This possibility opens a whole new direction for expansion of the high-value-industrial-mineral industry.

Conclusions

To sum up, advanced materials are complex mixtures of chemicals, alloying elements, processing technology, and other things that are continually changing; we're not talking about a single element. The problem is, if we're going to begin to incorporate advanced materials into consumer products and enjoy their benefits (that is, consumer products as opposed to military applications), we'll need both adequate and assured supplies. A manufacturer isn't going to risk the capital investment to use an advanced material without sufficient quantities available. In some cases, we need to find primary sources instead of relying on byproduct sources. We need extraction technology that will allow us to win these materials from small deposits.

The key point I want to make in this discussion is that we need to know what's available domestically; we need to find out now before the lands are all locked up for other reasons and we lose access to the materials therein. I think the important point is that we need to get out there

and find out what and how much of these materials we have available in this country. We need geologic models to guide us in looking for some of those elements that will become components or constituents of advanced materials. We need the capabilities of the geological community to look for sources of virtually every stable element in the periodic table, because we don't know which elements will be the next front runners and impart appropriate properties to some new advanced material.

Governmental and Academic Research Applicable to the Industrial-Mineral Industry

USBM Research Activities

By G.R. Hyde

Yesterday, our speakers reviewed some of the problems faced by the industrial-minerals community. These problems can be grouped into four general categories: (1) resource-availability issues, (2) environmental issues, (3) technological issues, and (4) issues related to the development of new markets and new materials. I'll use these four categories of problems as a framework within which to discuss USBM research capabilities. Then, we can discuss how these capabilities may be focused to provide specific opportunities for technology transfers that will be beneficial to the industrial-minerals industry—that is, how can the USBM best assist industry through cooperative research programs?

Resource-Availability Issues

The USBM has two organizational functions: the Information and Analysis Directorate and the Research Directorate. Resource-availability issues are addressed primarily by the Information and Analysis Directorate, which collects and disseminates minerals and materials data, performs economic and resource analyses, and provides minerals and materials information for use by policymakers. For example, the policy-analysis group recently completed studies on the effects of acid-rain legislation on the respective prices of copper and aluminum. In addition, I'm sure most of you are familiar with the publications "Mineral Commodity Summaries" and "Minerals Today" published by this directorate.

Environmental Issues

The acute need for new environmental technology in the minerals industry has led to the formation of a new Division of Environmental Technology in the USBM's Research Directorate. However, the USBM has continually addressed technological solutions to environmental problems throughout its history. For example, basic research in solid-liquid separation of ultrafine particles has paved the way for new technology in dewatering phosphate slimes. Byproducts from wastes and tailings have become key constituents of advanced or engineered materials. USBM research has made possible the recovery of scandium from processing waste. (Scandium, you'll recall, is an important element that gives aluminum the property of superplasticity.) The USBM has helped develop methods for stabilizing and revegetating tailings to minimize wind and water erosion. More recently, it has helped develop methods for closing down cyanide-leaching heaps.

Technological Issues

USBM research activities cover much of the materials-production cycle, all the way from extraction, processing of bulk materials, processing engineered materials, fabrication (for example, sintering of ceramics), recycling, and, to some extent, waste disposal, so that, in many cases, we cover almost the entire life cycle of a material from a technological point of view. Our mining research is investigating inplace and borehole mining methods for extracting copper and other elements. Our Comminution Generic Technology Center here at the University of Utah is focusing on automated grinding of minerals and materials. Using advanced imaging and computer-assisted tomography, we're laying the groundwork for building sensors for online analysis of particle size and composition.

Regarding the physical-separation technology relevant to industrial minerals, the USBM developed a flotation method to recover 13 percent more phosphate from Western ores. If the new high-temperature superconductors become practical magnetic separators, we'll know the ultra-high-magnetic-field properties of many minerals in advance through our present research in this area.

Chemical-separation research in application to industrial minerals includes leaching of aluminum from domestic clays and leaching phosphate values with acid-alcohol mixtures.

These are only a few highlights of our research aimed at industrial minerals. You should keep in mind that USBM research is directed toward obtaining an understanding of processes to provide the tools for use by industry for application to a specific deposit.

New Markets, New Materials

USBM research has contributed to the development of new materials and markets through such efforts as assessing phosphogypsum as a constituent of aggregate, understanding the ion-exchange properties of zeolites, and

developing acid/salt-resistant sulfur concrete. Industrial-minerals production is a regional activity, and so we have research centers in most of the region represented at this meeting. In addition to Tuscaloosa, Ala., and Rolla, Mo., we have facilities in Albany, Oreg., Reno, Nev., and here in Salt Lake City, Utah. We also have a major contract research program at the Idaho National Engineering Laboratory, as well as smaller programs at several universities—the University of Idaho, Moscow, the University of Nevada, Reno, and here at the University of Utah. Our research activities are located in geographic areas to best address regional problems, such as those found in industrial-minerals production.

Conclusions

Let me conclude with a few brief words on governmental industrial, and academic cooperative research. Why cooperate? Industrial-minerals problems are regional, and R&D is expensive and high risk. Economic benefits from new technology help all companies, not only the ones paying for it. To reduce the risk to individual companies, such mission-oriented agencies as the USBM provide most of the funding. The Technology Transfer Act protects intellectual-property rights with flexibility.

How do we cooperate? First, we must commit to joint generic-technology development on common problems. Then, we must work together as partners in planning, funding, and carrying out the research, utilizing Federal, university, and private laboratories. Above all, we must recognize the need for new funding to undertake additional work.

USGS Industrial-Mineral-Research Activities

By M.P. Foose

USGS Minerals Programs

I'd like to begin my discussion of the contributions the USGS could make in the area of industrial-minerals research by first tackling the more general subject of the overall USGS minerals program. Simply stated, the overriding objective of minerals work in the USGS is to ensure the long-term availability of mineral resources. To accomplish this, the USGS has three specific programs:

1. NAMRAP primarily involves the assessment of mineral potential on specific tracts of lands that may range in size from a few thousand acres to an entire State. Much of this work focuses on BLM or USFS lands for which mineral-resource information is needed to make land-use decisions; industrial minerals have always been a part of this land-assessment process. However, the USGS has encountered numerous problems when assessing industrial minerals, which generally haven't received the attention we'd like to give them or which they deserve. Over the past 5 years, the USGS has been working to change this situation, and these workshops are partly an outgrowth of that effort.
2. The Strategic and Critical Minerals Program focuses mainly on the potential for strategic and critical minerals on a global or national scale or within large geologic regions. Not surprisingly, much emphasis is placed on elements like platinum and chromium. However, this program also supports other commodity-specific studies and includes the work of USGS specialists who deal with industrial minerals ranging from abrasives to zeolites, including sand and gravel, dimension stone, and the rare-earth elements. As a part of these commodity-based studies, the USGS maintains a computerized data base on mineral deposits and occurrences. Known as MRDS, this system contains about 83,000 records, of which more than 19,000 include information on industrial-mineral deposits or occurrences. This information is used to facilitate USGS mineral-resource-assessment work, but it's also widely used by various other Federal agencies and by State and private groups.
3. The research program on the genesis of ore deposits provides information on how ore deposits form, generates concepts on how new deposits might be found, and develops tools to locate undiscovered deposits. Most of this basic research has focused on metallic-mineral commodities and has recently been synthesized into a compilation volume that summarizes both the geologic and the grade-tonnage characteristics of metallic-mineral deposits. This volume has proved to be a fundamental document used in regional mineral-resource assessments. In an effort to strengthen our ability to deal specifically with industrial minerals, the USGS is now putting together a similar volume for these minerals.

From this quick outline of the scope of the USGS' minerals work, I hope I've shown that the USGS is trying to strengthen its understanding and ability to evaluate industrial-mineral resources. However, I'd like to comment on why this process is sometimes difficult. Clearly, the feasibility of a sand-and-gravel operation may be directly affected by its location and the local transportation network. Similarly, small changes in chemical composition can radically change the usefulness of zeolites, and color variations can markedly affect the use of decorative stone. These and many other factors may all be important in evaluating an industrial-mineral resource. Many of the political factors, however, are locally controlled, and a Federal agency, such as the USGS, often has great difficulty in dealing with them.

As a result, much excellent work on the geology of industrial minerals has been done by the State geological surveys and by private industry.

Nonetheless, several issues require some Federal participation in industrial-minerals research. Increasingly, industrial minerals are becoming involved in various national and international issues. Let me briefly mention two of them. First, land-use decisions are being made almost every day in Washington, D.C. Some of these decisions, such as wilderness-related legislation, may affect the way large areas are utilized for the foreseeable future. The USGS is repeatedly asked to provide mineral-resource information about these areas before a land-use decision, and it must be able to represent the potential for industrial minerals, as well as for metallic-mineral commodities. Second, some parts of the Nation are beginning to experience real problems with industrial-mineral-resource availability. Many rapidly growing urban areas are either running out of the industrial minerals needed to sustain growth, or the costs of these resources are increasing rapidly. In some cases, large-tonnage, low-cost materials are now being imported from Europe, Mexico, or Canada, and so, to a certain degree, industrial minerals are becoming a national and international concern.

To address these needs, the USGS believes that there needs to be an increased effort at the Federal, State, and local levels. To foster this effort, the USGS began sponsoring these workshops.

Types of USGS Research Activities

Turning now to what specific types of research the USGS should be and is, in part, doing on industrial-mineral resources, we find that the activity falls into three categories: (1) research on the geologic controls of deposits, (2) research on how these deposits can be detected, and (3) the development of regional mineral-deposit information.

Geologically, the USGS mapping program will assist in the location of new deposits and in the identification of areas favorable for industrial-mineral resources. Clearly, it would make sense to do this mapping in conjunction with the State geological surveys. This work should involve both onshore and offshore studies, especially in such areas as New England, where offshore industrial-mineral deposits are assuming increasing importance.

Along with mapping, the USGS is developing new models and concepts about how these deposits form, where they are most likely to occur, and what their characteristic features are. As was done previously for metallic-mineral commodities (Cox and Singer, 1986), the USGS is preparing a "models" book on the industrial minerals that will meet some of these needs. Models for some industrial minerals were described by Orris and Bliss (1989), but the research program is only just underway.

I'm also struck by the need for basic geomorphologic studies that better define the surficial processes which form many industrial minerals. For example, recent USGS work (Dohrenwend, 1989) has shown that more than half of northern Nevada is covered by basins containing less than 1 km of fill and that deep basins make up less than 20 percent of the total basin area. The shallowness of these basins is unexpected and has important implications for the types of industrial minerals that they may contain.

More work also needs to be done on how to locate and evaluate industrial-mineral resources. There are many established tools, that work well, but there are also potential new tools of which the following are examples.

- Gamma-ray spectroscopy, which measures the natural radiation emitted by potassium, uranium, and thorium, is a potential tool in locating some zeolite deposits.
- Electromagnetic methods can be used to quickly map the thickness of alluvial deposits or to identify and delineate clay bodies.
- The spectral reflectance of many minerals is unique and can be used to find some industrial-mineral deposits, especially clay minerals and talc, and, possibly, even to distinguish the Mg content of limestone.
- Integration of ore-deposit models and regional geologic studies can identify areas favorable for such industrial-mineral deposits as phosphates, high-calcium limestone, barite, and zeolites.

Finally, data and information systems need to be maintained and upgraded. I've already briefly discussed MRDS, which can be a tremendous resource to local, State, and Federal agencies working on industrial-minerals and land-use issues. Similarly, the USGS is developing a GIS, which integrates geologic data with geologic models in defining areas of high mineral-resource potential. GIS's of this type that also contain information about property boundaries, transportation routes, and locations of population centers may significantly improve the land-use decisionmaking process.

Concluding Thought

These are only a few of the areas of industrial-minerals research in which the USGS is or should be involved. In closing, however, I'd like to return to one of my earlier points: Any such research will be most effective only when done as part of a program that recognizes local needs, and this research will be strengthened if it both supports and is supported by companion studies by academia and the State geological surveys.

Research Potential of the State Geological Surveys and Universities

By J.G. Price

My assignment is to discuss some of the research capabilities of the State geological surveys and universities. I'd like to point out some of the aspects of expertise available, in part, as demonstrated by the publications of the State geological surveys and universities, as well as some of the equipment that can assist industrial-mineral research. Some other issues I hope to cover include the availability of scientific manpower, the funding situations within State geological surveys and universities, the supply of future employees that the universities produce for the resource constituency, and technology transfer from the universities to the industry. Finally, I want to describe some of the frontier areas in industrial-mineral research.

What's Happening in Nevada?

I'd like to give some examples from the NBMG and UNR, which are somewhat similar to institutions in the other Western States. The NBMG is similar to some State geological surveys but differs from other surveys in some respects. About a third of the State geological surveys have administrative links to their respective State universities. That's the case in Nevada, but the. UGS reports directly to the Governor and is a direct-line State agency. The IGS is more like the NBMG, in that it operates administratively through a State university. We at the NBMG have a much closer tie to UNR than do many other State geological surveys; in fact, we're a part of the Mackay School of Mines. Some of the issues that I'll mention this morning will show that link between the NBMG and UNR. However, the main contributions of the State geological surveys and universities to industrial-mineral research are made in spite of administrative organizational differences.

One of the main points that I wish to stress with regard to expertise is that the staffs within the NBMG, UNR, and all the other State universities have the local knowledge which is needed for studies of industrial minerals, such as information about the locations of resources and the processing needs for them within local areas. The long-term involvement of the State geological surveys in this area is shown by their series of publications. Geologic maps and regional geological reports are the basis for all the current work on industrial minerals, including resource assessment and research on how these deposits form and where we're likely to find new ones.

Geologic Maps Are Needed

Currently, much of the Western United States is covered fairly well by 1:250,000-scale geologic maps, but that's not good enough to address the issues of industrial minerals. What we really need in terms of geologic mapping is the type of detail on a 1:24,000-scale map, the typical $7\frac{1}{2}$-minute topographic quadrangle provided as a base map by the USGS' National Mapping Division. There's an initiative out on the street right now, the NCGMP, seeking funding for an increase in geologic mapping. That initiative is probably the most important thing that we can get behind right now to address industrial-minerals questions. The program will involve cooperative work with the States, in which Federal and State moneys are matched, thereby softening the blow on the Federal Government in terms of the dollars to be allocated to the program. It will increase funding to the USGS for geologic mapping, specifically, and for work that supports geologic mapping, such as radiometric dating, paleontologic work to assist stratigraphic correlations, geochemistry, and geophysics to back up the mapping efforts. That program also has a component for support of the universities, where the needs of the industry will be addressed by expanding the source of trained mappers. We've lost much of our capability to do geologic mapping within the United States, and the NCGMP will give us back that capability. The ultimate goal of the NCGMP is to cover the entire United States at a reasonable scale, 1:24,000, with color compilation at 1:100,000 scale. The Association of American State Geologists and the USGS are going through the justification process with the executive branch and through Congress to get that program moving forward. We look forward to new funding forthcoming in support of that critical informational area within another couple of years. The NBMG and the USGS jointly have been producing numerous 1:24,000-scale geologic maps, and we hope to produce more of them and the 1:100,000-scale full-color maps as this new program comes into being.

Mineral-Resource Reports

The NBMG is also producing mineral-resource maps at a scale of 1:100,000, the first three of which came out last year. We intend to increase that program and mesh it with the proposed 1:100,000-scale geologic-mapping program as it develops over the next several years. The State geological surveys traditionally have been the primary sources of specific-commodity reports on industrial minerals. A few examples from the NBMG include industrial-mineral reports on zeolites, clays, talc, evaporites, fluorspar, barite, and gypsum. We're currently working on a commodity report on borates, and we've just initiated a program on aggregates that will lead, eventually, to aggregate-resource publications as well.

Sources of Resource Expertise

The overall scientific expertise within the State geological surveys and universities encompasses not only the staff they may have but also the equipment that's available. The universities are the primary places, along with some of the national laboratories, with regard to computing power. We're involved with the USGS and USBM in compiling some major data bases. M.P. Foose mentioned MRDS; most of the Western States have maintained versions of that resource-information data base, and they may also have other, more detailed, local data bases. The USBM has a comparable data base, MILS, and the States are using both of these data bases, embellishing and expanding them. Recently, the NBMG started a data base on resources and reserves, as well as on production, that's becoming a popular item. Along with the USGS, we're entering into GIS, and the universities are doing much of the fundamental work in developing these systems. We're building GIS links through the State geological surveys and universities into the local-government agencies that may use such information. In about 85 percent of the land-use applications for geographic information in the Western States, one GIS is preferred. We're trying to coordinate efforts at the State level to ensure that the national GIS layers which are being developed by the USGS and the layers which are being developed by the State geological surveys and other State agencies can be brought together and used at the county and city levels.

Remote-sensing facilities are extensive at some universities, and that's a capability that fits into the industrial-mineral-resource picture quite well. Urbanization is a major issue with regard to industrial minerals. D.L. Weide was telling me yesterday about a series of airphotos that he has for the Las Vegas area; he can almost do a motion picture from year to year showing how the area is expanding rapidly. The remote-sensing facilities that are available at the universities put us in the position of being able to address many urbanization issues.

One new development at the Mackay School of Mines is the fact that the Computer Science Department is now within the university as part of the School of Mines. Administratively, we now have the ability to work much closer with computer scientists, and we're anticipating being able to develop some new areas of research and expand some areas as well.

Research equipment for chemical analysis is also available in the universities, which traditionally are the places where new analytical work is developed. Several universities throughout the country are the primary analytical-chemistry developers. The State geological surveys and universities are commonly the initial developers, testers, and users of new analytical equipment, and they demonstrate its usefulness; a good example is ICP–MS. The Texas geological survey had the first ICP–MS used in geologic applications in the United States. XRF and neutron-activation facilities are available in the universities, as well as in several Federal agencies. The NBMG has at its fingertips most of the inorganic analytical facilities, as do most of the State geological surveys throughout the West; we also have selected organic analytical capabilities. The university chemistry, biochemistry, and biology departments have analytical capabilities to cover almost anything that we at the NBMG can imagine. We have capabilities for microanalysis and measurement of physical properties, which are quite important for many industrial-mineral applications. Process instrumentation is quite good. The universities, especially those with traditional mining-engineering programs, are the leaders in research on the processing of industrial minerals.

Manpower and Funding

I'd like to touch briefly on the issues of manpower and funding. One real benefit of the universities with regard to their research capabilities is their flexibility in utilizing faculty, undergraduates, graduate students, and staff scientists. There generally is a large group of people who work on specific research problems. We at the universities are involved with funding these efforts from nearly every conceivable source. The name of the game in research is, by and large, to do the work where the funding is available. If the funding isn't available, then go out and try to generate the interest to get that funding. Much of the work in the industrial-minerals area is funded directly or indirectly through the Federal Government. G.R. Hyde mentioned the generic centers that the USBM manages, such as the comminution center here in Salt Lake City. It's appropriate that State and local governments provide at least partial funding for some of their projects, because they concern local issues; industrial minerals generally fall into this category. Industry is, in fact, a major funder of numerous projects in which we're involved. An example at the NBMG is our geochemical sampling and characterization program, which involves basic data collection—the type of study in which the State geological surveys ought to be involved. We're sharing the cost of collecting these data with industry. Essentially, industry is providing the money for the analytical work, and we put up the geologists' salaries to collect and describe the samples. The companies that participate then get the first chance to look at the data. For example, if we discover a new high-calcium lime resource from those data, they'll have the opportunity to go do something about it within a year; but after a year, all the data become public information. We believe that everything we do in the State geological surveys has to eventually enter the public domain.

Providing Future Employees

The universities have a major function of providing the future employees for industry, government, and other universities; that function is the most effective means of technology transfer. We have frequent discussions with the USBM about the technologies that are developed in our laboratories and why these technologies aren't being used by industry. I'd venture to say that if you called up the USBM or some of the generic centers and discussed your process problems with the experts there, you may find out that, 15 years ago, somebody in the Federal Government or the universities had already solved that problem. Another way to find out is to hire the people who've been trained at the universities where that information is being developed; that may be the most efficient and effective means for technology transfer. The universities in the Western States are producing some of the real experts in those areas that industry needs.

Current Research Frontiers

Let me mention briefly some of the frontiers in research, some of the areas that are requiring fundamental research, and other areas that depend on good applied research. I've already mentioned the initiative for an NCGMP. Geologic mapping is a fundamental research tool; it's part of what you need to do in terms of research to figure out where industrial minerals are and what the grades of different advanced-material commodities are. There are several areas of future research to assist geologic mapping. M.P. Foose mentioned the avarice data that are acquired from remote sensing. New advances are being made in remote sensing that give us opportunities to do lithologic (rock type) mapping, actually locating individual mineral and chemical constituents of the rocks. Classic geologic mapping goes out and maps formations, not necessarily what the rock types are. What industry really needs, especially in the industrial-mineral area, is this rock-type mapping.

New analytical techniques are breaking ground with regard to mineral-resource assessment. Certainly, the universities are well tied into that research. Geophysical techniques can provide a better way of estimating the thicknesses of overburden and what the water situation is likely to be as we get deeper into the pits. We have to be able to assess deeply buried resources, ground-water quality, and the effects of pumping that water as we develop deeper deposits. Borehole analysis is an area of geophysics in which a considerable amount of research can certainly add to new advances in the industrial-minerals area. Materials handling is an area where research is going forward and needs to continue. Automation and robotics, certainly as applied to underground mining, are hot areas that link computer-science specialists with the mining folks. G.R. Hyde mentioned inplace borehole (solution) mining, an area of research in which the universities have been heavily involved for some time with the USBM. Reclamation is another timely area of research.

Conclusions

I'd like to conclude by just showing why we're all doing this and getting back to the fundamentals. The impressive productivity of Nevada's mines for about the past 12 years is shown in figure 33. In 1989, the average Nevada miner produced about $176,000 worth of mine products. Folks in industry might want to go back and take a look at their own operations and figure out where they fit on this curve and whether or not their company is producing that much. It's been impressive that we in Nevada have been able to stay well above inflation, such that productivity has increased significantly in real terms within the past few years. The reason for these increases is largely greater efficiency, because in addition to good people working for you, you're using new technology. You're picking up technology that's being developed by the industry, by the universities, and by the State and Federal laboratories, and you're applying it out in the field. The only way we can stay competitive is to keep our productivity high, and productivity is the reason why we're in the research business.

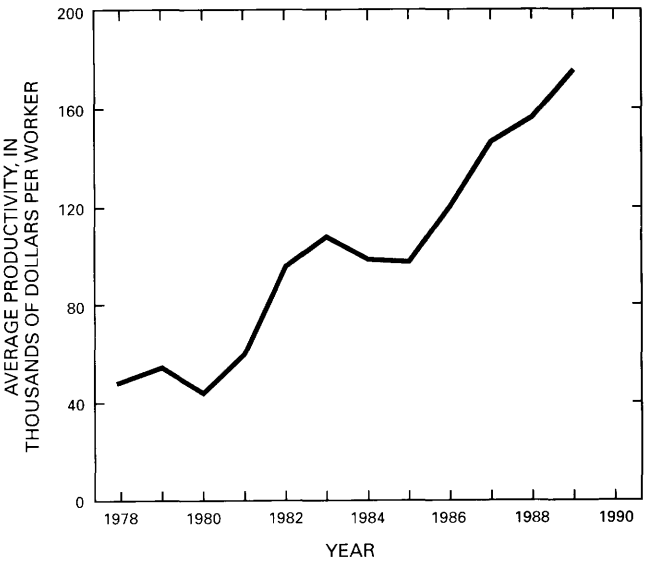

Figure 33. Value of annual production per mine worker in Nevada (exclusive of petroleum and geothermal energy).

• I've wondered about the advisability of using some of the high-technology minerals like neodymium, for which there are only so many tons of material that exist in recoverable deposits. Is it practical to use it in low-technology applications, like a nonessential part for a car? Is there any reason for a national direction on strategic and critical uses of some of these materials for which uses are inverse to their small supply? Shouldn't some things be reserved for high-technology medical or strategic uses rather than put into consumer goods?

Reply by J.G. Price: That may be true for some commodities. We're talking about the whole periodic table, and some materials, as far as we know, exist only in small quantities. I don't think there's much of a problem with neodymium because, fortunately, there are many deposits around this country and elsewhere (China, for example) that we can tap. Your point may be more appropriate for elements like scandium and some of the much less common materials.

• Those who want to develop a national mapping program can refer to the one State that the USGS did a few years ago. I think it was Kentucky, and they made a complete coverage at 7½-minute scale. Where are funds going to come from to mount a campaign even approaching that type of coverage for the rest of the United States?

Reply by M.P. Foose: Mapping is a fundamental task that the USGS should be and wants to be engaged in, and it's trying to do the best it can with current dollar and staff resources. We're like most other government agencies, right now, that are in a very tight financial situation. I venture to guess that it's not going to improve soon. The number-one Federal issue is the deficit. We're not going to see many major new funding proposals go forward. The USGS is not, in effect, the master of its own destiny in many respects. We can't just go out and do whatever we want with the funds that we have; those funds come with strings attached. Thus, we can't increase our mapping activity unilaterally; those funds have to be justified and made available, and we can't make them available to ourselves. That's a Congressional action, so, ultimately, it comes down to the fact that the people of the United States, the user community, the constituents who want that specific product done must go to their elected officials and say, in effect, "I'm an important constituent; this is an important task that the Federal Government should be engaged in, and I want you to look after my interests." The public should be doing that at all levels. Without that type of input, little will happen. In my personal opinion, industry hasn't provided that input at the Federal level to the degree that it should. But without that type of input, the decisionmaking processes in Washington go on but don't reflect the concerns of industry and the needs for the mapping that industry wants. In effect, I'm hitting the ball back into the public's court—maybe not just industry but whoever else feels the need for geologic mapping.

Comment by J.G. Price: The mapping initiative actually has a fairly strong momentum at this point. Legislation will be drafted, possibly this summer, that will get sponsorship from key Senators and Representatives. Once that's in place, we in the State geological surveys will get the word out to the folks in industry, to the environmental organizations that are also concerned with mapping efforts, and to the general public. We'll ask those people to show their support for the initiative to their own congressional delegations.

The funding that you asked about will come from the initiative—in other words, the initiative will call for new moneys to be appropriated to the USGS and DOI. It will call for matching moneys coming from the States. Exactly how that gets worded in the end will be decided by the congressional delegations, but essentially we'll start off with a proposal that will initiate authorization legislation to create the program. Once that legislation is passed, there will follow appropriation legislation, so there'll be two pushes to try to move the legislation through the Congress and Executive Branch successfully. A draft of the legislation is being discussed among the USGS and State geologists. Ultimately, the money has to come out of the Federal budget and the budgets of the States. You can take the point that, when you have all the other pressing social needs within this country, is it likely that we'll be able to increase money for geologic mapping? It's likely that we can increase money for such mapping if we can demonstrate to the Congress that, in fact, it's a major issue, as important as some other current social issues. There's a big pie called the Federal budget. There's never been a Congress that's had more money than programs on which to spend it. The situation now is no different from what it was 100 years ago: It's a matter of setting priorities and deciding what's most important. We think, for various reasons, that the NCGMP initiative is important and will be able to fly.

• I'm a little unclear about the relationship between the USGS and the State geological surveys, particularly with regard to industrial minerals. Mapping is one thing, but how do you perceive it will operate? The States have always had the lead in industrial minerals. What's the plan for cooperation between the several State agencies and the USGS?

Reply by M.P. Foose: With regard to industrial minerals, the USGS is feeling its way as it tries to strengthen its program efforts in that direction. I think most of the specific work on industrial minerals that's done is probably most appropriately done at the State and local levels. The State geological surveys have a strong role to play in accomplishing the specific work that needs

to be done. We've established a field center in Reno, Nev., to strengthen the direct interactions between USGS and NBMG activities. In the past, most of that work has been focused on metallic-mineral commodities, because that's where the USGS' traditional interests have been. As we strengthen our activities with regard to industrial minerals, I'd anticipate that the field center will become the arena of exchange of program priorities where we can transfer and test some of the concepts and regional and national research results which have been done by the USGS, whether it's remote sensing, ore-deposit models, or new geophysical tools, to assist the States in their more specific mapping activities of looking at the distribution and resources of particular deposits.

The USGS began to evaluate what it could do in the industrial-minerals area, and the industrial-minerals-workshop concept was adopted to examine the needs in this program area. In 1988, the first industrial-minerals workshop was held in Tempe, Ariz., sponsored by the AZGS and the USGS. In 1989, the second workshop at Marina Del Rey, Calif., was sponsored by the DMG and the USGS. Now, we're a part of the third workshop sponsored by the State geological surveys of Nevada, Idaho, Utah, the USBM, and the USGS. These workshops are another attempt to bring the State geological surveys, the industry, and the other parts of the resource constituency together and, in the process, begin to develop a wider program concern for industrial minerals.

Reply by J.G. Price: Some examples can be given to show how the USGS and NBMG have interacted, including the provision of some State-appropriated moneys for cooperative work with the USGS. The source of these funds is in a piece of legislation that's been passed by the Nevada Legislature every 2 years and, we hope, will be continued. I made a list recently, when the Chief Geologist of the USGS came through Reno, of all the cooperative programs that we currently have with the USGS; it amounted to about 20 different projects. The industrial-minerals area is one in which we can use some of those funds for cooperation with the USGS. The local USGS field office in Reno has centerpiece projects; they pick a particular area to focus on and use that as the main field center's research project for several years. Right now, they're working on the second year of a 2-year project looking at Jurassic-Triassic mineralization in western Nevada and eastern California. NBMG scientists are working cooperatively on that project. As it winds down, they'll start up a new project that may be for 2 years or longer. The USGS has asked for our input, and one area where we've given it is the potential for industrial minerals, specifically aggregate materials around the expanding metropolitan areas in Nevada (see cover). Another area of cooperation we're trying to develop is a better relationship and funding base, so we can address the issue of upgrading the USGS' computer system for mineral resources (MRDS). This system contains several thousand records for the State of Nevada, many of which have never been thoroughly checked in the field and which also need to be looked at in more detail. We've proposed to the USGS to evaluate those records, specifically to upgrade those needing it and to make the system more usable for the State of Nevada. This data base will include the industrial minerals.

Moderator's comment: Because each of the panelists is a public servant, you each might comment briefly on the best mechanism for the public to get help from or interact with your staff.

Reply by G.R. Hyde: The USBM encourages direct communication with its staff. The first important step is to pick up the telephone and find a knowledgeable staff person. The USBM would also appreciate your keeping us in the technical loop. We'd like information from the public, so when we're at meetings holding discussions about issues that the USBM or USGS can help you with, keep us informed. If you're having a meeting at which we might provide or derive insights, call us and let us know what you're trying to do; we might be able to send someone to visit and at least listen to what's going on. It was interesting yesterday to hear discussions with some of the environmental planners, people who have to take a problem and bring it into reality and build a system that will work. We also need input from them regarding mineral and mining technology. So, keep the communication loop open both ways—asking for help and offering your information, advice, and expertise.

Reply by M.P. Foose: The USGS also encourages direct communication. I'm always amazed at the effort that the Government makes to answer any request that comes in. We can get a letter from someone in Iowa saying that he has a great cobalt deposit in his backyard; somebody came along and said that his rock ledge has cobalt in it. That letter will come in to our Director, and somebody's going to spend a significant amount of time drafting a reply. We'll spend that amount of time for that type of letter; however, we'll spend a lot more time when somebody comes to us with a serious professional query. In the Basin and Range, in particular, we've targeted the information area as one in which we'd like to increase our activity. We've established field centers in Tucson, Ariz., Reno, Nev., and Spokane, Wash., as local offices where a taxpayer can come in for information or advice. The centerpiece projects in those areas increase our visibility and our interaction with the State geological surveys and the mining industry. I'd ask you to direct inquiries to those field centers in our Western region. You can also talk to Bill Bagby, chief of the Branch of Western Mineral Resources, headquartered in Menlo Park, Calif. Call these people, talk to the geologists, and I'm sure you'll get a

response. If you don't, keep talking, or go higher in the system. In my experience, it seems to work.

Reply by J.G. Price: In the NBMG we're all information resources, and each one of us in a State geological survey has the function to serve the public. The NBMG has three geologic-information specialists whose primary job is to answer questions from the public. If those persons can't answer the questions or point out the NBMG's and others' publications (including journal articles) that might contain the answer, we'll then refer them to one of our other staff experts. If an industrial-minerals question comes up that can't be answered by our frontline folks, we bounce it over to Steve Castor. If he can't answer the question, we go look for Keith Papke, our emeritus staffer and long-time industrial-minerals specialist. Direct communication is a major part of what we do. As the director of the NBMG, I can assure you that's taken into consideration when it comes around to annual reviews and merit raises. We look at what people do in terms of interaction with the public, as well as scientific productivity (in-house and outside). It's part of what we seriously consider to be our jobs.

New-Market Development: How It Has Been Done

R.C. Bradt, *Moderator*

We now consider examples of how some creative parts of the industrial-minerals industry are helping themselves to overcome difficulties and move forward in the days ahead, by developing new markets for their products and by joining in coalitions to foster PR activities that will be beneficial to the industry. Two examples of the development of new markets for industrial-mineral materials follow. First, Tom Parsonage, director of sales and marketing for the Beryllium Mining Division, will tell about Brush Wellman, Inc.'s efforts to expand the market for beryllium, a high-unit-value material. We recognize that beryllium is a metal, by definition, but its uses are primarily as an industrial mineral; in fact, beryllium and Brush Wellman, Inc., are included in the Industrial Minerals Directory (1987, p. 520). Next, Donald Seehusen, president of Idaho Quartzite Corp., will demonstrate what's been done with quartzite, a low-unit-value material, to expand its market.

Developing New Markets for Beryllium, a High-Value Specialty Material

By T.B. Parsonage

Brush Wellman has been active in developing new markets for beryllium, a relatively high price material used principally in applications that require its light weight, high strength, and high thermal conductivity. This unusual metal is one-third lighter than aluminum, yet it's six times stiffer than steel on a weight-for-weight basis. Beryllium is used as an alloy and metal in aerospace and defense applications, as an alloy and oxide in electrical and electronic components, and as alloy, metal, and oxide in other applications.

Brush Wellman is an R&D-based firm with special expertise in extractive metallurgy, is publicly owned, and is headquartered in Cleveland, Ohio. It's the world's only fully integrated supplier of engineered beryllium materials, which include metallic beryllium, beryllium alloys, and beryllia ceramics. Annual sales amount to about $350 million; most sales are for commercial applications, and the rest are for defense applications. Brush Wellman has a strong base in Utah; its primary source of beryllium ore, bertrandite, is from their Spor Mountain mine at the edge of the Thomas Range and Great Salt Lake desert in western Utah. On average, each ton of ore contains 4 lb of beryllium. Proven ore reserves will assure an adequate supply of beryllium at least through the first half of the 21st century (fig. 34).

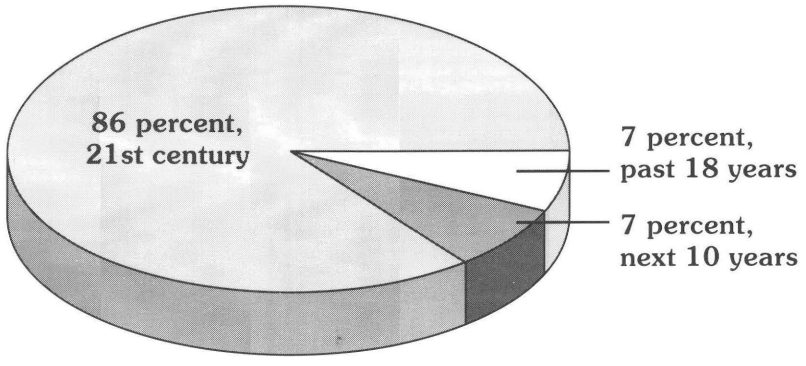

Figure 34. Consumption of Brush Wellman, Inc., reserves of beryllium ore.

A concentrate of beryllium hydroxide, which is extracted from the ore at the mill in Delta, Utah (fig. 35), is the feedstock for all of Brush Wellman's beryllium products. New R&D technology is being applied at the Delta mill as part of an expansion and modernization program. The program objectives are to reduce waste and to provide added protection for the environment. The beryllium hydroxide concentrate is shipped to a complex of plants at Elmore in northwestern Ohio, where the material is processed into metallic beryllium, beryllium alloys, and beryllium oxide powders, the starting materials for beryllia ceramics. Beryllium can be purchased in different grades for specific applications as block, bar, sheet, plate, and foil forms.

Special Properties of Beryllium

Beryllium has a unique combination of mechanical and thermal properties. In addition to being lighter than aluminum, beryllium metal has a high resistance to deflection under heavy loads. It absorbs heat better than any other metal, is the best thermal conductor, and has a high thermal diffusivity (that is, high dimensional stability when exposed to extremes of cold and heat). Because of these desirable properties, the largest market of beryllium has been for strategic and spaceborne applications, such as load-bearing structures for satellites and other spacecraft, components for inertial-guidance systems, mirrors, and optical benches for space telescopes.

Although beryllium is an expensive engineering material, the weight savings provide an enormous payback in spaceborne systems. For every kilogram of weight saved, launch costs are reduced by from $9,000 to $20,000. An all-beryllium optical-tracking system weighs only about one-sixth as much as a comparable all-aluminum system. Because of the low inertia of its active beryllium components, which includes the mirror, it acquires targets faster; and because of its stiffness and dimensional-stability characteristics, the system tracks targets more accurately. Weight savings are important also for airborne systems. Payloads of beryllium instruments, for example, which weigh as much as 7 times less than those constructed from conventional materials, enable additions to the payload or fuel supplies.

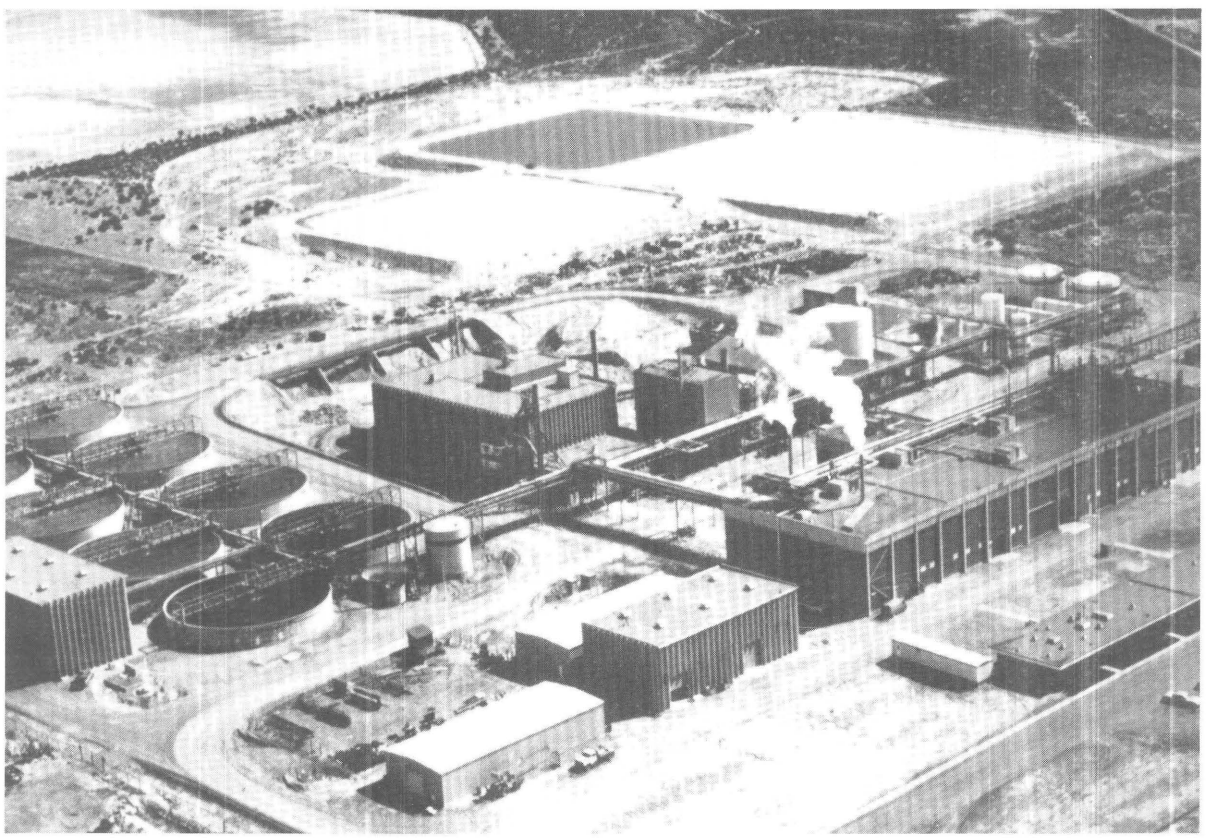

Figure 35. Brush Wellman, Inc.'s ore-concentration facility at Delta, Utah. Beryllium hydroxide concentrate is produced and sent to the Elmore, Ohio, fabrication facility, where metallic beryllium, beryllium alloys, and beryllium oxide powders for beryllia ceramics are produced. Photograph courtesy of Brush Wellman, Inc.

New-Market-Development Problems

Getting a foothold in the tactical optical-systems market wasn't easy. In our traditional markets, materials selection is performance driven: Designers select the best material for the job, regardless of the cost. In the tactical optical-systems market, however, materials selection becomes cost driven: Designers may have to select a lower-cost material than beryllium, even if this means paying a penalty in terms of reduced system performance.

Brush Wellman's market research for tactical optical-system materials discovered that designers were considering various alternative materials. In the case of structural applications, such as targeting pods, the competition came from aluminum, graphite-epoxy composites, silicon carbide-aluminum metal-matrix composites, and titanium. In the case of mirror applications, the competitors were aluminum, fused silica and other glasslike materials, fused silicon carbide—a ceramic—and silicon carbide-aluminum metal-matrix composites. None of these materials enhances performance as much as beryllium, but they were all lower in cost. A new family of engineering materials, metal-matrix composites—such as aluminum stiffened with silicon carbide particles—were being promoted as alternatives to beryllium and were acceptable in performance for some applications. They also were very cost competitive with beryllium.

Faced with the possibility of being priced out of an attractive new market, the R&D staff was challenged to find a new, more efficient process to make beryllium components more cost competitive and to increase optical market-performance characteristics. The staff was successful in perfecting a new technology, hot isostatic pressing, for forming beryllium components to near-net shape directly from beryllium powders in a single step (fig. 36). When a customer needs a component, he sends a drawing of that component. Traditionally, we'd cut a block of beryllium from a billet and rough-machine it into a blank that matched the component shape; the customer would then machine it for the finished product. This method is inefficient in both time and personnel, and the cost is high. In contrast, the new system reduces the cost of beryllium optical components by 25 percent or more, making beryllium cost competitive with other high-performance engineering materials; the near-net-shape processing technology results also in improved material properties (table 13). We can produce complex components directly by this process, forming structures that don't require machining, resulting in reduction of production costs. The material properties are stronger because the powder is compacted isostatically and properties are uniform in all directions, resulting in superior dimensional stability. In addition, the R&D staff has developed a new mirror material that's easier to polish than previous materials; it also has reduced optical scatter and thus provides sharper images, higher reflectivity, and brighter images with

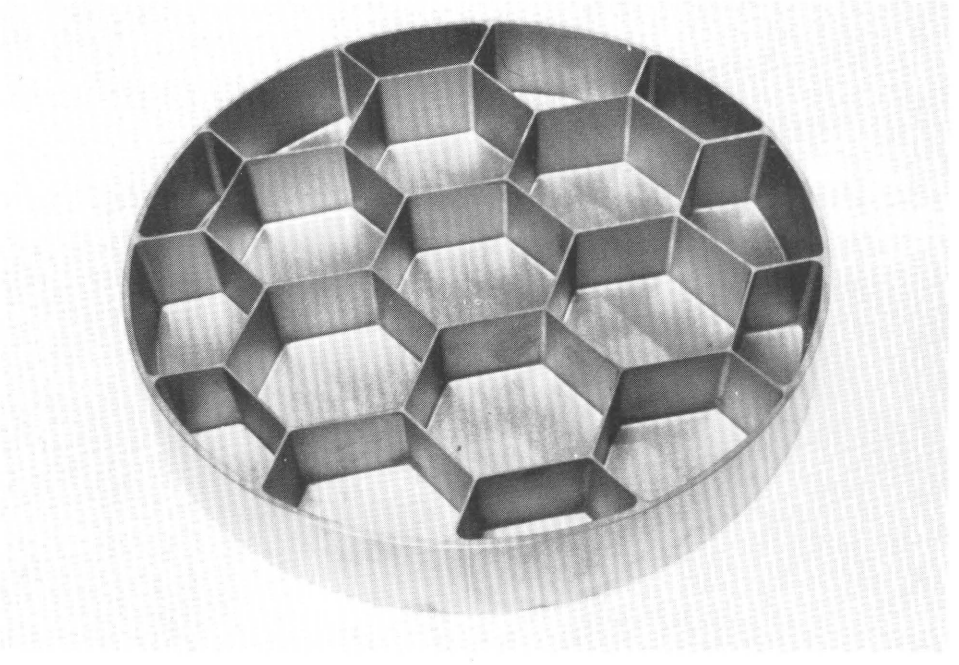

Figure 36. Complex precision-formed components like this generic lightweighted beryllium mirror blank can be made almost directly by the hot-isostatic-pressing process and do not require machining. Photograph courtesy of Brush Wellman, Inc.

Table 13. Typical material properties of lightweighted beryllium mirror

Material property	Direct hot isostatic pressed	Vacuum hot pressed
Ultimate strength (10^3 lb/in^2)	49.5	35.0
Yield strength (10^3 lb/in^2)	31.3	25.0
Elongation (percent)	4.4	2.0
Grain size (μm)	12.1	20.0
Variation in coefficient of thermal expansion in two directions (ppb/°F).	10.1	100.0
Density (percent of theoretical)	99.9	99.3

sharper focus. They've also developed new structural materials from beryllium.

A new process, cold isostatic pressing, also has been developed. It has the advantage that blanks can be formed very close to net shape, reducing machining to a minimum and leading to high-volume production. Materials produced in this way cost 35 percent less than through making beryllium blanks by conventional technologies. The materials are now cost competitive with blanks made from competing materials, and their optical performance is better.

Conclusions

As the preceding examples show, advanced processing technologies have had a tremendous effect on Brush Wellman. We've been able to penetrate new markets and qualify beryllium for a broader range of applications in traditional markets. We've also been able to develop new, higher-performance materials to satisfy special customer needs. Looking ahead, the R&D staff are developing entirely new beryllium-based materials, such as lightweight, stiff foams of beryllide intermetallic compounds for high-temperature applications. We see many new market opportunities in the electronics business. Our strategy for entering these new emerging markets is simple: Continue to develop new, more efficient processes and new, higher performance engineered materials. Our policy is to offer the right materials for new applications at the right time and at the right price.

New-Product Development From Low-Value Material by the Idaho Quartzite Corporation

By Don Seehusen

Idaho is known throughout the world. Last year in Japan, I explained that I was from Idaho. A Japanese man said, "Ah, famous potatoes." I guess we're well known for our potatoes; it's on our license plates. Actually, Idaho is the gem State, but we also have one of the more interesting and, possibly, more mundane materials, quartzite; it's a down-to-earth material that you walk on, and it comes in many different colors. However, this low-unit-value material wasn't always the highly desirable architectural material it is today. Basically, I'll describe a case history of how quartzite materials were made extremely useful for the building trades and how they're marketed.

Origin of the Idaho Quartzite Corporation

We started our quartzite business in 1973. Quartzite had been sold for many years as a bulk-stone product extracted from the ground in a flagstone form. We began by trying new marketing techniques with a stone product that had been used for years and years. Stone is one of the oldest building materials, if not the oldest building material, in various parts of the world. We've developed numerous new products made from quartzite: tiles, bulk flagstones (which were the traditional material), stone wall blocks, and rock-cast walls. Rock-cast walls represent a technique that we developed during the early 1970's in what is now known as Silicon Valley, Calif. I was in the construction business, involved in tiltup constructed buildings. It turned out that quartzite was an excellent material for casting architecturally into the face of industrial-building tiltup wall panels. For those of you who're familiar with buildings in that area, all of the stone-faced buildings in northern California were done with quartzite from Idaho and Nevada. We obtained a patent on that process and started using so much quartzite materials that we went to Idaho and obtained a quarry. Thereby, we got into the stone business through the back door.

We were fortunate to have obtained a beautiful deposit of quartzite (see cover). In fact, quartzite is probably the hardest building material produced commercially in the world today. We have four different colors—gray, gold, light green, and white, a new color that we're just starting to produce in southern Idaho. We also have a couple of quarries near the Idaho-Utah State line. Our materials are exported to Europe and Japan; I even have a distributorship in Fiji, of all places, where they're using quartzite as a paving material. We import some quartzite materials from other deposits in the world. There's a black variety—mesquite charcoal—that comes from the middle of Sweden; a similar deposit extends into Norway. We bring in quartzite material from China—a unique mauve variety called Mandarin mauve; all of the sidewalks in downtown Reno, Nev., are partly made of Mandarin mauve quartzite. We also have a light-gray quartzite imported from South Africa, and we're researching Russian quartzite.

New-Product Development

We made a video about the company that shows how we've marketed our products. This tape was made primarily for architects, for a couple of reasons: (1) A lot of people can't see our quarries, and (2) it shows how quartzite has been used effectively. Descriptions of a few of the quartzite products shown have been abstracted from the tape. The following information shows how remarkably adaptable Idaho quartzite is in many situations.

The Idaho Quartzite Corp. owns and operates four quarries in Idaho. Our geologist has determined that these quarries contain more than a thousand-years' supply of gold, gray, light-green, and white premium-quality quartzite. The unusualness of these deposits is that the quartzite is layered about every ⅝ths of an inch; these layers are separated by mica planes that formed as the rock was metamorphosed. Quarriers unearth large stone slabs and then split them into the thinnest sheets possible by carefully chiseling along the mica planes until the stone breaks apart (see cover). This naturally rough face is similar in texture to that of a flame-treated granite. The coefficient of friction is 7, which rates in the highest nonskid category. Idaho quartzite's bending strength has been tested to 3,000 lb/in^2, which is twice that of most granites.

When the quarrier has finished the splitting process, the pieces are sorted for thickness, quality, and color dominance. The sorted and crated materials are then shipped as flagstone or sent to our plant to be cut into tiles. At our plant, the stone is again sorted for size, thickness, and color; the material is then cut with diamond saws specially designed for this purpose. Because Idaho quartzite rates 8.5 on the Mohs hardness scale, it must be cut with diamond saws, the only material that's harder; quartzite is significantly harder than granite. Each piece of stone is precision cut and checked for squareness. Metric measurements are used not only for accurate workmanship but also because it's preferred in the industry, especially overseas. The tiles are cut into nominal 8- by 8-in. pieces that are actually 195 by 195 mm. A high percentage of our tile is produced in 8- and 12-in. sizes; pieces as large as 24 by 24 in. are also available. In addition, bulk flagstone is stocked, and the company has a reliable network of domestic and foreign sources from which other types of rock materials are obtainable.

Idaho quartzite can be laid like any standard tile, either by mortar setting or in a medium-bed application. Pieces are standard width by random lengths. Completed projects are scattered around the world as confirmation that quartzite is valued for many types of applications. The largest quartzite project in the United States, and one of the largest in the world, was recently completed in Reno, Nev., which was 175,000 ft^2 in area. To minimize field cutting on a project of this size, the architect chose to use a random modular pattern composed of pieces of stone in sizes 6 by 12, 12 by 12, and 12 by 18 in. within a 10- by 10-ft control joint. Any combination of these sizes fits within the pattern without requiring cutting. Idaho quartzite's compressive strength is more than 30,000 lb/in^2, and in Reno, fire trucks and automobiles run over the tiles with no adverse effect on the stone.

Another excellent example of Idaho quartzite's usefulness is on the floor of the lobby of a mass transit station of the Miami, Fla., Metro system. Thousands of people cross this floor daily. Idaho quartzite is a heavy-traffic material; it can be used indoors and outdoors in any climate. Idaho quartzite is used effectively on stairs and as patio flagstones, and because it's so hard, it's recognized as an ideal material for golf-course clubhouses; golf cleats won't damage this stone. Because of Idaho quartzite's unique color, economy, and superior performance, it's used in the Tropics, where slip hazards are of concern. Black algae grows on most absorbent materials in warm climates and becomes slick when it rains. Because quartzite's absorbance rate is only 0.2 percent, it won't support the growth of algae and thus remains highly slip resistant. Finally, Idaho quartzite is inert and harder than sand, so the beauty of quartzite's surface cannot be destroyed by tracked-in beach sand. Quartzite is cooler on bare feet than concrete under the tropical sun.

Brick-shaped builders are another product available from our quarries; they're used to make rugged dimensional walls. A stone wall block is a simple idea of taking an 8- by 16-in. piece of quartzite and gluing it onto a concrete block, so that it can be laid up in one shot out in the field, where labor is expensive. By doing it in this way, making the block in the factory and installing it in the field, we save about a third of the cost of a stone wall; it also makes a beautiful wall. Office builders use our builders as a main architectural feature because they're maintenance free.

Video presentations are shown quite often to architectural groups. Not many people want to drive all the way up to the middle of Idaho and out to our quarry areas to take a look, so it's better to bring the quarry to them and make a positive presentation with the whole package together, rather than doing it piecemeal.

Marketing Strategies

How do we market a new product of low value like this? We, first of all, find a need, and then we fill it. We started off trying to sell the product in various ways. We looked at other products of similar nature. How were they sold? Mostly, in the old days, bulk stone was sold through stone yards. If you wanted to build a little barbecue out in the back yard, you'd go down and buy some brick or stone and some sand and cement from a local building-materials

supplier. By chance, he might have some quartzite sitting in the back corner of the yard, but he's not typically an aggressive salesperson.

We wanted to do something more than chance sales, so we got into the marketing of stone through distributors, but many of the people that we tried to set up as distributors said, "Well, we've never heard of this product before. We don't know how its going to sell, so we don't want to stock any of it." After going through that scenario for a while, we decided that probably the best thing to do would be to sell our product to architectural firms, project by project, and Reno represented the last rather large project that we sold directly in that way. That process becomes self-defeating because you have only a few people trying to sell across the Nation and around the world. It's a difficult to sell a product project by project.

Next, we decided to expand our operation from two to three salespersons to a whole series of distributors. About a year and a half ago, we took on a line of about 40 distributors of ceramic-tile products. These fellows sold similar things (in marble and granite—mostly produced in Italy—as well as ceramic tiles) to architectural specialists; they went in and specified with architects. Now, our sales force is more than 100 persons, and the results are starting to show. We've also come up with the sample book of actual pieces of the tiles, which has helped considerably in letting architects see a sample to decide whether they want to try the material or not.

Another interesting marketplace is overseas. Right now, we export about 25 percent of our product overseas, mostly to Europe and Japan, because the existing markets there for stone products are rather large. Here's a new product on the marketplace, or at least new colors, that they haven't seen before.

We also transformed our material from a simple, low-value product into a value-added product by cutting the stone into various sizes and shapes for use in different applications. That's helped to give a wider appeal to the product and more business volume. One thing that we have to do yet is to gage the back of the stone—cut the back off so that the tile is uniformly thick and can be used in many applications where it can't right now. Marble and granite come out exactly 10 mm thick. We need to be able to do that, too, and it's expensive because our product is so hard, but we're looking into it.

In marketing a product, you have to ask yourself, "Am I going to make a market or fill a market?" Making a market is more difficult to do. We started with a product that people didn't know, a specialty item. What we really want to do is make it a commodity that everyone knows and build a commodity-market position; then, we could fill a good part of that market. It's much harder if you have to make the market with a specialty product. Now, we're slowly making a specialty product into a commodity.

As I mentioned before, we're also marketing by identifying new ways of using stone. Our patented rock-cast process is one way. That product goes up and down with the interest rates, depending on where building is going on. We have one project on the drawing boards right now in Boise, Idaho. We licensed the rock-cast product out during the major recession of 1979 to 1982. Things slowed down, and we really haven't gotten back into promoting that product line as much as before because of other things going on now.

The other way we market our product is to let people know what's been done. We advertise; our sample books are probably one of our more lasting advertisements. We put quite a bit of money into those books every year. Our distributors help with that and are passing out these books to architectural offices all over the world.

We get into trade publications, also, as illustrated by the story about Reno that appeared in one of the stone-tile trade magazines. That article was helpful in giving credibility to our product. Magazine articles are great. Sometimes, we happen to sponsor the writing of a particular article, and the magazines use it verbatim because they want it. Magazines are lazy and would rather take something for nothing and put it in their magazine. The residual value of something like that is also great. Therefore, if you want to market a product or tell something about it, write the story for them. The publishers may modify it a bit, but they'll usually publish it sooner or later. The result is that you can hand out reprints for years later.

The other thing we've done recently is a video, which has been helpful to our distributors because of the technical product information in it. We've extended this tape and added a lot of question-and-answer sessions taken at a distributor meeting. When you have 100 people selling for you on a regular basis, you have to educate them equally; we felt that the video was an excellent way to accomplish this. We also give talks around the country, like this one today. I was at a trade conference the other day talking about the European Economic Community. We do this on a regular basis; it helps a lot for people to know about our products.

Concluding Comments

In 1973, when we first started, people were saying, "What's quartzite?" Then, about 5 years ago, they were saying, "Gosh, what a beautiful product; where has this been?" Now, architects are saying, "We're going to use either quartzite or granite." So, we've come a long way. There's a big community out there to which we sell—the architectural community—and it's a big educational process that really helps our sales. Education is teaching people about something that they may know nothing about. So, you now know something about quartzite.

- I happen to be from Reno, Nev., and I agree that the quartzite downtown is beautiful. However, they've had some trouble cleaning it. Were you aware of that?

Reply: I was there about 10 minutes after a lady dropped some nail polish on it. That doesn't help any! With 6,000 people an hour going across those sidewalks, the city needs to do a regular maintenance program, and Reno, as I understand it, hasn't done that; it hasn't spent the money to keep up its sidewalks. All materials, even concrete, have to be maintained. Reno is an interesting town; it has some of the worst conditions in the United States as far as climate is concerned. When we were laying stone down one morning, the guys started out in T-shirts, by noontime they had their jackets on, and by 3 p.m. there was a foot of snow on the ground. You can have as many as three or four freeze-thaw cycles in one day, which, on most materials, would be very difficult.

Let me interject another item here. I happen to sit on the board of directors of the Marble Institute of America. This name is a misnomer because it's really the dimensional-stone institute of America. Our official title hasn't changed since 1944, when the organization was founded. The United States is sound asleep right now in the dimensional-stone marketplace. We're importing huge amounts of material from Italy—granite, marble, tiles, and slabs. I noted last night, while checking in, that the registration counter of this hotel is made out of Swedish Balmoral MG granite—right here in Salt Lake City. Why don't we have an industry producing marble and granite in this country? The answer is that we're sound asleep, and other countries are outpacing us. As a group from industry addressing a group in government, one thing we need to do is help identify deposits of marble and granite in the United States. Only the Cold Springs Granite Co. has done this; they have a virtual monopoly on domestically produced granites. The marble- and granite-tile business is growing by leaps and bounds with available new technology to produce granite and marble tiles at very low prices. We, the dimensional-stone industry in the United States, really haven't taken up the challenge. It's business as usual—mom-and-pop shops, primarily, and smaller contractors. Everyone is buying from Italy. I was in Mexico the other day. They have some very beautiful marbles—15 types, to be exact—that are absolutely gorgeous. The reason they haven't been used as widely as they could be is that the technology of cutting and polishing those marbles hasn't been developed to where it needs to be. The Mexicans are coming on fast with Italian equipment to produce marble and granite at $3 to $4 per square foot (distributor price). I think it would behoove us as a group to recognize that the dimensional-stone business is growing rapidly. Marble usage has grown 684 percent in the past 7 years; granite usage has grown 2,100 percent during this same timespan. Those statistics may be somewhat old now, but they indicate a very large growth trend. Ceramic tile is also coming on strong. All of these materials are coming from overseas. We're sitting here not identifying comparable materials that we have. We have marbles; we have granites; and we need to do more as a group to get our act together. We should be able to outproduce the Italians. Italian products are about a $3,000 container load away from this marketplace. If we could produce the material here at the same price as they're producing it at over there, we'd have a terrific competitive advantage. I think there are some things as an industry and government that we need to work on together to try to identify, and I know that from the industry side, there are many people who'd be willing to do that. It's very capital intensive to buy the new machines, to open quarries, and to stock materials in the quarries and open new marketplaces. There aren't that many people doing it yet, but, believe me, it's going to happen soon.

- Dimension stone traditionally has been very labor intensive. Is that going to be a limiting factor for dimension-stone production?

Reply: The answer is no. There are mechanized techniques. We've brought in a Swedish technique that we don't want to show anybody yet. It's very simple, but it's basically to drill, blast, and haul away to split all winter. What you see on the cover is a summer operation. It makes sense to leave all the waste, which isn't much, in the quarry, but it also makes equal sense to be able to work all year round with a steady force. Labor is the least limiting factor; the greatest limiting factor is the marketplace for our product. The production process is pretty straightforward.

Industrial-Mineral Opportunities Derived from an Effective Public-Relations Effort

Finally, in this session, we consider how to best get across the message about the importance of mineral-resource development. Without widespread public backing that can be developed through education, the industry will be severely handicapped or eliminated from the local scene. John Marz of Dunn-Draper-Glen-Marz, a PR firm in Las Vegas, will describe a recent project undertaken by them for the NMA.

Public Education Through Public-Relations Expertise and Communications Technology

By John Marz

It's always good to address a group of people who, I think, need the type of services that our company provides.

I'm not here to sell you anything, but I hope you'll gain a better understanding of some of the situations in which you may find yourselves and some of the things you can do to deal with those situations. I'm going to focus my remarks on our recent experiences in Nevada and give you some background about some of the things that we did. As you may or may not know, the mining industry of Nevada faced some monumental challenges from the legislature during the past year. The legislature wanted to take some of the protections on the taxing of mining out of the constitution, which the mining industries in the State have operated under; it wanted to redirect the way mining in Nevada was going to be taxed. The NMA and some of the mine operators in the State accepted the task that needed to be faced. How could they tell people about the mining industry in Nevada and stop the plan to amend the constitutional provision regarding mining taxes?

You may not think PR and advertising go hand in hand with the mining industry, but I'm going to show you how they do. People in the mining industry had two options. It doesn't make any difference what you're mining, whether it's precious metals or industrial minerals, and it doesn't matter what your product is. When it comes to meeting the public, you can either (1) direct your own PR and have the story go out the way you want it to, or (2) sit back and rely on other people to tell your story for you. If you sit back and rely on someone else to tell your story, you're taking a big risk, because you don't know how that story is going to come out. You don't know what other people are going to say about you, and you'll find that it doesn't take a large group to start formulating public opinion. It can be done with three environmentalists who don't like you digging up the earth; if they're vocal enough, they can cause you lots of problems. Or it can start with a bunch of hunters who don't like cyanide in ponds, which kills ducks; then, all of a sudden, you have headlines on the front pages of newspapers saying that miners are killing the wildlife. The ability to tell your story is now out of your hands and in someone else's hands. Once you lose that type of control, PR becomes difficult, so, as I go through what I call a little scenario in Nevada, I hope you can look at your own positions and maybe draw some parallels. More important, I hope our experience will give you encouragement that you can put your case before the public.

Objectives of a Public-Relations Plan

The first thing you need to do when it comes to PR is identify your goals. What do you want a PR plan to do for you or your industry? What's the end result? Next, you need to identify the people whom you need to influence. In Nevada, we identified four basic publics that we needed to talk to, and we identified them in terms or degrees of importance. First, we had the general public who knew absolutely nothing about mining in Nevada. Second, we had what we considered opinion leaders—influential business people in the State who were highly vocal, who had high profiles. Third, we had the legislators—they were a target that we certainly needed to address. Finally, there was the press. We talked with people in each one of these groups in different ways. I'll show you some examples of the things we did.

Before we began a PR plan, we decided that we needed to find out exactly what people in the State of Nevada knew, or didn't know, about mining. We hired a research firm and spent about $20,000 on this research. We polled 800 people in the State over the telephone and asked them specific questions about mining to find out what they did or didn't know. It was really amazing: The public knew virtually nothing about mining! They didn't know how mining affects the State; they didn't know how many people were employed in mining. What they thought was that mining is a bunch of people going out and digging holes and sinking shafts with shovels and mules. That's literally what we found, and you may wonder how anyone could think that these days. Well, it's very easy if you aren't in this industry. Most people just don't know, because 92 percent of the mining is done in rural Nevada. Mining doesn't affect the people in Reno or Las Vegas from a day-to-day-living standpoint; it does affect people in such mining towns as Winnemucca, Elko, Wells, Tonopah, and Goldfield, but their populations are small. When we polled the people out there, they knew what the effect is, but nobody else did in the centers of the State's population. What you also need to understand in any situation is that the majority are going to make things happen when it comes to public opinion. The people whom we really needed to address were in Las Vegas and Reno; we needed to develop a campaign that would speak to those people.

Next, we identified subjects that we needed to talk about and areas in mining that people didn't really understand. We broke these down into some basic issues. We wanted to talk about taxation, how mining in Nevada helped as far as tax income was concerned, what kind of contribution mining made to the tax base of Nevada. We wanted to talk about the overall economic factors for mining in the State, how many millions of dollars were poured into the State because of mining and how that affected the citizens of the State, whether they lived in rural Nevada or not. We wanted to talk about the social and economic effects of mining on the State of Nevada. There are many things which, once we started to dig into it, we found that mining companies were doing for the citizens of the State, which the citizens never even knew about. The mining companies just went about doing them anyway. Those were the basic areas that we wanted to cover in the PR and advertising program that we initiated.

Operational Plan for Public Relations

I'm going to show you some examples of the things that we did for the NMA, so you can get an idea of the PR messages that we sent out. I have to tell you that the two specific goals of this campaign were both very simple. First, we wanted to educate the citizens of the State on what mining does for Nevada; second, we wanted to persuade the public to pass a ballot question that aimed to raise mining's taxes in the State, but which would also protect the mining industry's position with regard to taxes already secured in the Nevada Constitution. Both of those goals were reached, through what I would consider one of the most aggressive PR and advertising projects ever launched on the public by any mining association or industry that I know of in the Western United States. First, I'm going to show you some TV spots we produced that talked about the areas which I just mentioned, addressing taxes, the economy, and social effects.

Reaching the General Public

The following are six examples of what was said in brief spot commercials on TV:

(1) "How does mining keep your taxes low? Well, in 1987, mining paid over $40 million in taxes to Nevada and its counties. Those dollars helped pay for schools, parks, and public services that people depend on. Without mining's contribution, those tax dollars might have to come from *you*. It's simple, and simply another way that mining works for all of us."

(2) "Mining has an effect on the environment. So do airports, ski resorts, and shopping malls. Mining's job is providing the natural resources we depend upon. In doing that job, the mining industry is doing more than it's ever done to protect and reclaim the land. Mining has an impact on the environment—no argument, no apology. Mining has a job to do, and it's working for *us*."

(3) "This is State Senate Joint Resolution 22. What does it do? It raises the taxes that Nevada's mining industry is paying by 150 percent—from $40 million in 1987 to over $76 million in 1989. *Mining supports SJR 22*. It offers a stable and predictable tax rate. What does it mean to you? Stay tuned!"

(4) "Mining gives jobs to 11,000 Nevadans. In some counties, mining employs one out of every two people. Those mining jobs create another 14,000 jobs and another 14,000 paychecks, which pay for goods and services that other Nevadans provide. It's simple, and simply another way of saying that when mining works, so do a lot of people who don't work in mining."

(5) "I've told you about SJR 22, which raises the taxes on Nevada's mining industry by 150 percent. Should you care about that? Only if you care about better schools, improving our highways, building more parks, and helping people. SJR 22 would help *and* provide one more public service. It's called helping to keep your taxes from going up."

(6) "Is mining a people business? It is to the families of 11,000 people who work in Nevada's mining industry. It is to a mother with a child in a day-care center built by a mining company or to a student on a mining scholarship. It is to anyone who uses a park or a library built with mining tax dollars. Maybe we don't all work in mining, but mining works for *us*."

Along with those TV ads, we ran newspaper ads that had the following headlines. A brief commentary that follows explains the thrust of the messages:

(1) "One of the chairs we help endow is a school chair." This ad talks about mining's contributions to education in parts of the State of Nevada.

(2) "Mining gave him a job." The man is an appliance salesman. This ad points out that every dollar that's generated in the mining industry generates more dollars outside the mining industry; it goes to pay the salaries of those people who are providing goods and services. Believe it or not, when you start multiplying those dollars, especially in Nevada, they head into astronomical numbers.

(3) "Portrait of a tax cutter." This ad shows a photograph of a man working a piece of heavy machinery at a mine.

(4) "She depends on mining or depends on you." This ad shows a woman in a senior-citizen center that's provided by the State, which tax dollars go to support.

(5) "Some people's idea of mining is pretty old fashioned." This ad shows a photograph of a man and wagon with a mule team. What we talked about here was the new technology available and that mining now is a very high-tech business. Because of the technology and mining's ability to use that technology, mining is able to do the things it does in the State of Nevada. Two of the mining companies literally built a school out in rural Nevada, and this ad said that not all the valuable cargo which we helped transport comes from a mine. Not only did they build the school, but they also bought the school buses that transported all the children in that county to that school.

(6) "Endowed chairs at both universities in Reno and Las Vegas." This ad talked about the mining industry's commitment to higher education.

(7) "Not all important discoveries are made in the ground." In Battle Mountain, one of the mining industries donated X-ray equipment to the hospital, which needed it badly. So this ad talked about other things that mining was doing for the citizens of the State of Nevada.

The main idea behind these TV and newspaper ad campaigns, which ran for about a year and a half, was, literally, to educate the general public in the State of

Nevada about the benefits of mining and what mining was really doing for the people, whether they were directly involved or not.

Reaching Opinion Leaders

We developed a series of eight direct-mail pieces that went to opinion leaders within the State. A list of 2,000 persons was developed, and we mailed these pieces on a monthly basis. They answered questions about mining that were not well understood by many people. We wanted to make sure that those people who have influence over the legislature were up to speed on the effects of mining on the State of Nevada. We took topics from everywhere, from the environment to all of the steps that the mining industry is taking to reclaim the land. We really tried to educate the people in the State about what mining is doing.

We Set Up a Speakers' Bureau

The NMA had committees on taxation, environment, reclamation, and many other pertinent subjects. We had a list of topics that were available to be discussed on the speakers' bureau list, and we sent people out from the mining industry into the community—to Rotary, Lions, and other service clubs. There were about four meetings per month throughout the State at which representatives from the mining industry would meet with these organization and talk about what mining was doing in the State. We prepared a video tape (8 minutes long) for that purpose. The speakers would go into a service organization, play the tape, give a prepared speech that we helped them with, and then open up the session for questions and answers.

Reaching the Legislators

We met with the legislators on a one-to-one basis, and we used all the information pieces that had been prepared. Lobbyists who were employed by the various mining companies did the talking. Each of them targeted a legislator in the State; each lobbyist had so many legislators that he was responsible to contact. The lobbyists went through the same educational process with the legislators that we tried on opinion leaders and the general public.

Reaching the Press

The last group that we wanted to target was the press. During this whole campaign, the press suddenly became very interested in mining; mining got to be a very hot topic. The Governor and some of the State legislators were after the mining industry. Any time you have a hot topic, obviously the press gets very interested. I work with the press every day, and I've found that either they can help you or they can hurt you, but most of them are open-minded people who are willing to report the facts if somebody is willing to educate them on the facts. What we did both north and south, in Nevada, is literally gave all the press people opportunities to visit working mines. As we took them through mines, various people from the mining industry joined them to talk about taxation and economic impact on the State and to give the press information on the environment, on reclamation, and on wildlife protection. Any time a reporter went through a mine, someone was there from the mining industry who could answer his questions. Then, we gave reporters all the backup information we felt they needed to put in their files, so, when mining issues came up, they would have a handy resource available. They met people from the mining industry whom they could call and talk to. They could call up someone in the mining industry and say, "OK, the Governor (or the Sierra Club) is saying this or that about reclamation. What's your side of the story?" The reporters didn't have to search for people with answers; instead, those people were readily available to them. It turned out to be quite valuable for the mining industry; it made some good friends with the press, and the press appreciated the effort that the mining industry went through.

Concluding Thoughts

I read this morning's business section of the Salt Lake *Tribune*. On the front page was an article talking about your workshop. It mentioned the fact that industrial minerals aren't the most glamorous of mineral materials—not like gold and silver. These resources include aggregate, sand, gravel, cement, and other industrially important minerals being mined. As far as I see it, there's no difference. When you dig a hole in the ground or when you affect certain people, you've got to be prepared to answer to the press. You've got to be able to answer to the general public, and the more mining that goes on in a particular region, the more prepared you have to be. As mining grows and its economic effect grows in a particular region, you'll find that all sorts of people get interested in mining, mainly government people.

You have to be prepared to present your story to a bunch of publics. If you're in a position where you think you need to do that, I'd suggest that you carefully analyze what your goals are, know what you want to say, and then decide what public you need to talk to and who specifically you need to address. Then, design specific programs to address those people. The other thing I'd suggest that you do is find out at the end whether or not you had any effect. We conducted a survey at the end of the Nevada campaign to find out from the general public if their awareness of mining and their perception of mining had

changed. After a year and a half, we determined that it had changed significantly. More people were aware of mining a year and a half after the program started than before it started. Not only were they better aware of it, but they also had a better idea of the effect of mining on the State of Nevada. As far as the campaign was concerned, it turned out to have a distinctly positive result for mining.

Participants' Discussion and Comments

- Why was the mining tax increased by so much in the State, and why did the industry support that tax? Usually, the mining (or other) industries are fighting such increases.

Reply: Some background is needed to explain why the Nevada mining industry supported the tax increase. In the original Nevada Constitution, which the miners helped write, a ceiling of 5.5 percent was placed on how much the mining industry could be taxed in Nevada. The current battle was very simple. If this ceiling were taken out of the constitution, it would put the mining industry at the whim of the legislature to be able to tax them at will. Alternatively, the industry supported raising mining taxes to the maximum of what legally (constitutionally) can be taxed. The industry felt that it was to their benefit to raise their own taxes to that limit and keep themselves protected by the provisions of the constitution, rather than risk taking themselves out of it and having to fight tax battles year after year. It did go to a vote of the public, and the vote was the largest win on any ballot question in the history of the State of Nevada—it was 3:1 in favor of the proposition. Nevada's mining industry, for the present, is still protected under the constitution.

- I understand that now there's another initiative to raise taxes again on the mining industry.

Reply: As long as the mining industry is healthy, there are going to be initiatives. The one thing that I've found in working in this arena is, if there's a need for money, government is going to go after those people who they think are healthy, to get that money. I'm sure there's going to be another battle in the legislature, and probably in the years to come in Nevada there'll be more initiatives on the ballot about amending the Constitution. I'm not saying that, in the long term, the mining-tax-issue war has been won in Nevada; I'm saying that that particular battle was won very handily by using the methods I've outlined.

- One difference between what you just related and the industrial-minerals operators is that most industrial-mineral operations are small activities; they aren't major mining ventures that can invest hundreds of millions of dollars to fight such initiatives. How do you see putting together a group that could be identified as industrial-mineral producers in the State, which could become a single, effective entity?

Reply: I don't know how you'd do that; I've not been good at putting groups together. But there is a need. There've been some newspaper articles in southern Nevada that were critical of the sand-and-gravel industry because of dust and traffic. As you may or may not know, southern Nevada has been getting more mining activity, so the people there are getting more interested. It's not just precious metals; it's the industrial minerals like sand and gravel that are becoming known by the public. Mining is developing there because of the growth in population that's happening down there. As that area grows and those problems expand, mining's going to be an issue that the people who are mining those particular minerals will have to address sooner or later. If it were me, and I were in that industry, I'd start talking to my competitors and say, "We're going to have a problem down the road; I think we'd better sit down and figure out how we can address it now," because, as I said, once you let people start doing it for you, start telling your story, then you have no control over it. The best way to get an acceptable message out is to control the story. You control what goes out into the marketplace as far as information is concerned, and you try to develop a program that gets your point of view across, rather than let someone else do it for you.

- The value of PR at the individual-company level can't be overlooked. As environmental planners, we find that the projects which are most successful are those by companies that have a good, positive PR program. When companies, no matter what size, move into a community and become a part of it, they work with local government, are on the boards of directors of community groups, play on local softball or soccer teams, and buy uniforms for the little league. It's true that the smaller the company, the less time or money is available to donate, but such indications of community support are appreciated. One reason the company proposal that I mentioned yesterday went so smoothly to approval was that the company had a long history of positive visibility in the community.

Reply: The 1990's are going to be the decade of the environment. Everything that you read is centered on the questions of protecting or preserving the environment. Any time your company has anything to do with the environment, you're going to be in the public eye, and there are things you can do to make that a positive image. I suggest that you start looking at that problem soon, because the public is going to start looking at you. Probably this is truer in the 1990's than ever in the past. If you can forge your own destiny, as far as public opinion is concerned, then you'll be ahead of the game. If you don't already have PR expertise on your staff or have access to it, as individual companies or a group, I'd suggest in the 1990's that you look at this option.

- It was suggested last night by Gov. Matheson that the Utah industrial-minerals people join the UMA.

There are differences between industrial minerals and metals, and, in Nevada, the NMA is dominated by gold producers. What would be your perception of the mining industry's acceptance of the sand-and-gravel industry joining its association, rather than forming a separate association? Traditionally, the aggregate producers haven't joined in mining-association activities—they may have their own producers associations.

Reply: I believe that industrial-minerals producers can join the NMA, and there already are some sand-and-gravel producers in that association. I know that there aren't just gold and silver producers in that association. There are obvious differences in the types of mining operations, but they need not preclude working together.

- In Utah, some of the sand-and-gravel operators are part of the UMA, but there's a group of industrial minerals that may not be represented. Another distinction is between small and large operators. The groups that you frequently don't see in mining associations are the mom-and-pop operators, the small operations; these are the groups that the public sees and that the environmental community voices concern about. It may not always be a question of metals versus nonmetals and industrial minerals, but of an organization that effectively serves the small as well as the large companies.

Reply: I think that's always a problem.

- What did the PR campaign that you showed us cost?

Reply: It cost $1.0 million and was paid for by contributions from mining companies in the State as a special assessment on NMA members. Remember, their goal was to put a limit on the taxes they were going to pay. That million dollars saved them lots of money. I don't know if you can calculate how much it'll save them in the long run, but in the short run, it saved them about $40 million. The investment was probably worth it!

- There's a tendency in Australia for the smaller industrial-mineral companies to choose to be under a policy of co-conglomeration. None of us likes to be considered overwhelmed by large corporations. Under this policy, the smaller companies are able to still have their independence. There are distributions of profits under their control. The corporate entities provide services, press releases, media presentations, and so forth, which largely overcomes the difficulty of competition within associations. There seems to be a problem, for example, in the UMA, where we have metal producers versus industrial-mineral producers. In Australia, we don't have that problem because some corporations have an integrated system whereby companies producing metals may, at the same time, have a magnesite refractory business as well. It also makes spending in service areas, taxation and lobbying, and press releases a cheaper alternative.

Reply: There's one thing I want to point out—and I don't want this to sound critical, but you have to understand something. The only people out there who distinguish between metals and industrial minerals are the people in the industry. For the general public, a mine is a mine; they don't care whether it's for gold, sand and gravel, copper, or whatever. As far as they're concerned, that mine has the same impact on the environment; they don't care what the product is because they're not that well informed. I think, then, the biggest thing you or any industry needs to overcome is thinking that everybody knows as much about your industry as you do. Let me tell you the reason why we did the TV spots and for the way we did them. We had a large audience with people on the PR committee in the NMA. They wanted to go out and show mines; they wanted us to go out and film these big holes in the ground. We said "*No*; that's not a good thing to do right now. Let's talk to people; let's tell them a little about mines and the impacts that they have on society, not about big holes in the ground. Such films probably would do more harm now than good." These mining people, though, were proud of those holes in the ground, of what they were accomplishing, that they had giant machines moving millions of tons of earth and rock. This was their environment and the greatest thing in the world; "Let's let everybody see it!" We said, "Bad idea!" We literally had to fight them off. But you in the industry see things a lot differently from how the public sees them, and that's one thing you need to understand. People don't distinguish such differences. You know your business, your industry; nobody else does.

- What's happened since the original campaign ended? Are the ads still on TV and in the newspapers?

Reply: No; the ad portion of the campaign is no longer running. The speaker bureau is still running. We still do direct mailings to opinion leaders. There's still an ongoing contact to develop favorable press for the NMA, but now it's sitting back and waiting for the second storm to hit. And it will hit.

- ***Comment by E.H. Bennett:*** I'd like to tell the users and producers here today to turn to the State geological surveys for help with PR; they're there and available for the long run. In Idaho, we put together a canned PR program every year that relates the accomplishments and contributions for the entire mining industry of the State; this program is presented to 40 or 50 service organizations each year. It's not a million-dollar campaign, but it seems to meet the needs for information in Idaho.

The point I'm trying to make is that we treat all parts of the mining industry the same. In my earlier presentation, I reported about $4 million of clay production in Idaho, but you should note that we glossed over that number and talked about the jobs related to mining. How many people are employed in that industrial

organization? The Idaho Quartzite Corp. gets more pictures in our presentation than J.R. Simplot, and Simplot is part of one of the largest privately owned corporations in the world. You're absolutely right—in a 20- to 30-minute talk, the distinction between a gold mine and a clay-pit operation is merged.

The thing to do is convince the population of the State how great this whole minerals industry is. There are a huge variety of mineral resources, and we stress the accomplishments of the industry. We're number one in the United States in garnet production. Number one in garnet production means 27,000 tons of finished product a year; that's 1 day's production for a heap-leach operation. What the public realizes is that we're number one; people like to be number one. We use the analogy of the bulk-hull displacement of an aircraft carrier compared to the 30,000 or 35,000 tons of ore per day that's running through the Thompson Creek mill. This means that about three aircraft carrier *Enterprises* are run through that mill every week. People begin to understand that it's a big deal to produce that much ore, and they begin to understand that a deposit can be more than just a bad or dirty hole in the ground. I think you're right—you can't promote an individual segment of the industry in a short period of time, especially if you're a service-oriented organization or even a mining association.

Reply: The other thing I was suggesting, if you're looking at doing a PR program, is that consistency is the key in grading the success of any program. You can't get into it and think that you're going to do it in a 6-month period; you need to make a long-term commitment. If mining is going to have an effect on the region for a long period of time and you're going to be in the public eye, you need to make a long-term commitment to a PR program. Whether it's large or small, you need to know what you want to do, and you need to identify what people think of you. The first thing you need to know is what people out in your areas think about mining. What things are going to come down the road that will affect mining? If you can start telling your story now, the things that are coming down the road are going to have less of an effect than if you waited until the last minute. That, in fact, is what most people do—they react rather than plan. PR is just like anything else: If you plan for it, and the planning is correct, you can save yourselves a lot of heartache and grief down the road.

- In Nevada, there was another group formed to combat the tax issue; it was called "Nevadans Against Mining Taxes." It was, I believe, separate from the NMA. Was that group effective? Did they help in the overall effort, or did they complicate matters? It was headed up by some of the equipment dealers and some of the mines. They solicited fund from many sources.

Reply: That campaign ran mainly in rural Nevada. Its objective was to muster support for what the group was trying to do with its own workers. It did the job.

FUTURE ACTIONS TO MEET INDUSTRIAL-MINERAL NEEDS

J.G. Price, *Moderator*

The organizing committee has chosen two panels to consider appropriate future actions to assist society in meeting its serious needs for industrial minerals. The first panel will consider the important problems faced in gaining access to and mining of these materials, and in trying to regulate industry activities in the best interests of the public. The second panel will look into the possibility of a public process to address these problems systematically. This panel will consider the formation of some form of a representative coalition organization in which the information essential for solving resource problems can be collected and placed in proper channels for action. After these presentations, discussion and comments will be invited from the workshop participants.

What Are the Problems to be Solved?

Having looked at opportunities for expanding industrial-mineral development in the Basin and Range region, we now return to consider the problems that must be resolved before examining future actions that may lead to the solutions of those problems. This first panel will look at the major problems from industry and land-planning perspectives. Douglas Clark is vice president of Monroc, a producer of crushed-rock aggregate in Salt Lake City, Utah; he speaks for the large-volume, low-value materials. John Harmon is president of Standard Industrial Minerals in Reno, Nev.; he gives us his perspective as a producer of a low-volume, high-value commodity. Finally, Michael Harper, assistant director of the Department of Comprehensive Planning for Washoe County, provides the point of view of a government land planner.

Industry Perspective for High-Volume, Low-Value Materials

By Douglas Clark

When I received an invitation to speak to you, I looked at the title, "high-volume, low-value" and thought that someone had been looking at our profit-and-

loss statement. It truly is an appropriate title for the sand-and-gravel industry. I sometimes get the feeling that we're rather insignificant. The reason I say that is that a recent USBM (1990) publication shows the total production of sand and gravel and crushed stone in 50 of the United States; there was a lot of tonnage, but the value was approaching only $7 billion. For you and me, that's a lot of money, but that isn't much money in the business world today. If you look at the major companies on the New York Stock Exchange, you'll find a considerable number that approach or exceed that amount in sales volume. Getting closer to home, if you combine the value of aggregates in the three adjoining states, Utah, Idaho, and Nevada, production approaches $120 million. Again, for us that's a lot of money, but in the business world that really isn't much. In spite of our business insignificance, however, our operational problems are not insignificant. I propose to discuss some of the most important problems or issues for the sand-and-gravel and crushed-stone operators in this area and elsewhere. These problems are, I suspect, common to most industrial-mineral commodities of this type.

Environmental Problems

The nature of the sand-and-gravel business will continue to make compliance with safety and environmental regulations an ongoing headache, but we must master these problems if we plan on being in business tomorrow. I think I can say with some assurance, speaking for the industry in Utah, that it's not our desire to be known as polluters; it's not our desire to destroy the environment we live in. Some of the toughest environmental regulations now affecting us are those standards relating to the PM–10 program. We've heard considerable comment about the PM–10 program already. The requirements for reduction of emissions that the operators are going to be meeting on our properties truly will be a challenge for us. The PM–10 program for reduction of diesel emissions from those units that are powered by diesel engines is 20 percent. I'm sure you're all aware that most of our transportation is done by large hauling units using diesel engines. There's no question that this requirement will seriously affect how we do business. Also, the proposed "long study" by this agency to encourage reduction of travel along the Wasatch Front will significantly affect the sand-and-gravel industry.

Those operations involved in blasting face real potential problems. Commercial and housing developments spring up ever closer to these operations. These same developments are the potential issuers of complaints against ground vibration from blasting activities. We used to think that we were an island unto ourselves; that's no longer the case. We used to think those housing developments were far away, but they're coming closer and closer to our activities, and we must respond positively, if possible, to their concern for the environment.

Zoning and Reclamation

Reclamation activities are becoming more intensified. Even small communities now demand a mining plan and a reclamation plan before a mining permit is issued. The activation of new pit or quarry sites depends on the reclamation track record of previous owners and operators at mine, pit, or quarry sites. I've been interested in this aspect, and I've watched developments across the country. Some recent activities by governmental agencies in the Denver, Colo., area introduced some highly interesting concepts in relation to a new zoning designation, MC. The only use by right under MC zoning is the conservation of commercial-quality aggregate deposits. In other words, the operator can conserve aggregate deposits while putting surrounding landowners on notice that someday the designated property may be mined. I think that concept has real merit. In this country, we've literally covered up vast deposits of high-quality aggregate with real-estate and commercial developments. Those deposits probably now will never be used. We're forcing the operators to move farther out—out sometimes to aggregate deposits that are not of the best quality—so I think this factor must be considered by those of us in this region.

At the same time, in neighboring Jefferson County, Colo., which has fairly extensive deposits of aggregates, the county will now issue mining permits with the county's requirement that the operations be subject to an annual review. The potential exists, every year, that the entire operation could be shut down for noncompliance or perceived noncompliance. Without question, this type of regulation is going to force the operator to stay on his toes. Can you imagine making an investment as an investor in a sand-and-gravel or crushed-stone operation, knowing that you could be out of business next year or the year after? That could be a tough and regressive regulation and could force more extensive transportation of materials from outside that county.

Materials Specifications

We live in world of quality. "Quality" is becoming the keyword for all people involved in construction; specifications are focused to achieve that goal. Let's look at the problem of gradation of fine aggregate. As you know, most of our sales are to concrete producers. As traditional sources of sand are depleted and new sources become available to us farther from the marketing area, we'll have to ask regulating agencies to allow broader limits on gradation in fine aggregate. As the good deposits become

depleted, we're forced to look for deposits that are not quite so nice in gradation and so are not conducive to making workable concrete. Also, we're finding many operators now who are forced to crush the large fragments into smaller ones to produce sufficient fine aggregate from the remaining, less desirable resources available to them. Thus, we'll have to recognize this limitation and possibly accept more "manufactured" sands in the Basin and Range region.

Aggregate requirements for pumping concrete present a special case. Concrete placement by pumping has become a predominant method. As you drive around the city, you see these large pumping outfits that pump concrete to almost unlimited heights. But there's one serious problem: Not all concrete aggregates are suited for efficient placement by pumps. New methods must be developed to improve the pumpability of these aggregates; this technology will become more necessary in the future. When the concrete-pump manufacturer designed and built that monster, he didn't come around to various producers in the country to determine whether his pump would or could handle the existing diverse types of aggregates. In most cases, we try to make our aggregate fit his machine, so that the concrete aggregate is pumpable and will serve the requirements of the purchaser of the materials.

Improved Materials-Testing Methods

We need to work on test methods for aggregates. I'm talking about the need not only for better but also for more reproducible tests. There continues to be an inconsistency of results between different laboratories testing a sample of the same aggregate. Believe it or not, many times, one split from a sample of aggregate is found to be acceptable to the testing agency of the purchasing agent, whereas another testing laboratory finds the same material unacceptable. We need to look at this problem to improve the specifications and the way materials are tested.

Economic-Use Factor

In conclusion, I want to talk about the economics of construction. Both a basic advantage of and a basic requirement for construction materials made with aggregate is that they be economical, that mixtures and gradations for use in paving or structural applications be designed to make the best use of the aggregates readily available. I'm saying that we need to tailor specifications to allow some flexibility in specified values, where equal performance can be demonstrated. I'm not here asking or pleading that we cheapen the product with the idea that we could use my aggregate. I'm saying, let's look at the end results that we're trying to achieve. If we can achieve those results with the available aggregate materials, then I think we're truly looking at the economics in construction. Believe me, we all suffer from the inefficiencies of having to haul aggregates too far too many times.

I hope that I've given you something of a synopsis of the most serious problems that the sand-and-gravel and crushed-stone businesses face. Although they seem simple and obvious, they're not going to be overcome simply or by the industry alone. We need help!

Industry Perspective for Low-Volume, High-Value Commodities

By J.R. Harmon

As I've listened to the recitation of existing and anticipated problems confronting the industrial-minerals industry, I've wondered how we in the mining industry can begin to make headway in solving them. Education of the public is one means of presenting our need for industrial minerals of all types and for the land and equipment to mine them. Under the aegis of State mining associations, professional mineral societies, and service clubs, industry has tried to make its case. The NDM's plan for educating teachers in the elementary and high schools through seminars, workshops, and teaching support to prepare them to educate their students seems to have great promise. The CMA is also trying to develop ambitious programs to educate the public. There's room for the government sector to participate in these efforts.

Many industrial-minerals operations, other than for sand and gravel and, possibly, fertilizer materials, are rather small and do not involve disturbing large areas of land, but these deposits are where they are and not where we might like them to be. It would be nice to have five areas from which we could select one that was the least environmentally sensitive in which to mine high-quality white barite, kaolinite, sericite, or garnet; these are generally the small-volume, high-value types of commodities. I might say, as an aside, that these materials sometimes seem to be low-volume, low-value commodities, for, in most cases, their value is not particularly high after the costs of mining, processing, and shipping them to the buyer are considered.

A major problem for my company is going to be responding to the new environmental laws on stricter particulate emissions. When grinding dry to –400 mesh, total dust recovery is very difficult. In all my 25 years' involvement with Standard Industrial Minerals, except for a major addition of grinding and classification equipment in 1967, more than 80 percent of our capital improvements have been for dust-mitigation equipment. For the past 3 years, more than 40 percent of our gross

profit has been spent on upgrading the dust collection and mitigation operations during processing of barite. We're not opposed to having clean air, and we know that we must comply with EPA regulations to stay in business, but for the small company, the costs to meet these regulations are high.

Another serious problem that we face, and which I would hope will clear itself up with time and our perseverance, is the issuance of conflicting signals by BLM and USFS regulators. Most of our experiences with these government agencies have been favorable, and their staffs seek to be helpful and cooperative while trying to stay within the legal directives' rules. Once in a while, however, this system simply fails, and our costs rise appreciably.

I can relate one incident that happened to our company. In May 1987, we filed a plan of operation with the USFS. A few minor changes were requested, and on July 16, an appendix was filed. For 7 months, the district ranger refused telephone calls made at least every 2 weeks to find out if we could go ahead and mine the deposit. I considered sending a letter to the ranger's superiors in Washington, D.C. Our attorney took over and found out that the district ranger had never opened our application; it was found on his desk. Our plan of operation, involving 3,000 ft of 12 ft-wide roadway, a 0.75-acre mine, and a 1-acre stockpile, was finally approved on April 6, 1988. This delay cost our small company over $300,000 in lost sales.

A second example involved the BLM. At an iron operation, we had stockpiled ore on an approved ¾-acre site, 1.1 mi from our minesite, in anticipation of its shipment to cement plants. Our trucker tried to avoid the stockpiling for several months because of the steep road and the loss of several truck differentials. He decided to start stockpiling again on the already-leveled site of a reject dump from a previous operation; this site would have been easier to reach and service. A local BLM official stopped us from doing this, saying that, because we hadn't used that area for 1 year, we couldn't use the site now. We were unsure of the basis for this rule, and so, not desiring confrontation, we applied for a permit to use this site. Eight differentials later, and for a bond of $4,000, we obtained the permit. Once again, the delay was not only frustrating but also costly.

Better education of the government-agency personnel or just our getting to know them better might have resolved these types of problems sooner. We could also add on these extra costs to our customers. In the case of barite, however, we find that the Chinese are exporting to the west-coast ports. Will they also raise their prices? There still remain problems of proper handling of hazardous materials like crystalline silica. We hope that the technology to do so arrives in time.

The Land Planner's Perspective—Local-Government Regulation of Mining Activities

By Michael Harper

I'm pleased to be invited to share my perspective as a planner with you on the issue of industrial-mineral mining. The primary problem, as I see it, is the variety of multijurisdictional regulations that the mining industry is required to comply with. We want to dispel the impression that the sole purpose of planners is to regulate the heart and soul out of the mining industry, and that regulations are made just to create employment for the planners. Therefore, I'll try to concentrate on the planning that the mining industry needs to do, not on the regulations, and on local government's responsibilities toward developing effective, less painful planning processes. The Washoe County planning process is sketched as an example.

Industry's Planning Responsibilities

It's imperative that industry take responsibility for understanding and working with the planning process. The first step in that direction is to become familiar with the master plans of the community or area: (1) Find out whether the property under consideration is shown to be appropriate for mining activity. If it's not shown to be appropriate, discover what the process for amending the master plan is. (2) Recognize that the master plan is what guides most decisionmaking where discretionary permits are required. (3) Also, recognize that if a change is going to be proposed to permit mining, the applicant should identify what will result when the material being mined is exhausted; mining is considered to be a transitory state by most local-government agencies. (4) Take time to develop plans for the ultimate, permanent use of the land if an amendment is to be proposed. (5) Notwithstanding the amendment process, insist that local government identify appropriate mining districts through the master-planning process. The applicant should determine, up front, where good minable material exists and plan for the exploitation of that resource.

Another critical step is knowing the process of applying for permits before committing significant dollars to formulating development plans. We can tell you what regulations will cause delays, because you have to win over the county commissioners, who get elected by the folks who are next door to your mine and, in fact, probably don't want you there. Don't assume that every community welcomes mining, and don't assume that local governments have regulations which may be less stringent than the current State or Federal regulations. The fact that there's no need to get a permit to operate the deposit doesn't stop local government from shutting you down.

Professional advice is needed. Above all, don't use the example that the last county in central Nevada, in which you operated, didn't have stringent regulations and was glad to see you come in. In fact, the current community or county probably doesn't care where you were located last time. In such counties as Washoe, mining isn't a big industry. Mining is commonly looked upon in Washoe County by certain segments of the population as a negative intrusion. I can't recall when a mining operation was turned down in that county, but that's probably because it's well regulated.

You should accept the fact that different levels of government will regulate you on the same matters or issues. To explain that the BLM is already regulating your deposit and to ask why the county is looking at it again is futile. I'll tell you that the regulations of local government differ from those of BLM or the USFS or the NDM. If possible, attempt to get these government agencies together before you submit applications, so that the same information can be used when and where it's relevant to the same issue.

When making applications, get to know who the interested players are, whether they be government regulators, special-interest groups, or individuals. By the way, most environmentalists live in the house next door; they're not folks who were born in a different part of the country and somehow became environmentalists. They're people who are really concerned. Planning staffs generally are good resources for identifying these players. Contact the players, preferably before the application is submitted. You may not get a positive reaction from them for your proposal, but you'll know what the issues are and be ready and able to address them in your application. I'm glad to hear that you realize this is the decade of the environmental movement; if you don't believe it, you may want to reconsider what business you're in. Find out who those folks are—your neighbors, the Sierra Club, the hunting group, and the Board of County Commissioners. You need to contact them. I know that some of you have gone through that public-contact process and come out with less than positive experiences. The bottom line, however, is that local-government permitting bodies expect you to make that effort.

Next, find out what an approval will likely result in with regard to specific conditions. Financial and reclamation conditions are almost always *pro forma*. I've heard a couple of comments about mitigation and bonding and that financial insurance for mitigation is the wave of the future. I can tell you that we've had that wave for the past 10 to 15 years. We've required that you bond for the improvements for mitigation and reclamation. We have a condition which says that every year we reexamine your reclamation bond and readjust that bond. I'm sorry to say that there's a huge distrust between the industry and the regulating bodies. It's not just a planner's opinion of tract-lease standards that we have too many mine holes in Washoe County; you only have to look at them as you drive into Sparks. That's not your fault, but that's the legacy that you have to live with.

Many government agencies are beginning to get involved in regulating some or all of the operations of the mining industry. Therefore, it's advisable to have a good summary of what the mining operation consists of. Most planners have very little knowledge of what happens after the material is removed from the ground. A good operations plan will permit a reduction in the number of conditions imposed on the mining operation.

Finally, identify the benefits of mining the material that you're seeking. I'm pleased to see that, apparently, there's a subject to be talked about later concerning the idea of how to create a consortium, how you start getting down to educating the regulators and environmentalists.

Educate the planning staff and the public on exactly what's being mined and what it's used for. Many planners don't realize what types of materials you're producing. When the community is arguing against XYZ, Inc.'s aggregate pit, explain how this will argue against a close-in, cheap source of material to surface their driveways. Identify the consumers and where they're located, because many of us don't realize who they are; the consumers generally are the purchasers of products that are used every day. Identify the need for the material and why the particular location of the mining activity has a good source of that material. Such factors as cost, convenience, amount of reserve therein, and so on should be included.

Local Government's Planning Responsibilities

Local government should be responsible for developing procedures that meet identified legislative intent, not just for gathering lots of information that suits special-interest groups but that may be unrelated to consideration for a use permit. You should expect and demand that the administrative process meet legislative needs. These regulative processes should be clear and identify specified needs and results from implementation of the regulations. Industry should have certain expectations of the process. I cringe when I hear how long it takes EIS's to be done. All they do is evaluate the impacts and alternatives; an arbitrary decision still has to be made.

All levels of local government should be involved in a coordinated process of regulating the mining industry. Such issues as timing, using the same information for different levels of applications, identifying lead agencies, and coordinating the conditions of approval should be anticipated and agreed on through interlocal agreements. In our county, for example, we try to find out exactly where the process is. When dealing with BLM and the EPA, we'll suggest that you use the material which was created for

the environmental application to us; it doesn't make sense to create another document. We need to know where one part of the process stops and the other begins, but the same information should be used by both. In Washoe County, we have MOU's with BLM and the USFS; our program gets approved first. If an EIS is required, we'll tell you not to make application to us until you've completed the EIS; then, we can coordinate the process with BLM by telephone.

The Washoe County Planning Process

Local government should take it upon itself to identify areas of appropriate resource extraction through the planning process. Washoe County is embarking on this procedure at the direction of its Board of County Commissioners, which has recognized that the location of mining activity hasn't always followed a rational process or been justified from a logical point of view. To this end, the commissioners have charged the planning department with the responsibility of creating a process for eventually identifying appropriate mining-activity locations and, furthermore, developing appropriate guidelines and regulations to ensure the orderly development of these mining resources. Our Board of County Commissioners got concerned last year about what it saw as a plethora of open-pit sites in an area of the county that it considered to be scenic or believed should be so considered; it was ready to propose a reform statute. The industry representatives who were monitoring this discussion indicated that this procedure wasn't a good step. Instead, a two-phase program was developed.

(1) The first step was to survey current mining operators regarding the type, location, and amount of material being excavated, the available reserves, and the use of the material. To date, the county has received outstanding cooperation from the mining operators. (2) The second step was to send me to this workshop to become more familiar with the topic of industrial minerals and to meet experts in the field. (3) The third step will be to convene a user committee of producers and users to formulate a work program for a contractor, who will analyze the types and locations of industrial minerals in the county. We hope that this work program will be a starting point for solicitation of funds from the users and producers to fund the contractor. (4) A fourth step will be to select a contractor to perform the above work and assist the committee in developing standards for the types of materials to be extracted for the identified uses. We'll need a more in-depth survey of materials and of potential sites. The committee will be responsible for reviews and for publishing maps. (5) The fifth step will be to develop a testing process and to identify where testing facilities are or should be located, so as to determine whether the material being mined meets the standards developed in step 4. (6) Finally, a report will be forwarded to the Board of County Commissioners with recommendations for guidelines and new regulations. From this program, we hope to get moving in the next year and a half, with the idea that we can begin to settle these types of problems quickly and amicably.

This is a good example of the type of initiative that local government can take. It's a process that the mining industry can take part in for its own self-interest, as well as for ensuring good societal decisions. We hope that this plan may serve as an example for other county governments to copy.

Concluding Thoughts

I've come away from these sessions with a greater appreciation of where you are, and I hope that we can, at least in Washoe County, expect that the planners I represent will work with you more effectively. I like to think that planning is problem solving, not problem creating. We need to work together in the best interest of our constituents, the people here and those yet to come.

Participants' Discussion and Comments

- I gather from your presentation that you aren't particularly fond of the sand-and-gravel people insofar as planning is concerned!

Reply: I hope I didn't give the impression that I have an intrinsic dislike for your industry, but the sand-and-gravel people have tended to be ignorant because they don't want to take the initiative to learn the rules. I think that "planning" tends to be mentioned with a snarl by some industry folks who'd lead you to believe that planners have similar attitudes toward miners. Yes, I believe that some of the sand-and-gravel industry have self-imposed blinders.

- Does your department have some minimum guidelines for planning? Are people aware of them?

Reply: Yes, we do have a standard set of conditions that we hand out at the time an application is made. That doesn't mean that all conditions are imposed, but they do indicate what conditions are or were specified at the time of application: materials to be provided to the U.S. Department of Mining Operations, who to go to, what the general period of time is, and so on. We supply a different application for mining operations from the one for general-use permits.

- Do you have designated areas for sand and gravel?

Reply: We don't at present, and that's why we want to get into the new process studies to designate those areas. The Board of County Commissioners feels, and industry representatives agree, that we probably have too many substandard sand-and-gravel operations in Washoe County.

One desire of this study is to create a minimum standard of sand-and-gravel materials for the purpose of public use and then to see whether that translates into a more equitably regulated industry.

- In future zoning, the one problem I see in evaluating aggregate sources is that, once you zone something, you exclude alternative uses, and as technology changes and the public's needs change, some of those areas not zoned for aggregate could turn out to be some of the better aggregate sources. What would be the mechanism to reopen the zoning classification?

Reply: Our zoning ordinance is 42 years old, which means that it's about 39 years too old. We're trying to revamp our ordinances, called the Development Code, so that, in fact, the situation you have just suggested, in which a new source area that's identified in a previously zoned area, can be produced. We're looking at a land-use-designation overlay that would extend for the life of that material for which it would be reserved. It wouldn't be the underlying use, but it would create an overlay that had temporary preference for mining over the underlying use. San Bernardino County, Calif., does that; they have a map process and a designation process. We have a GIS that will permit us to do that kind of mapping.

- How does your agency deal with conflicts over BLM land that might be within your general jurisdiction, where you technically don't have zoning priorities or where you can't zone? How are these conflicts resolved?

Reply: First of all, we zone all BLM lands. This isn't done under an MOU with BLM; we just go ahead and do it as part of our enabling legislation. Let me rephrase the question: If we get into situations in which conflict arises, we have an MOU with BLM to address jurisdictional issues. If the BLM disagrees with the classification the county has shown for a particular use on a property, the first thing we do is to move toward negotiation. We remind BLM of the long-term MOU, remind them that there are certain acts of Congress which say that the BLM should, to the extent possible, cooperate with local- and State-government regulations. I don't think it's unclear to anyone that we've been zoning BLM and USFS lands since the 1940's.

- We've had an interesting case in the Las Vegas Valley in which someone had staked millsite claims on BLM land in an R–2 residential neighborhood. The county zoning people were furious, but when they took it to court, it was thrown out, and the millsite claims were sustained because the county had no jurisdiction.

Reply: I think that's just an example of the county having a poor working relation with BLM. I have one person on my staff part of whose job it is to keep in constant contact with the Federal-agency people.

- How do you decide about the need for permitting a new deposit?

Reply: Yesterday, I may have told you that one problem we seem to be facing is identification of the need for a particular product. For example, I'd say that in a 1-mi radius in the Truckee River canyon east of Sparks there are probably five or six pits, and we may get an application for another one. The first question that comes up is, what's the need for this new pit? What's the basic reason that it should be permitted? We probably don't have sufficient information about the projected use of this material. The proposed study exercise should provide such information, so that when someone comes in and says, "I want to open this pit," and the county realizes that it looks like the material is for local consumption but, in fact, it's needed for a project outside of the area, the county can make an informed, balanced decision regarding the pit's approval. Environmentalists sometimes forget that they're making the taxpayer pay for something but, in effect, only transferring the money from one pocket to another.

- In the planning and zoning process, are you taking into account or are you aware of the resources in your area? Are you cooperating with the State geological survey? Do you know when you zone something for housing development whether you have a deposit in that area or not?

Reply: The answer to your first question is, no; we don't know. That's one reason why the proposed study is necessary. We're working with the NBMG, who convinced me to spend the taxpayers' money for the study.

- You were saying earlier that you're facing the problem of identifying the need for a product as you were going through the aggregate study. Do you go through the same process when you're zoning for casinos, warehouses, and residences?

Reply: Yes; we do. For example, we have a standard in our ordinance that indicates how much commercial floor area per population is appropriate, assuming that the need for commercial uses is met by that formula and that unacceptable impacts are not created. Do we do that for housing? To the extent that we can, yes. In a mix of housing we try to identify whether, in fact, the cost of housing meets a range of housing needs. We're starting to move into the area of special-cost housing that judicious planners can validate as meeting the community's needs. To the extent that we can, we try to identify that, at least, in our staff reports. We've seen the planning process move toward that in areas of limited land resources.

- In the Sacramento study that your office mentioned, I think it said that per four-person family, you need 684 tons of aggregate per year. I don't know how your study came out, but if you took the 684 tons times the 230,000 persons in our community, do we have that amount of the resource available? That might be your basis for determining the county's needs.

Reply: One thing I wanted to make clear to everyone is that we tend to staff committees without intending to lead the committee. We want to create a balance between industry, which we assume is desirous of having as positive a view as possible, and the users, who want as much material as they need at as reasonable a price as possible. Although we haven't structured preliminary plans, those are the best estimates of the need for planning to meet aggregate requirements that we have at the moment.

- I was interested in your comment about how, if you're going to try to develop a mineral deposit in one county, you shouldn't just assume that zoning regulations and permitting requirements in that county are the same as in another. Is there a trend among the counties in Nevada to make the regulations and zoning requirement more uniform, or is there is a trend in the opposite direction? Do the counties want to apply their own set of criteria, more and more?

Reply: There are two trends. The Nevada Division of Lands, which is a land-management organization, has created a model mining-reporting program. My experience is that most rural counties of Nevada are uncomfortable about imposing too much regulation, because mining tends to be the major, if not the only, industry that's keeping their tax revenues flowing. Those counties seem to be taking their lead from the State's suggestions and imposing them on mine operators. The Nevada Division of Environmental Protection has mandated reclamation regulations; in fact, Washoe County is seeking an exception to those regulations because we believe that the State regulations will be weaker. The county doesn't want to be in a position of selecting a weaker set of regulations.

- Let me preface my comment with the statement that well-established channels of communication are critical. In any operation, the local management should have comfortable, first-name-speaking relationships with everyone—BLM, the USFS, and city and county permitting personnel. But my question refers to the statement about someone coming in after he's done all the planning and before he talks to you. Right or wrong, I think there's often a perception that most city and local government offices have a live microphone hooked up to the local newspaper. What kind of assurance is there of confidentiality for competitive and other reasons? The industry may not want that kind of publicity. How do you deal with that problem?

Reply: First, that scenario isn't so. We keep preliminary information private. I always tell an applicant not to put anything in the application that he doesn't want disclosed publicly, but information provided on an informal preapplication basis is kept confidential.

- One of the key things that an operator might not want to disclose is the location of the deposit.

Reply: We have a process early on, when applicants come in, that's essentially a staff-only conference. The information is kept confidential at that point. We do tell people that their application is a public document and we can't hide information. We do suggest that they be careful about answering the questions. But our regulations don't require that a mining company disclose things like their financial ability. Usually, we don't even require them to disclose the type of material that's going out, although we may have to get to that eventually as the area study progresses.

- We'd like some assurance that the informal prediscussion can be kept confidential.

Reply: We do take notes, but we don't make them publicly available.

- My comment is on the taxation that mining in Nevada raises. I think there's been some misunderstanding of that issue. In Nevada, mining values are taxed the same as for everyone else on all the equipment, buildings, and so on. In addition, the State Constitution states that mining will be charged the net full proceeds of mining tax, which would be based on a property-tax rate set by the constitution, with a limit of $5 per $100 value, an amount that was the limit anyone could be charged as a property tax. The mining tax is a tax on the total sale of whatever is mined during a specific period of time less the actual expenses incurred during that time. Allowable expenses are listed by the constitution; for example, expenses in an engineering job outside of the State, or any work done, such as office charges from Texas, aren't allowed.

About 15 years ago, Nevada changed its tax structure from relying heavily on property taxes to a reduction in property taxes and a large increase in the sales tax. When it did that, it gave a legal windfall to the mining industry, and places that had been paying $4.20 to $4.50 property tax per $100 suddenly dropped to $1.90 or less. About that time, I was the president of the NMA. We attempted to make this look better; somebody was going to come down on us. We were way ahead of it, and we thought we owed something, so we agreed among our clientele that we'd suggest to the legislature that mining be taxed at the constitutional limit (5 percent) of net proceeds. That was placed on the ballot because it required a change to the constitution. At the same time, there were many bond issues, and the voters refused all the proposed tax increases. That vote killed it. Then, along came the idea of a gold tax, because of the excess profits on gold. The suggestion in the legislature was that a tax of $10 or $15 per troy oz be placed on mining. They didn't say anything about silver, barite, or other minerals—it was strictly on gold. The NMA then went back to the idea of increasing the tax on mining in the constitution. Not a whole lot was being given up. This tax structure passed and is now operative.

Possible Resource-Constituency Activities to Help Solve Industrial-Mineral Problems

This second panel will explore a possible course of joint action by the public and private sectors of the industrial-mineral constituency to overcome their problems and thus ensure that industrial-mineral resources can be made available economically and in a timely fashion. Having reviewed some of the industry and land-planning problems to be resolved for the continued timely production of industrial minerals, the organizers of the workshop felt impelled to do more than merely listen and then leave without considering a way to respond to what has been said here. One such alternative plan is to organize the industrial-mineral constituency to develop the political leverage and effective public support for finding equitable solutions to problems of resource availability, access to lands, and environmental protection. M.P. Foose offers a generalized "strawman" proposal (see app. 3) as a point of departure for discussion by workshop participants. His suggestion for developing local or regional coalitions of the resource constituency is only that—a suggestion. To amplify the composition and operation of the concept, G.E. Conrad, executive director of the IMCC in Herndon, Va., describes a well-established, highly structured, regional coalition of 17 Central and Eastern States that has high political visibility and has had notable success in projecting the mining-industry viewpoint. Mr. Conrad also offers advice for the formation of coalitions, whether as formal organizations like the IMCC or as informal discussion groups. J.G. Price, director of the NBMG and the Nevada State Geologist, E.H. Bennett, director of the IGS and the Idaho State Geologist, and M.L. Allison, director of the UGS and the Utah State Geologist, comment individually from their State's perspective on the coalition concept and offer further suggestions for consideration by the workshop participants in the discussion and comments that follow.

Proposal for Organizing Industrial-Mineral Coalitions in the Western States

By M.P. Foose

One overriding objective of the USGS' and USBM's mineral programs is to ensure the long-term availability of mineral resources for the Nation. In addressing these availability issues, especially for the industrial minerals, we believe that there needs to be increasing collaborative effort at the Federal, State, and local levels. To foster this collaboration, at least for the industrial minerals, the USGS and State geological surveys have conducted two earlier workshops, at Tempe, Ariz., and Marina Del Rey, Calif. (Tooker, 1989; Tooker and Beeby, 1990).

A logical and pertinent question now at this workshop in is, "Where do we go from here?" I think this workshop has successfully raised a great many important issues of regional scope. Conceivably, the USGS and USBM could continue to sponsor more such workshops, to cover the entire country in reasonable order and time. However, there certainly would be much repetition of the issues and information already expressed here and earlier in Arizona and California, without any action being taken on the recommendations that have already been made.

Nonetheless, these workshops could also be the start of something new, and some of you may have ideas as to what that could be. I'm going to take a few minutes to outline just one proposal.

Coalition Formation

State or regionally focused coalitions or forums could be developed to address critical industrial-minerals issues of multistate regions. These coalitions could consist of representatives of the private-sector industry and users, academia, State- and local-government groups, and some Federal Government representatives. When confronted with such a proposal, I think it's reasonable to ask three questions: (1) "What is such a coalition going to do and try to accomplish?", (2) "Why should such an organization be generated?", and (3) "Who's going to pay for it?"

I don't have a final answer to the first question, and I emphasize that, ultimately, an answer must come from the State-based groups who are most concerned about industrial-mineral resources, and by and for whom most of the work should be done. I can speculate, however, about some of the roles that individual groups could play. Local groups can identify the zoning and growth issues that they are confronted with, much as Gov. Matheson has suggested. The coalition could operate under the aegis of State mining associations or the State geological surveys, which are knowledgeable agencies that have the proven leadership and can help the local people identify and address priority issues for their area. Informational interactions could be possible with State legislative and regulatory agencies and with local planning and zoning groups that are involved in sizing and shaping growth, transportation needs, and environmental issues, while looking at future demands for local industrial minerals. The participation of State geological surveys would serve to identify industrial-mineral resources, characterize deposit types, and indicate quantities of materials. Academic institutions might have a role in this process in various ways, including project staffing, urban-planning research (including development of a working GIS), research on uses and mining technology, or establishment of laboratories to facilitate testing of industrial minerals. The Federal Government would certainly play a role in this process, as has

been discussed here already. Some of the types of research that the Federal establishment might be engaged in were discussed in previous workshop proceedings. It's my view that its most important contribution lies in an advisory capacity and in its capability to provide broad-based commodity research and an information structure that supports region-specific activities at the State level. This sketch does not cover all possible roles, and not all of these proposals may have high priority, but I hope it provides a general idea of the coordinated activities that a coalition might be able to accomplish.

The answer to the second question may be more obvious. These workshops have shown, in my opinion, that there's a real need to improve the effectiveness with which industrial-mineral issues are understood and being addressed. Time and time again, we see that urban growth goes forward with very little thought as to where the materials needed to sustain that growth will come from. The individual States can address these issues to a certain degree; however, sharing expertise and experience in solving problems between State coalitions could be a more positive step. Some resource issues are becoming more than single-State issues; an interstate coalition may be more effective than one State trying to go it alone.

The answer to the third question will depend on the scope and scale of a coalition. If started modestly, possibly as a State-wide periodic discussion group among the concerned industrial-mineral constituency, the cost might be minimal and divided across the board by the participants' employers as their investment in the future of industrial minerals. If, however, a more ambitious coalition is developed, such as that which G.E. Conrad will discuss, funding becomes a serious and critical matter that must compete with other of the organization's priority budget items. Currently, I can assure you that neither the USGS nor the USBM has available funds to support a more ambitious plan. Clearly, then, new funds would be needed, and the Federal Government may be the best source of them. In that case, we may have another argument in favor of an interstate coalition, considering that a group of States acting in concert may be more effective in obtaining funds than one State acting alone.

Concluding Thoughts

Let me conclude with several observations. First, the formation of a coalition must be State led and focused on local interests. It might be best to begin by considering a modest State coalition, possibly within the sponsorship of a mining association, that would meet at least annually to discuss the state of the industry, its problems, and strategies to mitigate problems. As confidence, interest, and support for the coalition concept grows, it might make sense to become more structured and affiliated with an interstate organization like the IMCC or the Association of Western State Governors, which have access to high levels of Federal and State government. G.E. Conrad will develop this proposal and the benefits that may devolve from such an association. As a basis for discussion of the coalition concept, the organizers of the workshop drafted a generalized "strawman" proposal (see app. 3) that was provided to J.G. Price, the Nevada State Geologist, who circulated it among his Western State geologist colleagues for comment; he will report on their reactions. In conclusion, some pertinent comments from the participants in this workshop are included.

Conceivably, a State or group of States may indicate that a coalition is unnecessary. Competition within the industry or higher priorities in the State geological surveys may preclude joining forces. Interstate interests may be too diverse, their needs too dissimilar, or their organizational structures too incompatible to add this new level of activity. Conversely, other States or regional groups of States may embrace the concept as a useful way to address joint industrial-minerals problems in their regions. In that case, development of a coalition may be an effective way to gain a local support constituency and continue the work begun by these workshops. Our sole intent here is to introduce an action alternative to recognize and deal with the current political/business environment. What happens to the concept ultimately depends on the local industrial-mineral constituency.

The Interstate Mining Compact Commission, An Established Regional Organization

By G.E. Conrad

State and Federal officials and regulators are required to mount a monumental effort to focus properly on the issues surrounding the development of our abundant mineral wealth, so as to assure production in an environmentally sound manner. We are pressed from all sides to perform our regulatory or research roles regarding mineral production so as to satisfy environmental, multiple-use, socioeconomic, and industrial concerns. Our charge from the citizenry of the country or respective States, as contained in duly enacted laws, is essentially to establish and maintain programs of land and other resource development, restoration, and regulation that assure adequate supplies of needed minerals and yet cope with the impacts of their production.

One mechanism that government has for accomplishing these objectives, especially in an area such as mineral development, is through coalitions—local, regional, and national. A practical reason for the use of coalitions is that, in many cases, mineral development and some of its environmental impacts do not respect

State or other artificial boundaries. Minerals must be mined where we find them, and the environmental consequences of mineral development may spread beyond even the best designed and projected permit area. When we include the economic impacts that may arise from interstate competition, the need for interstate cooperation becomes obvious. In fact, such concerns have led to Federal preemption on several occasions, as evidenced by CWA, CAA, SMCRCA, and recent efforts to revise the 1872 Mining Law. The value of coalitions is that they provide an avenue for cooperation among States, between governments (local, State, or Federal), and even among several affected parties, such as government, industry, and conservationists. Possibly the most formal type of coalition that exists today is the interstate compact, of which the IMCC is an example.

What Is a Compact?

A compact is both a statute and a contract; it's almost always a statute in each of the jurisdictions which is party to it. Even in those cases where this definition may not be strictly true, the instrument has the force of statutory law. U.S. Supreme Court decisions have established that interstate compacts are not only statutes but also contracts.

For the first 150 years of our Nation's history, compacts were used exclusively as a method of resolving State-boundary disputes. Most recently, however, they've served as a method of facilitating interstate cooperation on various matters of interest to State governments. Since World War II, several trends have surfaced. The number of regional and national compacts in comparison with bilateral compacts has increased considerably. Another trend has been the increasing number of service compacts in the areas in which the States have long played a dominant role, such as education, transportation, and taxation.

Generally, a compact is initiated by individual States and has only States as parties. In comparison, certain regional planning and multistate water-resource-planning agencies have been created by Federal statute; all of these agencies include the Federal Government as a party.

A compact may be used when a binding effect is desirable, such as when a specific project is to be accomplished. For informal planning or communication activity, some States have established voluntary conferences, councils, and coalitions without entering into a compact. Examples of these bodies are the National and Western Governors' Associations. Some of the details in forming a compact are described in appendix 4.

I'd like to discuss compacts by providing you with some background on their formation, use, structure, and success, using the IMCC as an example. I'll conclude by identifying what I see as some of the benefits of coalitions, leaving you with a plug for cooperative federalism.

The Interstate Mining Compact

Origin

The Interstate Mining Compact fits into the mold of a traditional compact as just described. This compact had its beginnings in April 1964, when the Council of State Governments held a meeting in Roanoke, Va., on surface mining that was attended by State and Federal legislative and administrative officials, mining-industry representatives, and conservationists. That fall, in the aftermath of this meeting, the Southern Governors' Conference called on the Council of State Governments to assist the States in developing one or more compacts to deal with surface-mining problems. These initiatives led to the subsequent adoption in many States of strengthened laws and programs for regulating surface mining; to supplement these intrastate activities, the Interstate Mining Compact was drafted and became available for consideration by the States in their legislative sessions of 1966.

The Interstate Mining Compact was thus conceived, and Kentucky became its first member, followed by Pennsylvania and North Carolina. With the entry of Oklahoma in 1971, the compact was declared to be in existence and operational. In February 1972, permanent headquarters were established in Lexington, Ky., and an executive director was retained. Since the establishment of a permanent headquarters, 13 additional States—West Virginia, South Carolina, Maryland, Tennessee, Indiana, Illinois, Texas, Alabama, Virginia, Ohio, Louisiana, Arkansas, and New Mexico—have become members.

Purpose

The Interstate Mining Compact is designed to be advisory and not regulatory, and its defined purposes are as follows.

- To advance the protection and restoration of the land, water, and other resources affected by mining.
- To assist in the reduction or elimination or counteraction of pollution or deterioration of land, water, and air attributable to mining.
- To encourage (with due recognition of relevant regional, physical, and other differences) programs in each of the party States that will achieve comparable results in protecting, conserving, and improving the usefulness of natural resources, to the end that the most desirable conduct of mining and related operations may be universally facilitated.
- To assist the party States in their efforts to facilitate the use of land and other resources affected by mining, so that such use may be consistent with sound land-use, practices, public health, and public safety, and, to this end, to study and recommend, wherever desirable,

techniques for the improvement, restoration, or protection of such land and other resources.

- To assist in achieving and maintaining an efficient and productive mining industry and in increasing economic and other benefits attributable to mining.

Participation in the compact is gained through the enactment of legislation by the States authorizing their entry into the compact; the States are represented by their respective governors, who serve as commissioners. The compact also provides for the establishment of a mining advisory body within each State, consisting of representatives from conservation groups, the mining industry, and other public and private interests.

Operational Philosophy

Among the Interstate Mining Compact's powers are the study of mining operations, processes, and techniques; the study of conservation, adaptation, improvement, and restoration of land and related resources affected by mining; the gathering and dissemination of information; the making of recommendations; and cooperation with the Federal Government and any public or private entities with an interest in any subject within the purview of the compact.

The compact acts through several committees that have responsibility for particular subject matter or policy areas, including environmental affairs, mineral resources, legal issues, abandoned mine lands, resolutions, and finance. The Governors are represented on these committees by duly appointed delegates from their respective States.

The IMCC was founded on the premise that the mining industry is one of the most basic and important in the Nation. Our manufacturing activities, transportation systems, and the comfort of our homes depend on the products of mining. At the same time, it is essential that an appropriate balance be struck between the need for minerals and protection of the environment. We recognize that the individual States have the power to establish and maintain programs of land and other resource development, restoration, and regulation appropriate to cope with the surface effects of mining. The IMCC would not shift responsibility for such programs, but our 17 member States believe a united position in dealing with the Federal Government and others affords us a decided advantage. Our commission feels strongly that a collective voice is important in our efforts to retain some semblance of States' rights.

Over the years, the IMCC has become an organization of national scope in Washington, D.C., serving as the eyes, ears, and spokesperson for the mining States. It strives to represent the interests of the mining States effectively in their dealings with Capitol Hill and the executive agencies, in an effort to articulate the concerns and recommendations of the States in their role as primary regulators of mining activities within their borders.

Benefits

I believe that the IMCC performs several meaningful and critical benefits and services which greatly assist the States in the development of their mineral resources and in their implementation and administration of regulatory responsibilities under such statutes as the 1977 SMCRA, FWPCA, RCRA, and CAA. Among the issues actively engaged in by the compact are Federal oversight of the States by OSM, State program grants under titles IV and V of SMCRA, the State program-amendment process and other significant OSM rulemakings, administration of the Applicant Violator System, and a various programs under EPA auspices. New issues on the horizon include ground-water protection, mine-waste programs, mineral-research projects, and national strategic- and critical-material policy.

The IMCC administers the COALEX search service, a computerized legal-research and informational network available only to the States through a grant with OSM. The entire subject of information exchange is an important part of what the compact is about. We recently completed a report on the regulation of noncoal solid minerals throughout the country that we've distributed to all 50 States.

The compact also is active in recognizing the accomplishments of the industries that we regulate. Each year, the compact presents a national reclamation award in both the coal and noncoal categories. We believe that such a program highlights the positive work which the mining industry and the States together are doing in the way of environmental protection.

The real value of multistate organizations like the IMCC is their ability to *coordinate actions* and to *speak with one voice* on issues of importance to the States. Without such opportunities and forums, the States are left to fend for themselves or, worse yet, are criticized as being unable to handle issues or effectively resolve problems that are uniquely within their own province. This view, then, serves as a justification for Federal preemption, and the States find their authority being superseded by national legislation.

The Functions of Coalitions

Depending on the issue or subject area, a lesser or greater degree of organizational formality will be called for, including the breadth of geographic reach. Mineral development, I believe, calls for a combination of both regional and national coalitions, each serving different needs. It's important for the regional coalitions to have access to and to communicate with one another, so as to

share common issues and information and to learn from one another's experiences in similar areas or undertakings.

National Coalitions

For example, the IMCC, which has been predominantly concerned with Eastern and Midwestern mineral issues, also works closely with the Western Interstate Energy Board, which focuses on Western mineral and energy issues. We've found that, although our perspectives may differ, there is substantial overlap in terms of our experiences on a whole panoply of issues, particularly with respect to surface coal mining and reclamation. Close coordination and even joint working sessions of our organizations and member States have resulted in a more effective and concerted voice on issues of mutual concern in our dealings with Washington. The IMCC also works closely with other State organizations, including the Mine Waste Task Force of the Western Governors' Association, the Association of Abandoned Mine Land States, the National Association of State Land Reclamationists, and the Conference of Government Mining Attorneys. These efforts have all resulted in better coordination on issues of mutual interest and in a fuller understanding of the issues among the affected States.

I should note here that the IMCC also maintains coordination with other nongovernmental coalitions representing affected parties who have an interest in many of the same issues, including the AMC, the National Coal Association, the National Wildlife Federation, the Environmental Law Institute, and the National Stone Association. A better understanding of the positions of the regulated industry and the environmental community enhances our ability as regulators to be more responsive, more responsible, and more effective.

Regional Coalitions

There's clearly a need, in my view, for regional coalitions focused on mineral development. Continual emphasis and study is needed on the state of the mining industry, its potential for development, and the attendant environmental, socioeconomic, and multiple-use impacts. These efforts call for research, planning, information gathering and sharing, and coordination. To the extent that a regional coalition can accomplish any of these objectives, mineral development in the region will be well served.

Several aspects of an effective coalition must be considered, however—not unlike those taken into consideration in the formation of an interstate compact, including resources, infrastructure, organizational aspects, communication methods, and necessary approvals from local, State, or Federal governmental authorities. The more informal such a coalition can be kept, the better it will function on a regional level. Also, to the extent that its coalition can operate under the auspices of or in connection with existing organizations with established infrastructures that can lend support to the coalition, the chances of success are enhanced. Such a relationship is likely to bolster the legitimacy of the coalition in the eyes of those who must approve it, and provides the needed support and consistency of operation. Even under such a scenario, the coalition can operate as a credible, recognizable, and freestanding organization with its own identity, goals, and objectives.

Advice for Forming Coalitions

On the basis of our 19 years of experience as a multistate organization, I want to mention several other aspects of coalition building. We can call them *Conrad's Critical Criteria for Coalition Success.*

1. Define the coalition's purposes and objectives. Identify the particular issues you intend to pursue, and stick to them. In this regard, remember that there are other State and industry coalitions already covering certain issue areas, and there's little sense in duplicating their efforts. Instead, coordinate with them to the extent possible.
2. Be realistic about the goals of the coalition and its anticipated accomplishments.
3. Prepare an organizational plan as to how the coalition will be run, who the players will be, and what the respective responsibilities will be. Consider the relationships between the coalition and other groups.
4. Obtain all necessary approvals for moving forward with the coalition and its work early on. Be aware of political considerations here.
5. Be prepared to give it your all. The initiatives proposed take energy, commitment, coordination, and perseverance. They also require resources—both personnel and monetary—and you should be cognizant of where this support is coming from on a yearly basis.
6. Consider the implications of pursuing certain issues through the coalition, especially in terms of how it's constituted (that is, the Federal Advisory Committee Act) and how the parties will resolve issues in the final analysis (will the Feds turn to individual States or companies if the coalition doesn't "represent" interests?).

The Principle of Cooperative Federalism

To the extent that any coalition involves the States and the Federal Government binding together, the likelihood of its success is enhanced. At the same time, however, the States should not fail to recognize that they have a unique role to play in the area of mineral development and environmental protection. There needs to be a sensi-

tivity, then, to the issue of State-Federal relations, and, as a representative of State governments, I'm duty bound to make my speech about the need for and the value of cooperative federalism. Perhaps Thomas Jefferson said it best when he claimed that State governments are in a better position to serve the people because they are closer to the people.

Elements of Cooperative Federalism

Two principles emerge as we chart the course of mineral development and environmental protection in general. First, there's clearly a role for a significant Federal presence. Second, as a balancing principle, environmental programs must involve the States in a substantive role as environmental action is assimilated into the local environmental and social order. These principles are the basis for a sound federalism in which each level of government works within its proper sphere and authority to serve to its citizens. Healthy tension between the States and the Federal Government works to moderate excessive action or inaction.

Environmental protection and resource management call for a stabilizing Federal presence, but the Federal Government must guard against fostering well-intentioned programs that produce costly activity without progress. Problems are inevitable with Federal legislation that paints the entire Nation with the same broad stroke. Americans live in a land of diverse environmental conditions and problems; Federal regulation of our environment must reflect the diversity of this country's many regions. Efforts to achieve and sustain a cleaner world require a balanced partnership between the States and the Federal Government, an arrangement that recognizes and builds on the relative strengths of the partners.

The Role of the States

For their part, the States shoulder the primary responsibility for planning, designing, implementing, and enforcing programs to achieve Federal and State goals and standards. This responsibility involves exercising discretion in the design and operation of environmental programs as long as program goals are achieved. It also involves the right to establish standards more stringent than Federal minimums, in accordance with the States' fundamental obligation to protect their citizens' health and welfare.

The States recognize that a strong Federal presence in setting national goals, providing assistance, and exercising performance-based oversight is appropriate in environmental programs, but the States must have flexibility in implementing and achieving Federal goals. The attempt to define one solution and technique for all occurrences of a problem is impractical in a country as diverse as ours. Flexibility is also one of the best incentives the Federal Government can offer for innovative and speedy environmental protection. For their part, the States must be willing to continue shouldering the responsibility and demonstrating their ability to administer the public trust competently.

Federal-State Balance

Given the appropriateness of cooperative federalism as the most effective, efficient, and constitutionally sound method of operating a major environmental program, the key to its success rests, to a large degree, on attitude. A relationship of any kind, be it a marriage, a business, or a State-Federal partnership, is only as good as the partners make it; it depends for its success on mutual trust and respect, effective communication, common understanding, and a desire to make the relationship work. A commitment is required whereby both parties see the accomplishment of a common objective as worthwhile and worth striving for.

The importance of attitude simply cannot be overlooked. The ultimate success of a regulatory program in which implementation and oversight responsibilities are divided between the States and the Federal Government depends on how you come into the debate on cooperative federalism. A predisposition by a Federal decisionmaker or policymaker toward a heavy "national" influence will affect his or her ability to reflect openmindedly and evenhandedly on matters of primacy. Similarly, an overly aggressive attitude about States' rights to the exclusion of an appropriate oversight role by the Federal Government will preclude any successful cooperative effort. Striking an effective balance between the States and the Federal Government is the goal of the federal system, and approaching such a balance with the right attitude is the key to its accomplishment.

Unfortunately, in the eyes of many in the Federal Government, the States are little more than interest groups that must lobby and litigate to protect the interests of their citizens. Nor has Congress shown much interest in correcting the growing imbalance in our federal system; Congress, the courts, and presidents have continued to expand Federal powers at the expense of the States'. Two startling indicators of the erosion of State and local authority are as follows:

- More than half of all the Federal statutes preempting State and local authority in the Nation's 200-year history have been enacted during the past 20 years, adding up to about 190 statutes out of some 354.
- More than 35 percent of all U.S. Supreme Court rulings declaring a State or local act to be unconstitutional have been issued during the past 25 years.

Final Thoughts

The fact is, however, that the States are able, willing, and eager to govern effectively. As one noted expert in the field tells it, "If any lessons are to be learned from the organization of effective institutions today, it is that noncentralization, networking, and diversity work better than hierarchies. The kind of hierarchy that has developed in the federal system—one in which State and local governments are viewed as lower levels—undermines the capacity for innovation, adaptation, and flexibility originally built into our federal system."

This workshop is evidence not only of the States and the Federal Government cooperating to achieve a common goal but also, perhaps just as importantly, of incorporation of the regulated industry as part of an effective coalition. I salute your efforts and wish you all the best as you move forward on this exciting new front. To the extent that the IMCC can be of assistance to you, we'd welcome the opportunity. In particular, we also look forward to cosponsoring a similar workshop with the USGS and State geologists in the Eastern and Midwestern States in the near future.

State Geologists' Views About the Concept of State or Regional Industrial-Minerals Coalitions

By J.G. Price

Thank you for giving me the opportunity to offer some perspectives from the NBMG and from the geological surveys of some of the other Western States regarding an industrial-minerals coalition.

I've received comments from many of the Western State geologists concerning this matter, and I'm pleased to say that, in general, the proposal is viewed to have some merit. That proposal, as presented to us in draft form (see app. 3), envisions a consortium with representatives from the industrial-minerals industry; academia; geological and mining surveys; local, State, and Federal land managers and regulators; environmental planners; and major users of resources and related geoscience information. We do think that many issues need to be addressed and discussed more fully by all the States that may be involved. We therefore propose to discuss the concept of an industrial-minerals coalition informally over the next few months and then formally at the next meeting of the Western State geologists.

E.H. Bennett, Idaho State Geologist, and M.L. Allison, Utah State Geologist, will be giving us some of their views as well, and we have other representatives of geological surveys with us, in particular, James Barker from New Mexico. In addition to these States, we've had comments from Arizona, California, Colorado, Montana, Oregon, and Washington; Alaska and Hawaii were omitted by the USGS.

Please allow me to note some of the issues and concerns that have been voiced by the Western State geologists. We don't have a standard disclaimer for such matters, so I take full responsibility for any misrepresentations in the following remarks.

- Because the term "industrial minerals" covers such a broad range of commodities, from low-value products like crushed rock for which prices depend highly on transportation costs, to high-value products like lithium carbonate, there is concern that a broad-based industrial-minerals coalition won't be able to adequately address some specific issues. Many producers of one commodity have little in common with producers of another. Coalitions based on commodities rather than regions of the county may be more appropriate.
- The structure of a coalition should be examined carefully because some of the most important issues affecting the minerals industry involve Federal laws and regulations. Direct participation of the main regulatory agencies, including the BLM, USFS, MSHA, OSHA, and EPA, should be considered. Other affected agencies, such as HUD and the DOT and DOC, could also have a role in such a coalition. However, if a major purpose of the coalition becomes lobbying for more Federal funds to support research on industrial minerals, then direct participation of the Federal agencies may be inappropriate.
- Many States feel that any formal coalition should be initiated by the States themselves and that participation should be optional. Many of the issues are local and need to be addressed at the State and local levels. For example, the State of Washington recently passed legislation that requires consideration of the long-term significance of mineral extraction in managing urban growth. A coalition, committee, or working group suggested by the States may be somewhat different from what M.P. Foose has presented here.
- Some States feel that a coalition is not needed to identify industrial-minerals issues and problems to be solved. That is, we already know what the problems are (such as the attitudes that "no one wants a pit or quarry within 100 mi of them," and "[industrial minerals are] common or found everywhere and [therefore] don't need to be developed"). The need for better industrial-mineral-resource information can be met by increased efforts on the part of the DOI.
- The USBM and State geological surveys or bureaus of mines need to continue to collect and disseminate accurate mineral production and resource data in a timely manner. The USBM should increase its efforts and should work closely with State agencies to collect the best statistics and to publish them as quickly as possible. The USBM should also expand its efforts on evaluating market demands, especially from foreign markets.
- The Federal agencies (USGS, USBM, BLM, and USFS) should continue to encourage involvement of local

experts on the staffs of the State agencies in Federal resource evaluation and analysis.

- The USGS and State geological surveys need to continue to provide the basic framework for exploration and development in the minerals industry: geologic maps, geophysical data on subsurface structure and thickness of overburden, and physical and chemical characteristics (grades) of the materials. The USGS should increase its emphasis on geologic mapping. Geologic maps are the basis for exploration, resource assessment, and land-use planning. Rapidly expanding metropolitan areas should be mapped in detail on a timely basis because established urban areas commonly are difficult to map. The USGS should continue to work with the Association of American State Geologists and with its sister bureaus and agencies in the Federal Government to see that the NCGMP initiative is implemented as soon as possible. That initiative calls for complete geologic mapping of the United States in digital format for easier use by regulators and land-use planners; the maps will be generally at a scale of 1:24,000, with final publication at 1:100,000. For the initiative to be successful, there will have to be widespread support from industry, government agencies, and the general public. We're convinced that such support can be won.
- In the areas of land-use policy, such as wilderness areas, the USBM and USGS need to demonstrate a commitment to undertake meaningful resource evaluations of industrial minerals, not just metallic-mineral resources. Some States feel that without strong commitments on the parts of the USBM and USGS to increase efforts in these areas, an industrial-minerals coalition would be ineffective.
- A coalition involving State and Federal agencies could have significant benefits in several areas, such as GIS, information and technology sharing and transfer, and assuring the availability of Federal lands for industrial-mineral production. Many State and local governments in the West are using compatible GIS software, which will allow much quicker dissemination of information and greater ease of using the information than were previously available.
- We recognize that part of the effort which the USGS is undertaking with organizing workshops on industrial minerals (here in Salt Lake City, last year in California, and the year before in Arizona) may be laying the groundwork for an initiative to increase Federal funding for research on industrial minerals. In general, we agree that more should be done in geologic mapping; determinations of the qualities or grades of industrial-mineral resources; collection of production statistics; research on mining, material handling and separation, and marketing; education of the public about industrial-mineral issues; and better incorporation of information into Federal land-use decisions.

In summary, most Western State geologists believe that there's merit in the proposal to meet regularly to discuss issues regarding industrial minerals. We plan to discuss the coalition concept at our upcoming meeting.

Some Additional Observations About Coalitions

By E.H. Bennett

I want to thank the sponsoring organizations for holding this workshop. It's been useful to exchange ideas, especially when we meet participants, such as those from the regulatory agencies, whom we don't normally converse with. You sometimes get a different slant on matters during exchanges of ideas. However, after a while at such meetings, you begin to hear the same things repeated. Let's hope that Gov. Matheson's advice about the need to repeat the obvious is true!

What's the situation in Idaho? (1) Today's the IGS is doing as much as it can to help in the education of our citizens on the importance of mining. Several speakers have already addressed that need. I'm not sure, considering our income from the State, that we can do much more. (2) We try to support all of the industries within our State. (3) I think our industrial-minerals industry is unique in its own right; certainly, all the industries in other States are unique. You may have, for example, a commodity such as phosphate for which the industry in Utah doesn't have a particularly strong voice. In Idaho, the phosphate industry is half of the Idaho Mining Association; it has a built-in group speaking for it at the State and national levels. In the past, it's been an extremely effective spokesperson for the industry. (4) With respect to the laws that all of us have to follow, all of the agencies, coalitions, or compacts that are working on behalf of the mining industry in Washington, D.C., also have to comply. I'm not sure whether another coalition will do much more to solve that problem for you when they haven't been able to do anything for you so far. The AMC, which is the national organization that speaks for the whole industry, with all the money behind it, looks at the problem of defending the 1872 Mining Law. It gets no argument from anybody in the industry about the 1872 law, yet that law is still constantly under fire. Thus, many organizations that are already out there have a "full plate" just trying to deal with the regulations that are coming on line. In my opinion, they haven't been extremely effective in being able to look out for specific aspects of the industry's viewpoints in dealing with those regulations.

The States are all different. The Idaho Legislature operates differently from the Nevada Assembly. The industry in our State differs from that in other States. I'm not quite sure how well a coalition would work when you're trying to work at the State legislative level. Coming in to talk with the Idaho Legislature about a joint interstate problem involving a specific industrial mineral would be

extremely difficult, particularly if you're trying to address four or five States at the same time.

Still, I don't want to throw a wet blanket on the concept of an industrial-minerals coalition. The Western State geologists are, in my opinion, a very close-knit group; most of us have known each other for a long time, and I have a lot of respect for my colleagues. Therefore, I echo Jon Price's sentiments in the need to talk to some of the other States more to get their opinions on these matters and to see where the States would want to go. If there's going to be a coalition, I think it needs to come from the States, not the Federal Government. Otherwise, it becomes a Federally oriented program, which won't necessarily be focused at the State level. I also suggest that we discuss this concept at Madison, Wisc., at the next Association of American State Geologists meeting, and I'll be most interested in the views of my colleagues in the West.

Funding is going to be a problem for a coalition. How many projects do we want to sponsor? Our requests for support, as Don Hull, the Oregon State Geologist, calls them, are "precious silver bullets." How many bullets do we want to shoot off to our congressional delegations at one time? Right now, incredible as it is, all of the State geologists are in accord that we want to have the proposed national geologic-mapping program go forward. It's a very large program for the State geological surveys; we're talking about a $50-million-per-year Federal program. We're going to be asked pretty soon to go to our congressional delegations seeking their support for that national program. For how many other programs do we want to go to them asking for their support at the same time? I don't think too many! We all have to watch our supply of "silver bullets" very closely, and we don't want to shoot unless we're pretty sure we can hit the target and get some return from it. Therefore, I think, in general, we're in favor of looking at an industrial-minerals coalition, but not at the expense of our first priority, a geologic-mapping program.

The industrial minerals have many problems that are inherent in each of the different commodities, and it'll be difficult for a coalition to address them effectively. I suggest, from the Idaho viewpoint, that we'll want to discuss this concept carefully with our colleagues.

A Utah Perspective on the Coalition Proposal

By M.L. Allison

In response to the coalition proposal, we can all agree that there are needs, and there are problems that need to be resolved; there are even problems that we need to avoid, and some that haven't come up yet. We have to be more effective and more efficient in what we're doing. The question is, how? I wonder whether this is the right way to do it—through a coalition as presently proposed. I wonder whether these are the right players to be involved in it. I'd like to run through the draft version of the coalition proposal and select a few points to comment on in response to some of the specific concerns that we have.

1. The coalition will obtain Federal or institutional funding. E.H. Bennett has just pointed out that this is a problem. We have problems getting funding just to keep our ongoing programs alive and well as they stand. To go out for new money is tough, especially when the proposed national-mapping program is as high a priority for the UGS as for other State geological surveys.
2. The coalition should be addressing policy issues. Sometimes, the State geological surveys go out and do that, but most of us are nonregulatory agencies; we're scientific agencies or technical agencies that are there to work with industry. We're your supporters, but as soon as we get in a position of going out to talk about regulatory actions, permitting, or environmental concerns, suddenly we're getting into a whole new area that we've never dealt with. We'd be taking on some burdens and baggage that may be bad for us and, possibly, for the industry in the long run.
3. The coalition will be concerned with research and technology transfer. There's a proposal here to publish results on a regular basis. There's a lot of money involved when we start dealing with publications, technology, and research. The question is, "Who's going to pay for this?" The idea of applying new technologies to industrial minerals, to develop cooperation between academic institutions and the Federal or State governmental agencies sounds good, but, in part, it may duplicate program roles that we presently have. A tremendous amount of money and effort may be required to establish a new industry-inclusive forum for research and technology transfer. I doubt that the Western States are going to be willing to fund some kind of multi-million-dollar program solely for the benefit of industrial minerals, and Federal participation in funding a coalition at any level seems moot. We're opposed to the idea of creating another large bureaucracy that might involve a lot of the UGS' or other State geological surveys' time and manpower.
4. The coalition will advise on Federal land-use policies. We agree that there are certain policy issues which are similar for all the Western States. These issues deal mostly with BLM-type questions of land use; other factors, such clean air, noise pollution, and mined-land reclamation, are all distinct from State to State and even from area to area within a State. It appears to us that some difficulty will arise in defining and prioritizing land-use-policy issues. California and Arizona, for example, have different problems from those in the Great Basin States. Additionally, there are organizations, such

as the Utah Resources Development Coordinating Committee, and broader regional entities, such the Western Governor's Association, that already deal with some of these issues and coordinate comments on Federal policies.

5. The State Geologists will form committees to encourage the coalition. We agree on a need to identify and categorize industrial minerals within the States and to work with the industrial-minerals industry in identifying new sources of these minerals. This type of economic evaluation is within the USBM's general area of activity. The USGS' traditional role is geoscience research, resource information and analysis, and study of other geologic phenomena. We believe that these Federal agencies already have programs in place that are dealing with such problem areas.
6. The coalition will establish local funding support. Again, as mentioned earlier, we have the problem of where do we get this money. E.H. Bennett has noted a possible misfire in using our "silver bullets" for this proposal.
7. There's a proposal to establish a Federally funded grants program. This is very vaguely worded, and it raises some concerns again. Where will the grants go? Who's going to pay for them? Who's going to run the granting program? How much money out of that program budget will actually go into grants, and how much will stay within the granting agency to supervise and run the program? Again, we have the concern over a whole new bureaucracy, a lot of money being set aside from other programs into this one. We don't see what the benefit to the States is.

We agree with some of the goals stated in the "strawman" proposal, but we think that approach is neither necessary nor desirable at this time. It's uncommon that a coalition would assume or be given a broad charter to cover such areas as land-use planning, Federal and State land-use policy, research and technology transfer, and basic-resource identification and inventory. We believe that this proposal encompasses far too many issues to be truly effective. We'd prefer a much-scaled-down agenda that could be organized and implemented through existing channels, such as the Western Governors' Association, possibly the local mining associations, or associations of industrial-mineral industries for geologists in industry, and that could work within established Federal and State guidelines. I'll have to be convinced a bit more about the overall value of this proposal.

Participants' Discussion and Comments

The following discussion offers both suggestions and cautions about the development of some form of continuing problem-solving coalition or forum and reemphasizes the special needs for public education and understanding of the problems that currently face the industrial-mineral industry.

Comments by M.P. Foose: At the outset, I'd like to correct what may be a misunderstanding or misrepresentation of the coalition proposal, which I presented as a "strawman." First, any coalition should be locally driven, consider local issues, and be run by local individuals from the industrial-minerals constituency, which certainly has to include industry representatives. During the early formulation stage, the coalition should not require much money, but State or industry funds may well need to be available if a significant body of work beyond the discussion phase is to be accomplished. In the absence of State funds, there is only one other source of funding—the Federal Government. To attract the attention and support of the Congress, a well-justified and broadly supported program must be developed.

Second, the USGS actually doesn't see a coalition as something that it's ever going to directly benefit from. The USGS, however, is concerned with the way industrial minerals are being treated. A forum where improvements can be discussed and then forwarded to those responsible for making changes would be beneficial to all. Right now, industrial-mineral decisions are being made without planning, and the Nation risks losing many potential resources.

Third, it would be encouraging if industry could and would take care of itself and somehow spontaneously organize itself to consider the issues we've been talking about during the past day and a half. But I don't see any evidence that industry will do that, or even that it "can" do that, considering its great diversity. We've held previous workshops in Arizona and California. Industry has taken part in those workshops, but basically business is continuing in Los Angeles and Arizona in the same way as before. I'm willing to be convinced that, as a result of being here today, industry will form a group which will effectively address these issues on a continuing basis. If it can't, then the question is, who "can" do that? In my opinion, that leadership must come from some part of the State and local resource constituency, which can provide a broad-enough base to exert influence. We suggested that the State geological surveys, as part of the constituency, might form the rallying point around which a coalition could be organized. There almost has to be some government guidance from the resource constituency, but clearly a government agency shouldn't take on any activities that might seem to involve a conflict of interest.

This "strawman" has some drawbacks, but I hope those aren't the sole focus of our discussion. Rather, I'd like to hear other "strawman" proposals. The important question is, "What do other people think can be done to

change the way industrial minerals are treated, not only in Utah but also nationwide?"

- I can agree with many of the points brought up during the past 2 days about the need for industry and government agencies to deal with industrial-mineral problems. But I have to agree with those speakers who indicate that it's not the proper role of State and Federal agencies to pursue a coalition type of endeavor, as it's been proposed. If we're going to have a Western industrial-minerals coalition, it needs to be industry initiated, industry organized and operated, and industry funded. For example, I think the NDM has acted correctly as a liaison between State government and the mining industry, but it's not that NDM's role to do the job for either of them. The NDM can help them, can advise them in many cases, and can go to bat for them when it agrees with their position. Government representatives run the risk of compromising agency positions by taking an active lobbying role, which much of the coalition's proposal would seem to be. Many problems and projects could be brought up for consideration and action by a coalition like this—in particular, mapping projects and industrial-resource inventories—that are appropriate roles for State and local governmental agencies and academia to be involved with. To have a government-run coalition would run the risk of missing input from industry representatives sitting down and actively organizing the coalition; it wouldn't go anywhere, because the people most affected wouldn't be involved.

If I were to make a suggestion, it would be to pursue the kinds of things we've discussed here at the workshop, possibly at a Western industrial-minerals conference where we can bring all the parties together. From my standpoint, as a government employee, I'd encourage industry representatives from the State mining associations to take a more active role and, with government support, become involved in your own State in mining-related issues.

Reply: The committee's idea wasn't to form a coalition at this workshop but to consider, before proposing further action, whether it was a practical concept worth developing, what its objectives would be, and who should be involved. It seemed that a local organizational structure was needed as a catalyst to get the State-level discussions moving; a State geological survey was such a possible organization. But you're correct that more industry representative should become involved in any such planning, and the suggestion of using the State mining associations to catalyze further local discussion and action is excellent.

- As an industry representative, I tend to agree with those speakers who stress that any industrial-minerals coalition needs to be industry driven. I liked the presentation this morning on the Nevada educational program. Those of us in the mining industry need to work together to educate the public and regulators. Every one of us drives a car that's made out of materials which have to be mined, and all of us live in houses that are made of mined materials. We all need to work together to support the industry. Granted, the industry may have some skeletons in its closet—things done in the past—but we're working on cleaning them up with the help of the government. These problems must be resolved. I think that education of what the mining industry does for the public and the country is essential.

I also agree that the planning bodies of State and local governmental agencies should be mandated to dedicate localities which need to be set aside for future resource development, so that we're not tripping over each other. Several industries, not only sand-and-gravel operations, have been shut down because communities have built right up to mine boundaries and people complain about dust, noise, and so on. My company encouraged a landfill project to become our neighbor just so we would have more protection from encroaching summer-home development. I've seen many parts of the lightweight-aggregate industry in the United States shut down just because of encroachment by the villages. So I agree, we need to do something as a group. It needs to be industry, not government, driven; however, I appreciate that the government is trying to help.

- One thing I've observed here is that we're not always lacking systems, processes, or involved agencies which are aware of what the problems are. Sometimes, they're not finding effective ways to deal with them at this point because they don't have the necessary information; they're not talking to their clients early enough. Maybe the issue isn't a need for a new system or framework for fixing the problem. Maybe the problem, in fact, is, how do we work within the existing structure or with an existing framework? How do we target to be more effective in using what's there already before we start looking for a new organization to address the issue? It's taken considerable effort to put a coalition group together to go forward effectively, as G.E. Conrad and others have indicated. Maybe our energy will be better channeled in seeing how much more effective we can be using our present system better.

Reply: This suggestion is excellent, but it doesn't answer the key question of what present system can and will do the job. There's still a need to find a leadership "home base," such as a local mining association, to convene and stimulate a local forum into developing some action. One of the first objectives of this group would be to examine the present operating structures and identify a leader.

Suggestion by G.E. Conrad: There may be value in segregating resource issues into two different areas. We've heard about some public-policy matters characterized as "political issues" during the past 2 days. There've also

been several more informational-technical-scientific issues. The type of issue has a large bearing on the type of coalition that States, local governments, or any type of industry organization might select in deciding how to pursue an initiative with regard to the issue at hand. When I think of the types of issues the IMCC traditionally has been involved in, most people would consider them to be public policy, sometimes even political issues on behalf of the States. The success of the IMCC as a coalition of States has been due, in large part, to the fact that the issues are structured in such a way that we can develop a similar mindset with regard to how they're presented to the Congress, to a regulatory agency, or to the industry.

For example, consider the mapping initiative that the State geologists are concerned about. They came to the IMCC and said that they needed some support for their proposal. With a minimal amount of discussion, we could see the merit of it, and so we adopted a resolution supporting their request. That added some weight to what they're trying to accomplish. What we can do that they can't is take the resolution to Capitol Hill, go before appropriations committees, and say, "OK, congressman, this $50 million is really important; we need this money for these reasons." That's something IMCC can do for the States, but the groundwork wasn't laid by me but by "a coalition of State geologists," and without them doing their jobs, I couldn't take the next step. It's an example of how you can work with organizations that are already in place and why some work better in advancing new or different needs of the States. There are other policy issues that definitely find their way before an organization like the IMCC and that work well because they cross over State boundaries or mineral issues. There are several OSM issues on the coal side that may have specific impacts on States, but because of the way they're currently framed, we can develop an overall State position on the issue. Then, we move forward with the issue on their behalf.

How this is done has to do with defining where specific issues fall and what backing or opposition is out there. One issue we've heard a lot about during the past 2 days is zoning and the impact local governments are having on planning, and on the State's ability to control things. It's an issue that's been raised by the IMCC States within the past few years, and at our next annual meeting, we're going to have a couple of speakers address that issue. I went to the National Association of Counties to try to get some ideas as to who might be able to address that issue. I asked it if, as an institution, it had given any thought about the impact that zoning and local planning have on mineral operations. Their answer was "yes," and they were able to give us several speakers to address that issue. There are other organizations out there that you can work with to advance the concerns and positions of the States with regard to the zoning and permitting issue. It's a matter of searching them out, and there may be more of them out there than we realize.

Comment by E.H. Bennett: In Idaho, when we have such concerns, we ask the Idaho Mining Association to address them. Sometimes it works out quite well, and sometimes less well. We look to them to help within their sphere of influence, rather than ask for involvement by a nonregulatory State agency. The real value of a State geological survey to the State is that of a credible nonregulatory agency which has no axe to grind. When we get up in front of a group, we can discuss the positive features of mining, and many people believe us. However, when the Idaho Mining Association gets up to give an eloquent talk about the benefits of mining in the State, the audience may question their objectivity. You can see that the mining association has its value when operating within its sphere of influence in the State, and we think the geological survey has its role. These shouldn't be confused or integrated.

Reply by G.E. Conrad: It's very important to distinguish the respective roles that agencies play within State government. These roles are defined carefully for good reasons. We have to be careful in the IMCC about mixing and matching, one example of which was in the Mine Waste Task Force. Some States have two distinct representatives sitting at the table in the State coalition—one from the environmental health department and the other from the natural-resources department. They both have different perspectives on how they'll regulate mine waste, and they differ on the operations of natural-resource industries in their State. Those arguments are all placed on the table as we try to resolve the issue at hand.

- What goal do you see industry taking in a coalition?

Reply: I think it would depend on the purpose of the coalition or on its objectives. Depending on how you define the purpose of a regional coalition, I could envision that the industry could participate at least as an advisor in whatever discussions might occur within the coalition. It all comes down to defining the basic purpose of any coalition before the roles and responsibilities for each of the participants can be ascertained. One thing that can't be discounted is the fact that there may already be opportunities for industry to find a way to move forward with initiatives, as, for example, within the AMC. Some AMC members didn't feel that they were particularly well represented within the larger scheme of the AMC, which represents basically the large mineral producers. The result was that the coal and the cement producers set up separate councils within AMC which would provide them the opportunity to focus on the needs of their particular industry. I'd suspect that there's an opportunity to do that same type of thing, as Gov. Matheson said, within organizations like the UMA

or within organizations in the east like the Virginia Aggregate Association, which already is specifically focused on aggregates, but they could develop specific councils as well.

Comment by M.P. Foose: My personal view after having gone through several industrial-mineral workshops is that we see common problems in different areas. There seems to be little common focus and no way to try to solve these local and regional problems on a regular basis. Once more at this meeting, the same problems have been addressed, and I hope this workshop won't end without recommending some way(s) to keep going whatever momentum we've established.

I was hoping that some organizational instrument would be proposed to consider unresolved industrial-mineral problems in Utah, Nevada, and Idaho. Whether convened as a part of the State mining associations or other existing agency, I don't see that such a coalition needs to be an expensive operation, particularly at the beginning. I think, though, that it ought to be done for both industry's and the region's own self-interests. If we just sit back and let things go on the way they have, then a real opportunity will have been missed to face the real and approaching issues. I proposed the development of coalitions, not to expand the USGS, USBM, or any Federal agency's programs but as a vehicle to address regional needs. I hope that this focus isn't lost in discussions among the State geologists.

- As a part of the primary-wealth-production industry of this country, I'd resist adding more levels of organization. There's a feeling among most people in the bureaucracy that this country won't take care of itself by following the marketplace. But I think it will! The marketplace is going to decide whether a gravel pile is worth digging up. It's worked that way quite well, and it may not work as neatly as we'd like to have it, but it's worked better than anything else in the world that I know about. The day will come when it's worth moving a house to get at the gravel beneath it; that house will be bought and moved. In the meantime, legislating or trying to push people in one direction or the other is counterproductive. I've heard two suggestions over and over again during the past 2 days. The first is education, and it's a two-way street; before you can teach someone something, that person has got to want to learn. The second is, "Who pays?" As a member of private industry, I know the answer to that one, and so do you.
- We're talking more about aggregates than other types of industrial minerals here, and from my experience, I've seen that the sand-and-gravel industry and the rock industry have been reluctant to join the mining associations. I don't think there's an aggregate association in Utah or Nevada, as such, that would perform the same function independently. I think the aggregate producers ought to reassess their position and join the mining associations. They'd make these associations stronger and probably more effective, but I have a hard time seeing how industry and regulatory agencies can get into bed with each other; I don't think that's going to happen.
- One subject that's come up here—and it seems to comes up at every meeting of this type—is the need for education. Whether we mine or not depends on the marketplace. That's fairly true, but I don't think it's as true now as it was about 5 years ago. Probably, it won't be as true 5 years hence as it is now. There are many other factors that may supersede the marketplace as far as determining whether an operation is going to make it or not. Much has to deal with public perception, regulations, and things like that. First of all, the USGS and USBM have done a real service by getting these workshops organized and getting us together. I wonder, if there were to be a long-term focus or a coalition of some sort, whether it should be an educational coalition, which could involve industry and government in a nonpolitical way. Nobody is adversely affected. Groups like the USGS, USBM, and State mining associations are already in the business of gathering data and disseminating it. I think it'd be within their realm to further that role. If government agencies took a strong role in creating an educational forum or whatever, it would facilitate getting factual information, so that the general public and other public agencies can make intelligent decisions (hopefully) on where mining is or isn't allowed, what kinds of laws will affect them, and so on. My recommendation is that if we're searching for a long-term goal, it has to be public education, nothing else. You can't have good government or an effective industry without it.
- The WSMA's directors hold several meeting every year. I think that the USGS and USBM should talk to that organization and explain where the major problems for the industrial-minerals industry lie. These concerns may not have been addressed by the WSMA; for example, the WSMA may not be aware of the aggregate problem. The WSMA may be the interstate group to look to as a home for a coalition to take on the political aspects of dealing with industrial-mineral problems.
- I agree that the WSMA would be a good place to assign the political aspects of helping the industrial-minerals industry. There could be separate subcommittees or councils set up in the related State mining associations. I can't see a coalition of State and Federal governmental agencies commenting on political issues to any extent; instead, they should concentrate on identifying industrial minerals.

Comment by E.H. Bennett: I was amazed at conversations during the dinner sessions at the Industrial Minerals Forum in Portland, Oreg., last year as we sat with a group of geologists who've been interested in industrial minerals all of their careers. They didn't discuss strikes

and dips, geologic structures, or the types of veins or deposit models; they know where all the deposits are. There are dozens of deposits sitting out there awaiting development if market conditions will allow. What they did discuss around the table were topics like—if this new Federal regulation comes in, this material over here is going to be a substitute for the one that's going to be eliminated over there, and so the deposits over here are the ones that are, therefore, worth looking at.

Right after the Portland meeting, one consultant was in my office going through all the IGS files that we have on limestone deposits in Idaho. We've been collecting this information for 70 years or more in Idaho. We have maps up to our necks, many of them never published. Most of the State surveys have similar extensive files on indigenous industrial-mineral commodities. We know where many industrial materials are located, but it's true that a favorable market condition determines whether or not a deposit is economically minable. Do we need more organizations doing the same thing?

• Contrary to what others may have said here, I don't think all the industrial minerals have been found. Take the barite boom in the 1970's; suddenly, a new resource was identified. Lightweight aggregates, which hadn't been recognized a few years ago, are now in production. As technologies change, different things can be used for different purposes. A lot of this type of knowledge has to be set down in a publication somewhere; that's where help is needed. I don't think the States should get into commenting on regulatory or wilderness-study-area designations; those questions are strictly political.

Moderator: As we're winding down here, what do you see as the benefits of your having spent 2 days and the government having sponsored these presentations and discussion? What lasting benefit has accrued to encourage conducting such USGS–USBM workshops in other parts of the country?

• I don't feel quite so lonely anymore; I see that other people have the same problems as I have. That's one benefit I've gotten out of this meeting.

Moderator: Do you think industry is going to spontaneously self-organize into lobby groups? Do you see that members of the industrial-minerals industry will hold hands and go forward to take care of this problem?

• I think they'll have to! I look at several government operations that have been running for the past several years, and I haven't seen them help industry out much, so I think the industry has got to hold hands and work together. I'm willing to participate as much as I can to do it, and to work with government agencies to help find ways to obtain logical answers. We've done enough bashing of the State and Federal agencies; that doesn't resolve anything. The industry has to work together to give the public a positive image of the mining industry and not have it looked on as a rapist of the Earth. We generate a lot of good commodities and materials for people. That's the story that has to get out to the public.

• What's the reason for an apparent lessening of industry participation in this workshop? Is the concern for industrial minerals less?

• I don't think enough industry people were invited. There are also obvious problems: Government people tend to be more meeting animals than industry people, and the timing of the meeting at the end of the month may have been bad for industry folk—it's budget time.

Comment by E.W. Tooker: About 50 percent of the participants who accepted our invitation were from industry or related consultants, and an additional number of those asked were unable to accept the invitation. A few of those who accepted were unable to be present only at the last minute. This apparently was a busy time because several industry participants accepted with our understanding that they could be present during part or on all of one day, owing to previous business commitments in Salt Lake City.

The original purpose of this workshop was to convene a group small enough to encourage informal roundtable discussions. The maximum these facilities could handle in that fashion was about 70. At the outset, the organizing committee recognized that there'd be many people who couldn't be included. In addition, the region to be covered, originally a four-State effort, was to include a broad constituency of government, academia, industry, banking, and environmental disciplines. This design limited how many persons from industry could be invited.

Judging from the participation of those present, the level of concern for industrial minerals is no less here than in the other workshops.

• This meeting has worked out quite well. We've aired many different viewpoints that otherwise we might not have. I'd have been happier to see more industry people here, and I'm disappointed that the industry turnout was so limited.

After listening to all of this, I conclude that it's the folks in industry who, if they feel the need for something to happen, will have to get together and do it themselves, but I think it's great that they could talk with Mike Harper and see where he's coming from, and listen to someone who's actually done a PR campaign for the mining industry. And it was good to hear the industry viewpoint as well.

• As someone from industry, I appreciate the opportunity and invitation to attend this workshop. We did get two notices and had ample time to arrange to be here. I'm sorry that more industry people couldn't make it. What I've gained from this workshop is confirmation that we haven't gotten the industry message out to the people. I've been overwhelmed by the effect or the accomplishments

that well-organized environmental groups like the Sierra Club have made. It's difficult for us to compete in the marketplace if we're losing all the reserves or ground where we need to prospect or where the minerals are. I'm not sure how we can combat that effectively unless we get organized. We haven't played a strong enough part; each of us from industry has to be more vocal and participate actively, and I think this participation should be mainly through the State mining associations. Most of us belong to the AMC, but from an industrial-minerals standpoint, we don't see a lot of influence there. I confess that as matters stand, I don't see the industrial-minerals industry cooperating much, because we're all working with different products and in different areas. Can we afford to drop the matter here?

Comment by James Barker: As the representative of the New Mexico Bureau of Mines, I'd like to second one of the recommendations by Jon Price that DOI support of industrial minerals be increased. Specifically, the USGS' industrial-minerals program commitment needs to be strengthened and its expertise developed. The philosophy seems to have been that the State geological surveys should take on this work. Decades ago, the States rescheduled some of their geologists to increase the work on industrial minerals. If new funds aren't available, I'd suggest that the USGS follow the States' example and redirect personnel to demonstrate their firm commitment to industrial minerals.

Reply by E.W. Tooker: To paraphrase an old saying, those who ignore the bad decisions of history are compelled to repeat them. The fact is that, in the past, well before my time, several of the powerful State geological surveys insisted that the industrial-minerals part of economic geology was reserved for them. That may have been an appropriate allocation of effort in the days when the impacts of industrial-minerals studies truly were local (State) affairs. In more recent years, however, with mobile populations and increasing need for the interstate distribution of these resources, there's now a greater call for some Federal involvement. One of our purposes in organizing this workshop was to help us begin to understand that new role and to define it more clearly. In addition to what M.P. Foose has already said about restriction in the USGS' unilateral program and fund reallocation, it's also a fact that the USGS has a substantial industrial-minerals program in comparison with its other competing programs that also must respond to national objectives, which generally differ from those of the States.

I wouldn't argue that the USGS' industrial-mineral efforts shouldn't be reprioritized or that more staff should be redirected to this part of the Federal effort. However, I don't believe that the Federal effort should compete with or duplicate those of the States. Those arguments aside, the "strawman" proposal suggests only that the USGS or USBM participate in a coalition and make a contribution, *if asked.* One topic for serious consideration by a coalition might be to examine and offer suggestions for redefinition of the roles and interrelations of the State geological surveys, the USBM, and the USGS to upgrade support of industrial-mineral programs across the board.

- Another way the DOI can help the industry in their development of industrial-minerals on Federal lands is by greater involvement of State agencies in the formulation of BLM resource-management plans. The BLM has geologists who collect data from private-industry, State geological survey, USGS, and USBM sources to support the management plan. The State offices should review these plans, and reviewers from private industry and other governmental agencies should be solicited. It's particularly critical that corporations review the plan, which sets up the rules and regulations for entry onto Federal lands. All too often in the past, the BLM has received too few comments from the mining industry.

Reply by E.H. Bennett: Of the 84 thousand mi^2 in Idaho, two-thirds is Federal land. I have at least 20 linear feet of land-use plans from the USFS and BLM on my library shelves. You must be patient with State agencies that have limited staffs to comment meaningfully on the plans; they're comprehensive and difficult documents to read and analyze.

- Does the BLM or USFS make regular archeologic studies on Federal lands, or do they wait until someone wants to use the land? There seems to be a long wait for the decision to let industry go ahead to develop a resource.

Reply by D.P. Bauer: Under the 1872 Mining Law, decisions on areas smaller than 5 acres must be made within 15 days. That means that after 15 days you can begin operations. For a plan of operation, we try to meet a 30-day requirement, but sometimes when getting into archeology or threatened and endangered species, we have to allocate another 60 days to confer with other agencies. Other State and county agencies and planning boards will take much longer. Keeping in close touch with the BLM and supplying pertinent information early on will help speed up decisions.

Summary of the Discussion About the Creation of an Industrial-Minerals Coalition in the Western States

By E.W. Tooker

It is clear to me as compiler-editor of these workshop proceedings that, although the concept of a coalition of the industrial-minerals constituency[3] was considered

[3]Defined as a group or body that patronizes, supports, or offers representation in a substantive way.

from many points of view, no clear conclusions or recommendations for developing and implementing a coalition program, if at all, were made. Time simply ran out, and the session ended with the subject unresolved. Although this commentary is not strictly a part of the workshop proceedings, I am inserting it before the closing statement to coalesce and focus the various lines of reasoning expressed during session 5. This summary may, in effect, represent the sowing of the seeds of an idea whose time to sprout may come, though possibly not entirely as envisioned here. We hope that this presentation and discussion will stimulate further consideration by the reader, whether as a workshop participant or as a concerned citizen.

A major objective in introducing the coalition concept at the workshop was an attempt to find a way to mobilize the industrial-mineral-resources constituency to act together as a whole, to derive equitable solutions to the problems of resource availability, and to provide pertinent and unbiased information to the public and governmental decisionmakers on a timely basis. In concept, the "coalition" was to be broader than a way to lobby for permitting sand-and-gravel operations. Accelerating population growth in the Western States will require increasing amounts of industrial minerals to construct homes, find jobs, and provide food and essential infrastructures. Meeting these needs will entail confrontation, in many cases, and will require a process for resolution. Michael McMahon (1990) offered some good advice for industry actions in his article, "Dealing with Environmentalism and Economics in the '90s." The problem cannot be considered as just an industry problem and resolved by industry action alone; McMahon suggested that the issues are bigger than any one company and that only coordinated, enlightened, industrywide response and outside support from a third party [the resource constituency(?)] can provide necessary legitimacy with government and environmental advocacy groups. The question, then, is, how can a positive, coordinated, and credible support activity be organized and maintained in the public interest? If not a coalition, then what?

The "strawman" proposal for a coalition (see app. 3), presented to catalyze spirited participants' discussion of the concept, which indeed occurred, has several flaws. The comments from the Western State geologists and participants have helped to begin shaping an instrument more pertinent to present political and societal realities. These comments fall into three main categories: (1) what a coalition should not be, (2) what it should be, and (3) program elements essential for success.

What an Industrial-Minerals Coalition Should Not Be

It was a nearly unanimous conclusion that a coalition should not become a lobbying group on policy issues, organized specifically for the benefit of industry or other members of the constituency. Further, the coalition should not be organized by the Federal or State regulatory or geological agencies, although they may offer information or expertise in support of its deliberations. The organization of a coalition should not be contrary to Federal and State laws. A coalition should not be just another organization as ineffectual as some of the present national (coalition) organizations are; its contributions should not be considered as biased and self-serving. Finally, a coalition should not be in competition with existing organizations for Federal or State funds.

What an Industrial-Minerals Coalition Should Be

Ultimately, a coalition should be an organization dedicated to meeting real public needs. It should be as noncontroversial and nonpolitical as possible and seek competent advice and information from all sources, so that its recommendations have credibility among most, if not all, segments of society. A coalition could also become a focus for public education and a source of information about industrial-mineral resources. An industrial-minerals coalition should include the resource constituency that is represented at this workshop, as well as other Federal and State agencies that may also have peripheral interests in industrial minerals. A coalition should be an instrument to encourage greater involvement and input from and by Federal, State, and local regulatory bodies, as well as from the environmental constituency.

Elements Necessary for the Success of a Coalition

1. Identify a leadership entity to convene the industrial-minerals constituency and derive the common objectives and purposes for the coalition. Make use of existing organizations in forming coalitions; do not create new ones. A Federal-agency official was deemed inappropriate as a coalition leader. Although the State geologists present were not eager to take on a leadership role, they should not be ruled out. One acceptable suggestion for an initial convenor-sponsor was the president of a State mining association; for example, the coalition could become a subcommittee of the mining association. If the State groups are broadened at some future time to form a regional coalition, there exist several interstate organizations that could shelter and guide the regional coalition.
2. Begin the coalition modestly at the individual-State level; any regional joining of State coalitions should await special need. Start small, possibly as an annual discussion or educational workshop session to explore the status of industrial-mineral resources and the industry's commodity/public-policy problems. Initial

emphasis ought to be on problems of universal concern to the constituency and the public, such as education regarding problems of industrial-mineral availability and demand. For example, the SMARA program in California should be investigated by the Basin and Range States. Within a coalition, it might be advantageous to segregate public-policy from technical/scientific issues. Controversial public-policy issues should probably be avoided or deferred until the coalition is more broadly based and credibly well established and its input is clearly identified as infor-mational. Examples of special-purpose regional coalitions in operation were detailed by D.R. Nielson and G.E. Conrad.

3. The Federal and State agencies can provide advice, when asked, and facilitate technology transfer, the formation of GIS's, and resource-information collection and dissemination. These agencies should provide *information* for consideration by land-use policymakers.
4. A coalition must have strong industry support without compromising proprietary interests. The main industrial-mineral commodities should be represented; some members may wish to participate at first in commodity subcommittees of the coalition.

Conclusion

The discussion and comments of the workshop participants regarding the advisability or practicality of organizing coalitions for fostering local problem solving seems to lead to the conclusion that something of the sort needs to be discussed further. The seed idea has been planted here, and, if the concept of an industrial-mineral coalition seems to have some value in a State, the State mining association could well take the lead in arranging for further discussion of the possibilities, objectives, and possible organization of a State resource coalition in some form. Federal agencies may be willing, when asked, to support such coalitions with advice and information. Thus, a recommendation from the workshop participants, if it can be so categorized, would seem to be that, in view of its potential merit, the coalition suggestion should first be investigated in more depth at the State level.

CLOSING COMMENTS

By M.P. Foose

I'd like to thank everybody for being here and showing your personal priorities by contributing to the success of this workshop through participation in panels or in discussion sessions. Many of you had to take time out of your busy schedules and incurred an added expense. Therefore, on behalf of the Geological Surveys of Nevada, Utah, and Idaho, the USBM, and the USGS, I offer our sincere appreciation for your support of this workshop. I think we've achieved some important understanding and clarifications in the past 2 days. It's my sincere hope that we've generated some conversations which will echo through the corridors of industry, academia, State and Federal agencies, and environmental planners during the next several years. Such excitement and dedication is necessary if we can begin to change the way industrial minerals are regarded in the eyes of the public and if we can start to work more effectively to plan how to wisely extract and use these resources in ways that meets societal needs, industry requirements, and environmental responsibilities.

We've covered a lot of ground in the past 2 days, beginning with a look at the status of industrial-mineral resources in the Basin and Range region of Utah, Nevada, and Idaho. Panelists examined the future needs for industrial minerals and the problems in obtaining them. The serious problems as seen from an industry perspective focused on economic and environmental issues. Then, Gov. Matheson gave us his insights on how the industrial-minerals industry must learn to deal with political entities. Insights on how to expand industrial-mineral opportunities in the Basin and Range by making use of the USBM, USGS, State geological surveys, and university research was followed by examples of how the industrial-minerals industry itself develops new markets and educates the public by using PR techniques. Finally, we concluded with considerations of the most serious problems yet to be resolved and the suggestion of forming a coalition or discussion group within individual States to begin working together to solve them. These subjects effectively rounded out the many-faceted industrial-minerals situation in the Western United States, which we have attempted to examine during the three workshop sessions.

I'd like to thank a few people here who've made this workshop possible. The organizing committee and moderators, panel conveners, and panelists all have done yeoman service in completing this last stop in the cycle of three Western State industrial-mineral workshops. The proceedings volumes from all of these sessions will become useful basic documents for developing new Federal and State industrial-mineral-program directions and strategies for education of the public. Carol Olsen, UGS, and Susan García, USGS, have been sitting quietly, taking care to record these sessions; their tapes will permit compiling a written record to document what's been said here. I want to extend special thanks to the UGS for being a generous onsite host; it's made a great difference in being able have strong support during the planning and convening of the workshop. We thank Charles Berry, University of Utah, who was responsible for organizing the laboratory and

aggregate and precast-prestressed-concrete plant visits. To you all, our grateful thanks.

Finally, I'd especially like to acknowledge the workshop coordinator, E.W. Tooker. About 4 years ago, he recognized the benefits that could accrue from holding these workshops, and began working to make them happen. The success of this and the previous two workshops is a testament to his hard work and commitment to these issues.

We'd encourage any of you, either as a workshop participant or as reader of this volume, to comment further or extend the discussions with appropriate State Geologists or the resource-program chiefs of the USGS or USBM (see inside front cover).

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APPENDIXES 1–5

Appendix 1. Program for the third industrial-minerals workshop

INDUSTRIAL MINERALS OF THE BASIN AND RANGE IN UTAH, NEVADA, AND IDAHO: CURRENT STATUS, PROJECTED NEEDS, AND FUTURE PLANS

A Workshop Sponsored by the U.S. Geological Survey, U.S. Bureau of Mines, Utah Geological Survey, Nevada Bureau of Mines and Geology, and Idaho Geological Survey

May 30, 31, and June 1, 1990
University Park Hotel
Salt Lake City, Utah

Registration—7:30 to 8:00 a.m., Bonneville Ballroom

Session l, Wednesday morning, May 30, Bonneville Ballroom

8:00 a.m.	Introduction and welcome, by M.L. Allison
	Status of industrial-mineral resources, E.H. Bennett, moderator
8:10	National supply/demand, focused on the industrial minerals produced in the Basin and Range, by A.F. Barsotti and V.V. Tepordei
	Regional summaries of present and future production of industrial minerals in Utah, by B.T. Tripp; in Nevada, by S.B. Castor; and in Idaho, by E.H. Bennett
10:00	Discussion and additional comments
10:20	Break
10:30	Future needs and problems in the Basin and Range region, B.W. Buck, moderator
10:50	Growth of population and limitations on resource availability, by Robert Buchanan
11:00	Discussion
11:25	Environmental concerns for land, air, and water, by James Scherer
11:45	Discussion and comments
12:00 m.	Lunch
1:30 p.m.	Interstate activity in the formulation of regulations governing mine waste, by D.R. Nielson
1:50	Discussion and comments

Session 2, afternoon, May 30, Bonneville Ballroom

	Industry perspective, a regional view, J.E. Christensen, moderator
2:05 p.m.	Economic problems of industry, Charles Berry, convenor
	Industrial-mineral marketing, by Larry Wiener
	The art of financing an industrial-mineral enterprise, by Robert Bernick
	Business deals, taxes, and economic-analysis problems, by C.W. Berry
	Discussion and comments
2:55	Break
3:20	Environmental and support-system problems, Brian Buck, convenor
	Land-access issues from the Federal perspective, by Steven Brooks
	Problems of mine permitting in the Great Basin, by Glenn Eurick
	Environmental and mining support systems, by C.L. Smith
4:30	Discussion and comments

Session 3, evening, May 30, Bonneville III

	Industrial minerals from the perspective of government, M.L. Allison, moderator
6:00 p.m.	Social hour
7:00	Dinner
8:00	Politics and industrial minerals, by former Governor S.M. Matheson of Utah

Session 4, morning, May 31, Bonneville Ballroom

	Opportunities for resource growth in the region, R.C. Bradt, moderator
8:00 a.m.	Advanced material potential in the Basin and Range area, by G.R. Hyde
8:20	Research potential in government and academia, by Garret Hyde (USBM), M.P. Foose (USGS), and J.G. Price (NBMG and universities).
9:05	Discussion and comments
9:25	Break
9:40	New market development: How it has been done
	Developing new markets for beryllium, a high-value specialty material, by T.B. Parsonage
	New product development from low-value material by the Idaho Quartzite Corporation, by Donald Seehusen
	Discussion and comments
	Public education through public-relations expertise and technology, by John Marz
10:50	Discussion and comments
11:30	Lunch

Session 5, afternoon, May 31, Bonneville Ballroom 1

	Future actions to assist in meeting industrial-mineral-resource needs, J.G. Price, moderator
	What are the problems to be resolved?
	Industry perspective for the high-volume, low-value materials producer, by Douglas Clark
	Industry perspective for the low-volume, high-value commodities producer, by John Harmon
	Land planner's perspective, by Michael Harper
	Future activities to assist in problem resolution
3:30 p.m.	Proposal for organizing industrial mineral coalitions in the Western United States, by M.P. Foose
	Example of an established regional organization in the East and Central United States, by G.E. Conrad
	State Geologists' views on the viability and usefulness of State or regional industrial-mineral coalitions: For the NBMG and other State geological surveys, by J.G. Price; for the IGS, by E.H. Bennett; and for the UGS, by M.L. Allison
4:30	Discussion and comments
5:00	Closing acknowledgments and thanks to the participants from the workshop organizers and sponsors, by M.P. Foose
5:10	Adjournment

Visits to laboratories and industry plants, June 1, 1990

7:45 a.m.	Leave University Park Hotel
8:00 to 9:20	USBM field-center laboratory facility
9:30 to 10:00	UGS computer-data laboratory and map information
10:30 to 10:50	National Cold Fusion Institute facilities
11:00 to 11:40	University of Utah College of Mines Research Laboratories
12:00 m. to 12:55 p.m.	Lunch, Union Building, University of Utah
1:00	Travel to the Staker Co., Salt Lake City, crushed-rock (aggregate) pit and facilities
1:30	Monroc precast-prestressed-concrete plant
4:00	Return to University Park Hotel

Appendix 2. Significant industrial rock and mineral quarries, pits, and plants in Utah with recent production

[Location is listed as township (T.), range (R.), and section (sec.) of the cadastral land grid. Most locations are referenced to the Salt Lake Base and Meridian, but one operation located within the Sixth Principal Base and Meridian (in Wyoming) is denoted by an X following the section number. Dashes, no data. Do., ditto]

Quarry, pit, or plant	Operator	Commodity	Location		Age/formation	Use/products
			County	T., R., sec.		
Cement						
Devil's Slide plant and quarry.	Ideal Basic Industries, Inc	Cement rock, sandstone.	Morgan	4 N., 4 E., 19	Jurassic Twin Creek Limestone. Triassic/Jurassic Nugget Sandstone.	Cement.
Poverty Point quarry	do	High-Ca limestone	Tooele	1 N., 8 W., 16	Mississippian Great Blue Limestone.	Do.
Leamington (Chaffin) cement plant & quarry.	Ash Grove Cement West, Inc	High-Ca limestone, shale.	Juab	14 S., 3 W., 33	Cambrian Ophir Shale	Do.
Nielson quarry	do	Sandstone	do	14 S., 3 W., 11	Permian Diamond Creek(?) Sandstone.	Do.
Halite						
Great Salt Lake Minerals and Chemicals ponds and plant.	Great Salt Lake Minerals and Chemicals Co	Sodium chloride	Weber	6 N., 3 W., 6	Recent surface brines	Road salt, water-softening salt, and livestock salt.
Morton Salt ponds and plant.	Morton Salt Co	do	Salt Lake	1 S., 2 W., 5	do	Table salt, road salt, water-softening salt.
Akzo Salt ponds and plant.	Akzo Salt Co	do	Tooele	1 S., 4 W., 34	do	Do.
American Salt ponds plant.	American Salt Co	do	Tooele	1 S., 6 W., 22	do	Road salt, water-softening, livestock salt.
Moab Salt plant	Texasgulf, Inc	do	Grand	26 S., 20 E., 24	Pennsylvanian Paradox Formation	Road salt.
Redmond Clay and Salt pits and plant.	Redmond Clay and Salt Co.	do	Sanpete	20 S., 1 W., 14, 23, 24, 25	Jurassic Arapien Shale	Livestock salt, table salt.
Crystal Peak ponds and plant.	Crystal Peak Minerals Corp.	do	Millard	24 S., 12 W., 16	Quaternary lake sedimentary deposits.	Road salt, water-softening salt.
Potash, magnesium chloride, and sodium sulfate						
Great Salt Lake Minerals and Chemicals ponds and plant.	Great Salt Lake Minerals and Chemicals Co.	Potassium sulfate, sodium sulfate, magnesium chloride.	Weber	6 N., 3 W., 6	Recent surface brines	Fertilizer, detergent, paper making, road-dust suppression.

Reilly Wendover ponds and plant.	Reilly Tar and Chemicals Co.	Potassium chloride	Tooele	1 S., 19 W., 14	Quaternary and Holocene lake sedimentary deposits.	Fertilizer.
Texasgulf mine, ponds, and plant.	Texasgulf, Inc	do	Grand	26 S., 20 E., 24	Pennsylvanian Paradox Formation.	Do.
Magcorp ponds and plant.	Magnesium Corp. of America.	Magnesium chloride	Tooele	2 N., 8 W., 10	Holocene surface brines	Magnesium metal.
		Phosphate				
Little Brush Creek mine and mill.	Chevron Resources Co.	Phosphate	Uintah	2 S., 22 E., 31	Permian Park City Formation	Fertilizer raw material.
Phoston terminal (defunct)	do		Wasatch	2 S., 5 E., 6		
Garfield plant	do		Salt Lake	1 S., 3 W., 10;		
Rock Springs fertilizer plant.	do	Phosphate fertilizer	Sweetwater, WY.	18 N., 104 W., 9, 15, 16, 17 (X)		Fertilizer.
		Limestone and dolomite				
Chemstar, Inc., quarry and kiln.	Chemstar, Inc	Dolomitic lime	Tooele	1 S., 7 W., 25	Ordovician Fish Haven Dolomite	Masonry mortar, dolomitic lime.
U.S. Pollution Control, Inc., kiln.	U.S. Pollution Control, Inc.		do	1 N., 9 W., 2		
Marblehead quarry	Utah Marblehead Lime Co.	Dead-burned dolomite, dolomitic lime.	do	2 N., 9 W., 22	Cambrian Lynch Dolomite	Refractories, waste disposal.
Cricket Mountain quarry and kiln.	Continental Lime, Inc.	High-Ca limestone	Millard	21 S., 10 W., 36	Cambrian Dome Formation	Flue-gas desulfurization water treatment, metal-smelting flux.
Keigley quarry	Geneva Steel of Utah.	Dolomite, limestone	Utah	9 S., 1 E., 27	Cambrian Bluebird Dolomite, Cole Canyon Dolomite, Herkimer Limestone.	Metal-smelting flux, coal-mine dusting.
Redmond quarry	Western Clay Co	High-Ca limestone	Sevier	21 S., 1 E., 5, 7, 18, 7, 8	Tertiary Flagstaff Limestone	Coal-mine dusting.
Oolite claims	Magnesium Corp. of America.	Calcareous sand	Tooele	3 N., 6 W., 19, 24; 3 N., 7 W., 9, 16, 17, 20, 31	Holocene oolitic sand	Flue-gas neutralization.
Beaver Dam quarry	L&M General Engineering.	High-Ca limestone	Washington	43 S., 18 W., 2	Mississippian Redwall Limestone	Gold heap leaching.
Pelican Point calcite mine and mill.	Cedarstrom Calcite and Clay.	Calcite	Utah	6 S.,1 E., 30, 31	Mississippian Humbug Formation, Deseret Limestone Great Blue Limestone.	Poultry grit, livestock-feed supplement.
Pelican Point limestone quarry and mill.	Larsen Limestone Co.	High-Ca limestone	Utah	6 S., 1 E., 31	Mississippian Deseret Limestone	Flue-gas desulfurization.

Appendix 2.—Continued

Quarry, pit, or plant	Operator	Commodity	Location		Age/formation	Use/products
			County	T., R., sec.		
Clays						
West Jordan plant	Interstate Brick Co		Salt Lake	3 S., 2 W., 12		Brick.
Pelican Point pits:						
Powell pit	do	Common clay	Utah	6 S., 1 W., 3	Mississippian Manning Canyon Shale.	Do.
Smoky Joe pit	do	do	do	7 S., 1 W., 9	do	Do.
Jim Gay pit	do	do	do	7 S., 1 W., 12, 13; 7 S., 1 E., 7, 18	do	Do.
Black Shale pit	do	do	Utah	6 S., 1 W., 36	do	Do.
Fivemile Pass pits	do	do	Tooele	7 S., 3 W., 4, 5	Mississippian Long Trail Shale Member of the Great Blue Limestone.	Do.
Montello pits	do	do	Box Elder	9 N., 17 W., 7; 9 N., 18 W., 12	Tertiary Salt Lake Formation	Do.
Anderton pit	do	do	Summit	4 N., 4 E., 33	Cretaceous Henefer Formation	Do.
Koosharem pit	do	do	Piute	27 S., 2 W., 2, 11	Tertiary Dry Hollow Formation	Do.
Harrisville plant	Interpace Corp	do	Weber	6 N., 1 W., 6		Do.
Pleasant View pit	do	do	Box Elder	7 N., 2 W., 13	Precambrian and Cambrian weathered schist.	Do.
Clinton pit	do	do	Utah	5 S., 1 W., 8, 9	Mississippian Manning Canyon Shale.	Do.
Redmond Clay pits	Redmond Clay and Salt Co.	Bentonite	Sanpete	20 S., 1 W., 14, 23, 24, 25	Jurassic Arapien Shale	Construction clay, drilling mud.
Western Clay Co. mill	Western Clay Co		Sevier	22 S., 1W., 4		
Aurora pit	do	Fuller's earth	do	21 S., 1 W., 31	Tertiary Bald Knoll Formation[1]	Filtration.
Redmond pit	do	Bentonite	do	21 S., 1 W., 2	Jurassic Arapien Shale	Construction clay.
Utelite quarry and kiln aggregate.	Utelite Corp	Bloating shale	Summit	1 S., 5 W., 5, 18	Cretaceous Mancos Shale	Lightweight aggregate.

Gypsum						
Georgia Pacific plant and pits.	Georgia Pacific Corp.	Gypsum	Sevier	22-23 S., 1-2 W.	Jurassic Arapien Shale	Wallboard, plaster, cores for fire-proof doors.
Mayfield quarry	do	do	Sanpete	19 S., 2 E., 30	do	Do.
San Rafael quarry	do	do	Emery	22 S., 9 E., 19	Jurassic Carmel Formation	Do.
U.S. Gypsum plant and pits.	U.S. Gypsum Co	do	Sevier	22 S., 1 W., 14, 15, 22, 23; 22 S., 2 W., 36; 23 S., 2 W., 1	Jurassic Arapien Shale	Wallboard, plaster, wallboard joint compound.
Nephi quarry	T.J. Peck and Sons	do	Juab	12 S., 1 E., 27; 13 S., 1 E., 3	do	Cement retarder.
Davis quarry	H.E. Davis	do	do	14 S., 1 E?	do	Do.
Welch quarry	Lanny Jensen (operator).	do	Emery	22 S., 9 E., 29	Jurassic Carmel Formation	Do.
Bloomington Hills quarry.	Standard Gypsum Products.	do	Washington	43 S., 15 W., 17, 18, 19, 20	Triassic Moenkopi Formation	Agricultural gypsum.
Whitecloud quarry	Sutherland Brothers	do	Emery	24 S., 13 E., 15	Jurassic Carmel Formation	?

[1]Bald Knoll Formation of Gillilard (1951).

Appendix 3. "Strawman" proposal for an industrial-minerals coalition in the Western United States as the basis for its consideration by the workshop

Coalition Objectives.—The purpose of forming a *Western States Industrial Minerals Coalition* would be to address the serious issues that affect the availability of these commodities and to ensure that they remain available for use as the States continue to grow and as land-management plans evolve. State participants would be the foundation of any interstate coalition.

It is envisioned that a consortium of representatives from committees in each of the participating States would meet regularly, or as needed, to consider local and State industrial-mineral problems or concerns and the best ways to solve or ameliorate them. The State-committee constituencies ought to be broadly inclusive groups representing the industrial-minerals industry, academia, geological and mining surveys, local, State, and Federal land managers and regulators, environmental planners, and major users of resources and related geoscience information. For the most part, Federal-agency participation in the State committees and the regional coalition may be primarily as a facilitator-advisor and support resource.

A formal or informal coalition of the State committees could then establish and prioritize the significant regional and local resource issues presented by each State. The coalition might also identify the program areas for which States can contribute needed information or perform needed research. The coalition could address how best to obtain public visibility through publications, hearings, or public forums. Finally, the coalition would need to act jointly to obtain funds from Federal, State, or other institutional sources if that is necessary to support high-priority joint projects.

The principal immediate objectives of the coalition would be to identify and address policy issues affecting industrial-minerals availability. However, the ultimate effectiveness of the coalition would be measured by its performance of specific tasks, one of which might be the application of new technologies to industrial-minerals issues. State agencies and academic institutions should cooperate with the Federal Government to identify the investigations needed to bring new technologies to bear on industrial-minerals issues. Examples of such contributions might be the implementation of a GIS, materials testing and applications research, or regional resource evaluations. This research and the other activities of the coalition should be published regularly, so that its workings are made available to the general public. The Western United States industrial-minerals coalition would also provide a way to advise on Federal land-use policy issues, such as those involving interactions with the BLM or the USFS.

Proposed organizational plan.—The State geologists (or State mining associations) in the West could appoint committees composed of members of the resource constituency from each State. From this representative group, a steering committee could be selected to examine the State's current and projected (10–20 year) resource position, prioritize the importance to the State, and recommend action(s) on them or propose special subcommittee studies. The steering committee could also begin the process of establishing local sources of funding support to assure continuity of the special activities of the committee. The coalition would consist of representatives from the State committees; such a coalition would have the option to stand alone as a new organization or to become affiliated as a committee or subgroup in an existing interstate organization, such as the Interstate Mining Compact Commission or the Western State Governors' Association.

Suggestions for coalition actions.—The following are several problem areas that might be considered by the State coalitions. These are issues that were identified during the Arizona and California industrial minerals workshops. Other topics could be added as the coalitions become more firmly established.

1. Develop a broadly based, unified, and clearly visible resource education position for the West that expresses the importance of and need for industrial minerals, particularly those required to provide housing, food, jobs, and economic infrastructures. This effort could also provide a reliable source of information for policy decisions.
2. Make periodic reviews of the status of resource development, identify priority problem areas that may exist, and consider solutions from the broad perspective of the coalition members.
3. Foster information and technology sharing and transfer, share expertise and personnel, and develop closer ties with universities to assist faculty and student research and develop jobs. Seek establishment of a source of funds to strengthen industrial-minerals research and technology and to assess the needs for and availability of industrial minerals.
4. Provide a central source of reliable resource information for government and private users and develop the method(s) to ensure that this information gets to the right place at the right time.

Appendix 4. Structure of a formal coalition such as the Interstate Mining Compact Commission, *by* G.E. Conrad

Organizing a Compact

Three basic steps in formulating an interstate compact have developed through practice:

- Negotiation
- Drafting of the compact document
- Ratification

Negotiation and drafting were done by joint commissions composed of governor-appointed representatives of each participating State until 1930. Since the 1930's, the procedure has been less formal. Usually, a proposed compact is drafted by State officials who want to address a particular problem. Negotiation with other States is accomplished through interstate forums or regional conferences.

Another method of negotiation and drafting is for a group like the National Conference of State Legislators or the Council of State Governments to propose an interstate compact. The first State to enact the compact is the offerer, and States that subsequently enact the compact are acceptors. Ratification of a compact by each member State is almost always done by enacting the compact as a statute.

Formal approval of the U.S. Congress is sometimes required before a compact can become effective. The U.S. Constitution provides the following: "No State shall, without the consent of Congress, ... enter into any agreement or Compact with another State..." U.S. Const., Art. I, Sec. 10, cl. 3.

Congressional consent to a compact is required only for those agreements that affect the political balance within the Federal system or affect a power delegated to the National Government. The consent requirement applies only to those compacts tending to increase the political power in the States at the expense of the Federal Government. See *Virginia* v. *Tennessee.*

The U.S. Supreme Court developed a two-part test to use in deciding whether a compact impermissibly enlarges State power: (1) whether the compact attempts to authorize member States to exercise any powers they could not exercise in the absence of a compact; and (2) whether there has been delegation by the States of their sovereign power to the commission administering the compact. See *United States Steel Corp.* v. *Multistate Tax Commission*, 434 U.S. 452 (1978).

In spite of the test developed in *Multistate*, uncertainties remain in trying to determine when congressional consent is required. A recommended "safe course" is that, if the compact enters a field of Federal concern and sensitivity, such as nuclear energy, air and water pollution, flood control, or air transportation, the States should seek congressional consent.

There are several common and general features of an interstate compact, including:

- Purpose provisions
- Definition of terms
- Who will administer the compact (be it an existing agency, individual administrator, or newly created agency)
- If an intergovernmental agency is created:
  - what the internal management and powers of the agency will be
  - what law will govern the agency's finances, personnel policies, and the judicial review of its acts
- What event will make the compact take effect (for example, enactment by a certain number of States)
- Provisions for amendment and review
- Withdrawal or termination clauses
- Construction and severability provisions
- Enabling and consent legislation

Advantages and Disadvantages of Coalitions

There are several arguments for and against the use of interstate compacts, including:

For:

- The interstate compact is a means for the States to preserve their positions in the federal system and to reduce the burden on the Federal Government.
- The interstate compact is the best device for bridging jurisdictional barriers.
- There are certain types of interstate activity in which there is a need for uniformity.
- The compact device has been widely used to establish permanent channels of interstate relations and consultations, notably by creating an interstate study commission.
- The interstate compact can be the most effective way for the establishment of joint agencies of two or more States.
- Compacts take precedence over ordinary State statutes; therefore, they represent one of the most powerful constitutional tools for intergovernmental action.

Against:

- It can take years to negotiate, enact, and secure consent to a compact. The difficulty of amending compacts and the need for Congressional consent to changes makes compacts inflexible. Including provisions for the method of amendment and review in a compact can help reduce this problem.
- Enactment of a compact usually reduces a State's sovereign power, and so the State should weigh the benefits derived from the compact against that possible loss before joining an interstate compact.

Appendix 5. Amendments to California's SMARA legislation (Beeby, 1990), which became effective January 1, 1991

[Reprinted from California Mining Journal (1990)]

SMARA Significantly Amended In 1989/90 Legislative Session

Sacramento, California—California's Surface Mining and Reclamation Act (SMARA) has been significantly amended by Assembly Bills 3551 and 3903. The amendments, which take effect January 1, 1991, substantially change the role of regulators and the requirements of surface mining operations for mining and reclamation practices statewide.

The new provisions of law are as follows:

° Amend Section 2207 of the Public Resources Code (PRC) to require that an annual report containing specified information, together with a reporting fee, be submitted to the State Geologist on any mining claim operation within California. The same report (minus a reporting fee and information on mineral production and commodities produced) would also be submitted by the operator to the lead agency. Reporting is required by July 1, 1991 for the first year, and by an anniversary date established by the Department of Conservation annually thereafter.

° Establish the maximum per mine fee at $2,000, and a minimum per mine fee at $50. Require the State Mining and Geology Board ("the Board") to establish, by regulation, a fee schedule, and to adjust that schedule annually to maintain the program within the limits established by law.

° Define "idle mines" and require interim management plans for mines desiring to maintain idle status (as opposed to active or abandoned status).

° Authorize the State Geologist to collect costs associated with completing mineral land classification studies on behalf of a petitioner, from that petitioner.

° Require lead agencies to adopt statements of findings when allowing land uses in classified and/or designated resource areas that would preclude future development of the identified mineral resource. Requires that these statements be forwarded to the State Geologist and the Board.

° Require financial assurances of all surface mining operations to guarantee site reclamation. Require that financial assurances be payable to the lead agency and the State Geologist, that financial assurances be submitted to the State Geologist for his review and comment, a review and approval period for financial assurances, a financial assurance appeals process to the Board, and that the Board establish regulations expanding the criteria for types of acceptable financial assurances.

° Require State Geologist action to forfeit financial assurances and complete reclamation in specified cases.

° Establish noticing and hearing procedures for the Board to follow when determining lead agency jurisdiction, and allow operators to bring a lead agency jurisdictional issue to the Board's attention.

° Require the Board to adopt specific minimum, verifiable reclamation standards (to be in place by January 1, 1992).

° Authorize lead agencies to charge mining operations for their costs of administering SMARA.

° Require lead agencies to annually inspect mining operations to determine SMARA compliance, and require lead agencies to notify the State Geologist of inspection results. Lead agencies, when conducting such inspections, must utilize a State-issued form.

° Require lead agencies to forward copies of approved permits, approved reclamation plans, amendments to permits and reclamation plans, and proof of inspections to the State Geologist.

Amendments and issues arising from these amendments are very complex. The Board indicates that it will be very active in the coming months developing policies and procedures to assist in the implementation of these provisions. Regulations for the fee schedule, reclamation standards, Board assumption of lead agency duties, financial assurances, appeals processes, and administrative penalties/violations processes will be developed. Readers that would like to receive notification of Board activities in this regard may request to be added to the Board's mailing list by contacting the Board's Secretary, Ms. Blanda Duncan, State Mining and Geology Board, 1416-9th Street, Room 1326-A, Sacramento, CA 95814, (916) 322-1082.

SMARA applies to all surface mining operations in California, including projects located on federally managed lands. The SMARA "lead agency" for these projects remains the city or county jurisdiction.

Reclamation plan approvals, including the new requirement for financial assurances of all surface mining operations, must be obtained from the SMARA lead agency.

Questions may be referred to Ms. Deborah Herrmann,Special Representative, State Mining and Geology Board, 1416-9th Street, Room 1326-A, Sacramento, CA 95814, (961) 322-1082. □

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