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Principles of the Mineral Resource Classification System of the U.S. Bureau of Mines and U.S. Geological Survey

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MINERAL RESOURCE CLASSIFICATION SYSTEMS OF THE
U.S. BUREAU OF MINES AND U.S. GEOLOGICAL SURVEY

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*Definitions of mineral resource classification
terms used by the U.S. Bureau of Mines and
U.S. Geological Survey*



UNITED STATES DEPARTMENT OF THE INTERIOR

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GEOLOGICAL SURVEY

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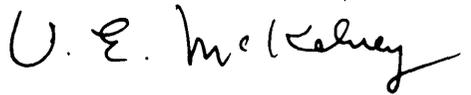
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FOREWORD

In order to use mineral resource terms with precision and common understanding and to compare resource data effectively, a joint U.S. Bureau of Mines and U.S. Geological Survey work group developed a standardized, definitive, broadly applicable classification system to derive uniform, coordinated resource estimates. This report presents the results of the work group that developed the basic terms of mineral resource classification. Other chapters in this series will present classification terms for specific commodities.



Thomas V. Falkie
Director, Bureau of Mines



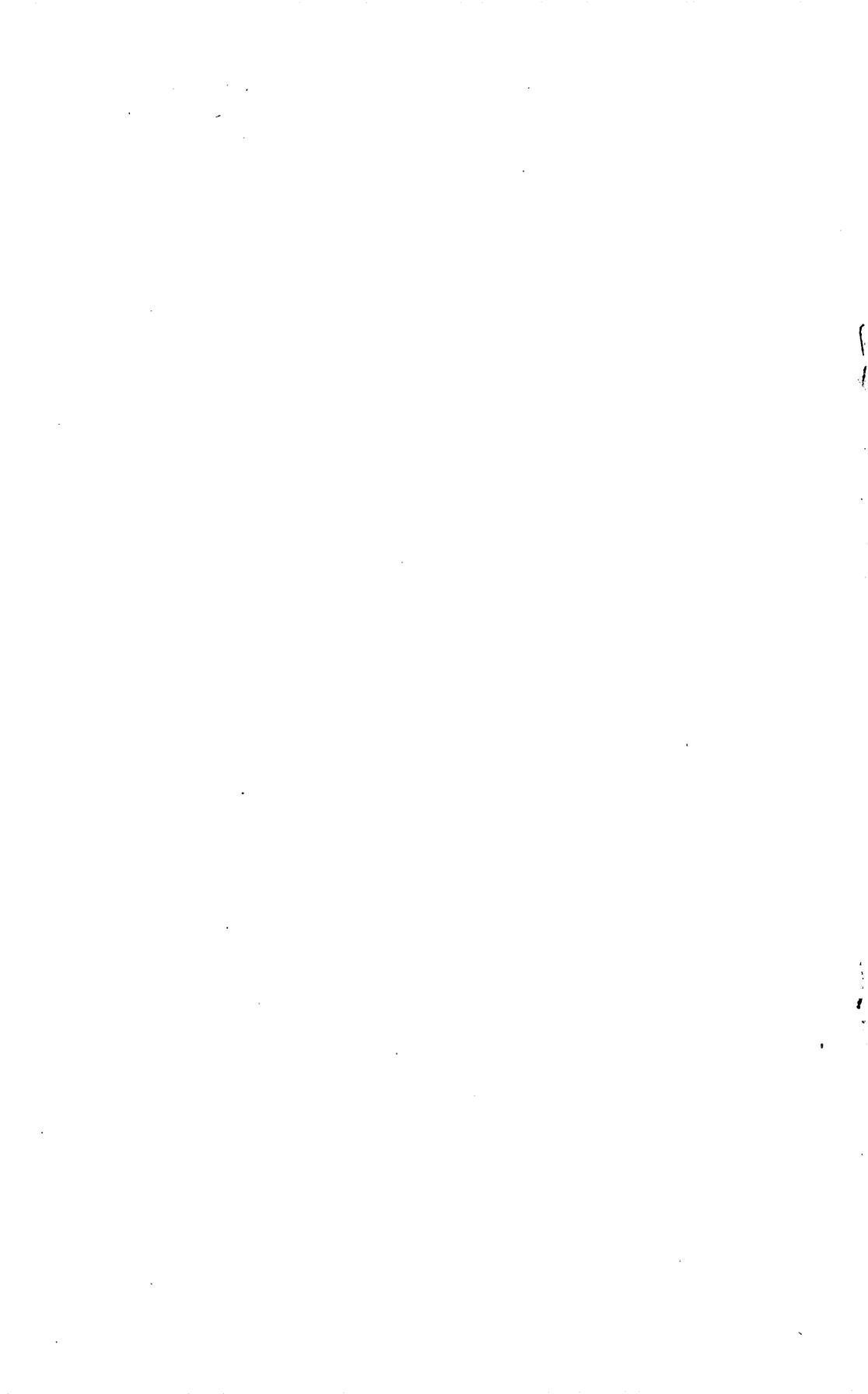
V. E. McKelvey
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CONTENTS

	Page
Foreword	III
General definition of mineral and energy resources	A1
Philosophic basis for a resource classification	1
Glossary of resource terms	2
Areas of responsibility and operational procedures	4

ILLUSTRATION

	Page
FIGURE 1. Classification of mineral resources	A2



MINERAL RESOURCE CLASSIFICATION SYSTEMS OF THE
U.S. BUREAU OF MINES AND U.S. GEOLOGICAL SURVEY

**PRINCIPLES OF THE MINERAL
RESOURCES CLASSIFICATION SYSTEM
OF THE U.S. BUREAU OF MINES
AND U.S. GEOLOGICAL SURVEY**

GENERAL DEFINITION OF MINERAL AND ENERGY
RESOURCES

The dictionary definition of resource "something in reserve or ready if needed" has been extended for mineral and energy resources to comprise all materials surmised to exist having present or future values. In geologic terms a mineral or energy resource is a concentration of naturally occurring solid, liquid, or gaseous materials in or on the Earth's crust in such form that economic extraction of a commodity is currently or potentially feasible. Material classified as a reserve is that portion of an identified resource producible at a profit at the time of classification.

Total Resources are materials that have present or future value and comprise identified or known materials plus those not yet identified, but which on the basis of geologic evidence are presumed to exist.

PHILOSOPHIC BASIS FOR A RESOURCE CLASSIFICATION

Public attention usually is focused on current economic availability of mineral or energy materials (reserves). Long-term public and commercial planning, however, must be based on the probability of geologic identification of resources in as yet undiscovered deposits and of technologic development of economic extraction processes for presently unworkable deposits. Thus, all the components of Total Resources must be continuously reassessed in the light of new geologic knowledge, of progress in science, and of shifts in economic and political conditions.

Another requirement of long-term planning is the weighing of total or multi-commodity resource availability against a particular need. To achieve this the general classification system must be uniformly applicable to all commodities so that data for alternate or substitute commodities can be compared.

A2 MINERAL RESOURCE CLASSIFICATION SYSTEMS

To serve these planning purposes Total Resources are classified both in terms of economic feasibility and of the degree of geologic assurance. The factors involved are incorporated in figure 1 to provide a graphic classification of Total Resources.

General guides for the use of this classification system are as follows:

1. Resource categories and definitions in the classification, as specified in the glossary, should be applicable to all naturally occurring concentrations of metals, nonmetals, and fossil fuels. The categories may be subdivided for special purposes.
2. Definitions may be amplified, where necessary, to make them more precise and conformable with accepted usage for particular commodities or types of resource evaluations.
3. Quantities and qualities may be expressed in a variety of terms and units to suit different purposes, but must be clearly stated and defined.

GLOSSARY OF RESOURCE TERMS

Resource.—A concentration of naturally occurring solid, liquid, or gaseous materials in or on the Earth's crust in such form

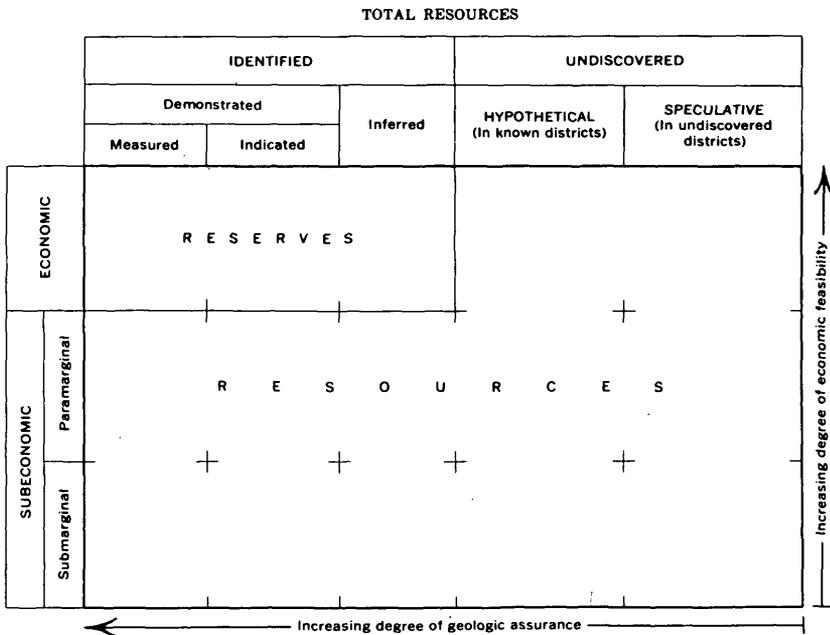


FIGURE 1.—Classification of mineral resources.

that economic extraction of a commodity is currently or potentially feasible.

Identified resources.—Specific bodies of mineral-bearing material whose location, quality, and quantity are known from geologic evidence supported by engineering measurements with respect to the demonstrated category.

Undiscovered resources.—Unspecified bodies of mineral-bearing material surmised to exist on the basis of broad geologic knowledge and theory.

Reserve.—That portion of the identified resource from which a usable mineral and energy commodity can be economically and legally extracted at the time of determination. The term *ore* is used for reserves of some minerals.

The following definitions for measured, indicated, and inferred are applicable to both the Reserve and Identified-Subeconomic resource components.¹

Measured.—Reserves or resources for which tonnage is computed from dimensions revealed in outcrops, trenches, workings, and drill holes and for which the grade is computed from the results of detailed sampling. The sites for inspection, sampling, and measurement are spaced so closely and the geologic character is so well defined that size, shape, and mineral content are well established. The computed tonnage and grade are judged to be accurate within limits which are stated, and no such limit is judged to be different from the computed tonnage or grade by more than 20 percent.

Indicated.—Reserves or resources for which tonnage and grade are computed partly from specific measurements, samples, or production data and partly from projection for a reasonable distance on geologic evidence. The sites available for inspection, measurement, and sampling are too widely or otherwise inappropriately spaced to permit the mineral bodies to be outlined completely or the grade established throughout.

Demonstrated.—A collective term for the sum of measured and indicated reserves or resources.

Inferred.—Reserves or resources for which quantitative estimates are based largely on broad knowledge of the geologic charac-

¹The terms proved, probable, and possible (used by the industry and economic evaluations of ore in specific deposits or districts) commonly have been used loosely and interchangeably with the terms measured, indicated, or inferred (used by the Department of the Interior mainly for regional or national estimates). The terms "proved" and "measured" are essentially synonymous. The terms "probable" and "possible," however, are not synonymous with "indicated" and "inferred." "Probable" and "possible" describe estimates of partly sampled deposits—in some definitions, for example, "probable" is used to describe deposits sampled on two or three sides, and "possible" for deposits sampled only on one side; in the Bureau-Survey definitions, both would be described by the term "indicated."

ter of the deposit and for which there are few, if any, samples or measurements. The estimates are based on an assumed continuity or repetition, of which there is geologic evidence; this evidence may include comparison with deposits of similar type. Bodies that are completely concealed may be included if there is specific geologic evidence of their presence. Estimates of inferred reserves or resources should include a statement of the specific limits within which the inferred material may lie.

Identified-Subeconomic.—Resources that are not Reserves, but may become so as a result of changes in economic and legal conditions.

Paramarginal.—The portion of Subeconomic Resources that (1) borders on being economically producible or (2) is not commercially available solely because of legal or political circumstances.

Submarginal.—The portion of Subeconomic Resources which would require a substantially higher price (more than 1.5 times the price at the time of determination) or a major cost-reducing advance in technology.

Hypothetical resources.—Undiscovered resources that may reasonably be expected to exist in a known mining district under known geologic conditions. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as a Reserve or Identified-Subeconomic resource.

Speculative resources.—Undiscovered resources that may occur either in known types of deposits in a favorable geologic setting where no discoveries have been made, or in as yet unknown types of deposits that remain to be recognized. Exploration that confirms their existence and reveals quantity and quality will permit their reclassification as Reserves or Identified-Subeconomic resources.

AREAS OF RESPONSIBILITY AND OPERATIONAL PROCEDURES

U.S. Bureau of Mines.—The Bureau appraises, analyzes, and publishes reserve estimates from base data supplied by the mineral and energy materials industry, the U.S. Geological Survey, and other governmental agencies. The Bureau judges commodity recoverability on existing economic and legal factors.

U.S. Geological Survey.—The Survey appraises, analyzes, and publishes estimates of Total Resources. It reports such measurable parameters of significance to resource evaluation as location, quality, quantity, and situation of Identified resources.

Annual Resource Summation.—The U.S. Bureau of Mines and U.S. Geological Survey will confer and agree annually on estimates in all of the resource categories defined above. These data will be in Bureau or Survey publications and will be available for inclusion in the Secretary's Annual Report required by the Mining and Minerals Policy Act of 1970.

Ad Hoc Joint Conferences.—The Directors will convene ad hoc joint work groups to resolve problems in the resource area.