U.S. Geological Survey / Department of the Interior

# U.S. Geological Survey:
## Earth Science in the Public Service

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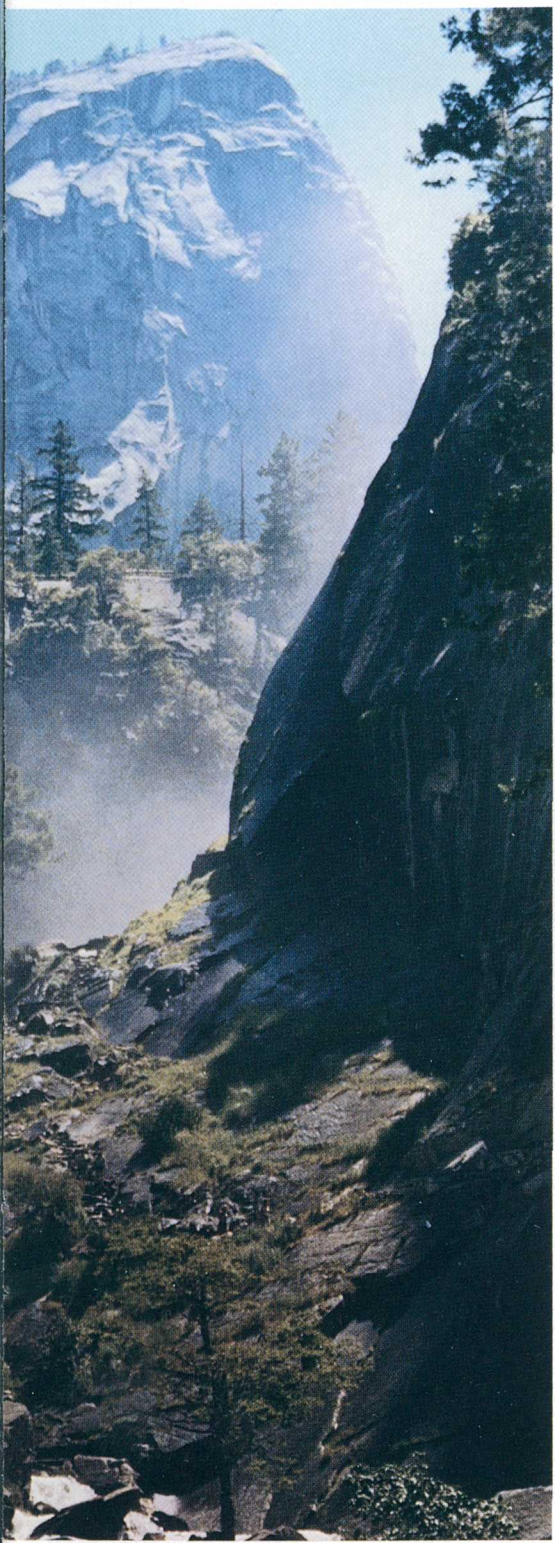


# National Earth Science Issues

Our Nation faces some serious questions concerning the availability and use of land, water, energy, and mineral resources of the Earth. How can we ensure an adequate supply of critical resources in the future? In what ways are we irreversibly altering our natural environment when we use these resources? How can we prevent or mitigate the effects of natural hazards? Our responses to these and similar questions depend on continually increasing our knowledge about the structure, resources, and dynamics of the Earth.

Providing the scientific information necessary to answer these questions is the primary mission of the U.S. Geological Survey (USGS), a bureau of the United States Department of the Interior. Such information is essential for the public and its officials to make informed decisions concerning the wise use of our precious and finite resources; these decisions, in turn, affect our standard of living, our economic growth, and our national security.

Vernal Falls, Yosemite National Park.

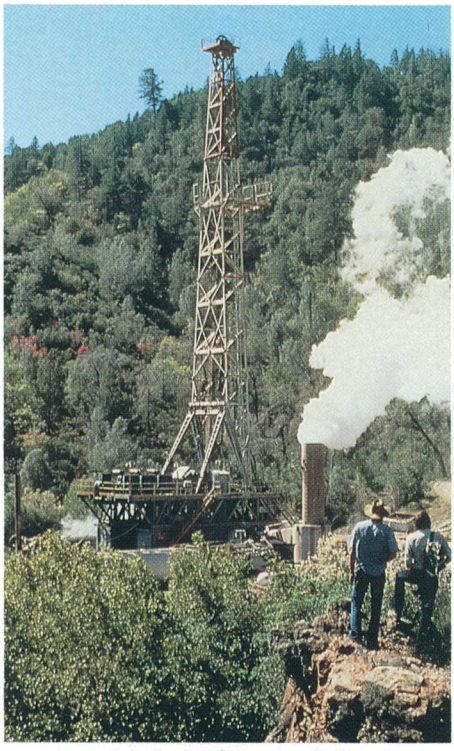
Some of the earth-science issues that we must consider are:

## Energy

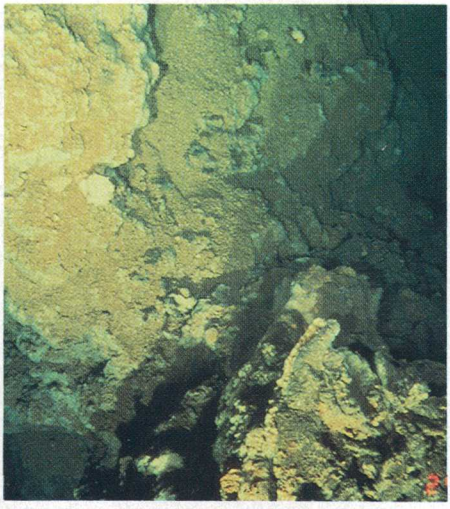
Our dependence on nonrenewable conventional energy sources such as oil, gas, and coal requires continuing efforts by earth scientists not only to locate new supplies but also to understand the genesis of these resources and to maintain current knowledge of their changing supply, demand, and discovery worldwide. Because conventional energy sources are limited, continued geologic studies are needed to prepare for future use of alternative sources such as oil shale, geothermal energy, and nuclear energy.

## Minerals

The expanding population of our modern industrial society requires increasingly larger quantities of minerals each year. Today, we are significantly dependent on foreign sources for at least 20 strategic and critical minerals. Geologic investigations are needed to appraise the mineral resource potential of onshore and offshore lands, to determine the long-term, worldwide availability of mineral commodities, and to provide essential perspectives on the local, regional, and global environmental impacts of mineral extraction.



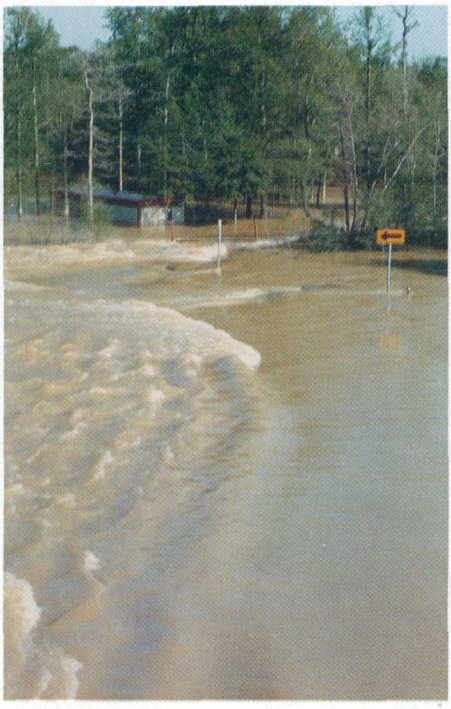
Geothermal well, the Geysers, California.



Sulfide mineral deposits on Juan de Fuca Ridge of the Pacific Ocean floor contain valuable mineral ores.

## Water

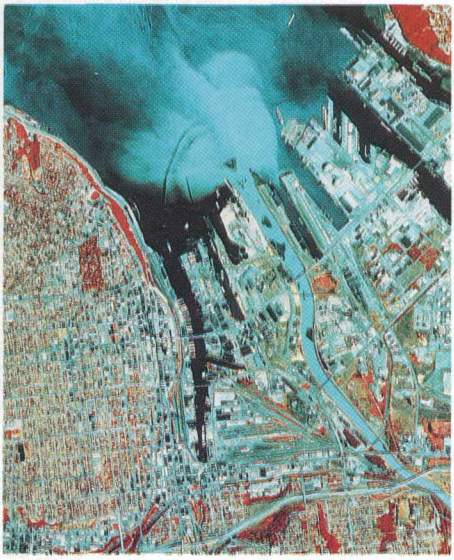
Water, a necessity for all living things, is also a key to future economic growth, particularly for the production of food and energy. Water use in the United States has more than doubled since 1950; at the same time, water-quality problems are limiting the available supply. Where will future supplies come from? Information on location, quantity, quality, and use is essential to effectively manage water resources and to predict the effects of future water development on the Nation's abundant, but often vulnerable, water supplies.



Backwater from flooding Pearl River near Slidell, Louisiana.

## Land

As the surface of our land changes from natural causes and human activities, the need for current and more detailed cartographic and geographic information increases. Conflicting uses and demands for land—for wilderness protection, for agriculture, for urban development, or for mining production—are often unavoidable. Managers must weigh the benefits of these potential uses against the potential impacts on the land. Topographic maps, land-use maps, computerized cartographic data, and images and data collected from spacecraft and aircraft are essential tools for use in identifying, locating, measuring, and comparing natural and manmade features necessary for the effective management of land resources.



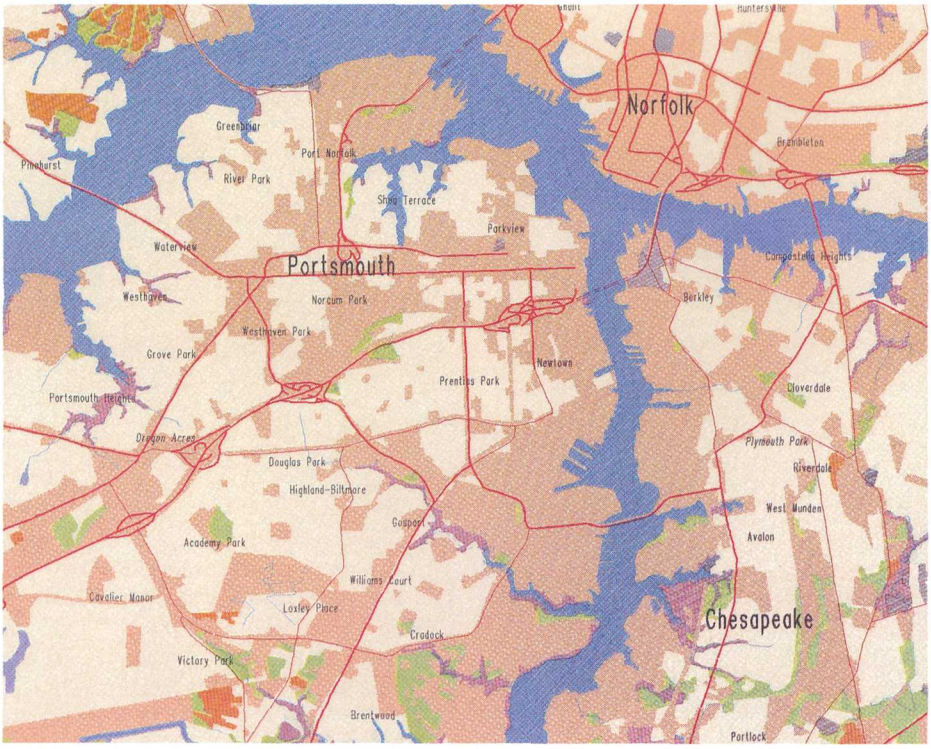
Color-infrared National High Altitude Photography (NHAP) of Tacoma, Washington.

## Agriculture and Irrigation

Soil and water are the essential resources needed to produce the Nation's food. Land and water managers need information on the processes that affect soils: processes that create them, that add and subtract minerals and chemically change them, and that erode and remove them. Accumulation of salts and other chemicals—either natural or applied by man—can make soils and water unproductive or toxic. Sustained agricultural production will depend on obtaining and applying better information about soil and water processes.

## Housing and Transportation

Deciding where new roads and powerlines should be built, where pipelines can be laid, or where new housing developments can be placed to accommodate our growing population requires an understanding of the engineering properties of rocks and soils, the slope of the land, and the potential for natural hazards such as earthquakes or flooding. Topographic, geologic, and flood-hazard maps are invaluable earth-science information tools used by planners and managers to evaluate the suitability of areas for further development.



Computer-based land-use map of Norfolk area, Virginia.

## Public Safety

Geologic and hydrologic hazards—such as earthquakes, volcanic eruptions, floods, tsunamis, subsidence, and landslides—threaten lives and cause billions of dollars of damage each year. Earth-science information can be used to delineate flood-prone areas, to determine geologically hazardous zones, and to evaluate future risks to people and property. By developing the means to forecast where hazardous events may occur and how severe they might be, earth sciences can aid in land-use planning, engineering design, and emergency-preparedness decisions.

Debris deposits from the summer 1980 eruption of Mount St. Helens, Washington.

# USGS: A Tradition of Public Service

Collecting, analyzing, and disseminating earth-science information to solve problems concerning the natural resources of the Nation has been an integral part of the USGS mission since its creation in 1879. A long tradition of providing accurate and impartial information to all underscores our continued dedication to "Earth Science in the Public Service."

The USGS was established on March 3, 1879, by an act of Congress to provide a Federal agency to conduct systematic and scientific "classification of the public lands, and examination of the geological structure, mineral resources, and products of the national domain." The USGS almost immediately began topographic surveys to prepare reliable maps of the Nation and, in 1888, began irrigation surveys to measure the flow of the Nation's streams. These basic tasks were expanded in 1962, when Congress authorized the USGS to examine the ocean floor and certain other areas outside the United States and its territories. The establishment in 1983

Drawing of the Grand Canyon, W.H. Holmes, circa 1882.

of the U.S. Exclusive Economic Zone (EEZ), which stretches 200 nautical miles seaward from the Nation's coastline, increased significantly the area within which mineral and energy resources must be assessed.

The current mission of the USGS is to provide geologic, topographic, and hydrologic information that contributes to the wise management of the Nation's natural resources and that promotes the health, safety, and well-being of the people. This information consists of maps, data bases, and descriptions and analyses of the water, energy, and mineral resources, land surface, underlying geologic structure, and the dynamic processes of the Earth.

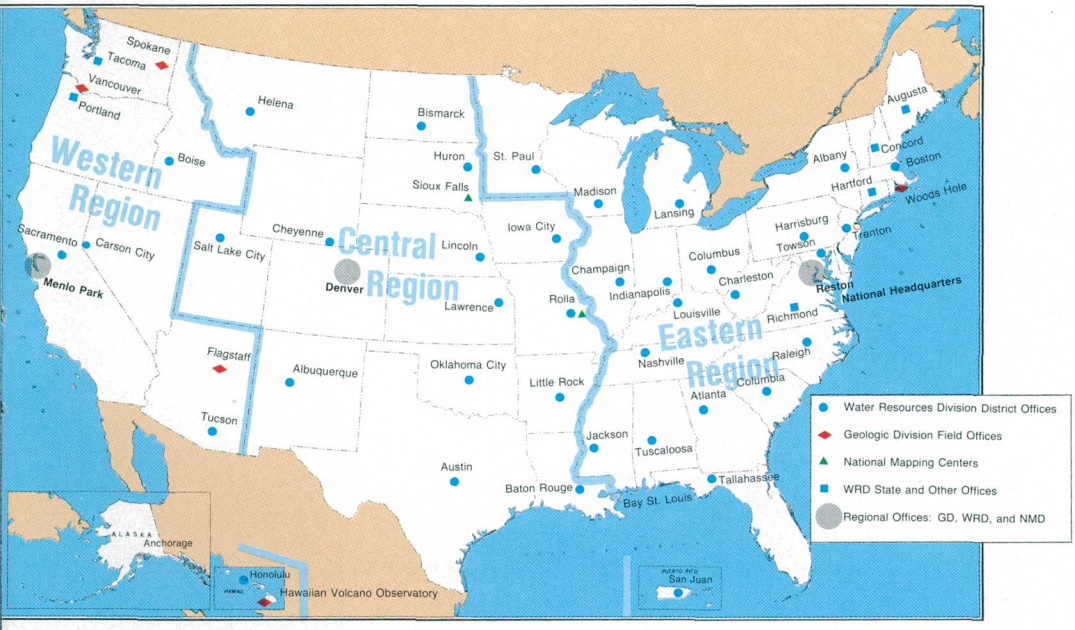
To accomplish its mission, the USGS:

- *Conducts and sponsors research in geology, hydrology, mapping, and related sciences and provides scientific support for legislative, regulatory, and management decisions.*
- *Produces and updates geographic, cartographic, and remotely sensed information in graphic and digital forms.*
- *Collects and analyzes data on the quantity and quality of surface water and ground water, on water use, and on quality of precipitation.*
- *Describes the onshore and offshore geologic framework of the Nation and develops an understanding of its formation and evolution.*
- *Assesses energy and mineral resources, determines their origin and manner of occurrence, and develops techniques for their discovery.*
- *Assesses water resources and develops an understanding of the impact of human activities and natural phenomena on hydrologic systems.*
- *Evaluates hazards associated with earthquakes, volcanoes, floods, droughts, toxic materials, landslides, subsidence, and other ground failures, and develops methods for hazards prediction.*

- *Publishes reports and maps, establishes and maintains earth-science data bases, and disseminates earth-science data and information.*
- *Coordinates topographic, geologic, and land-use mapping, digital cartography, and water-data activities with Federal, State, and local agencies, and with academia and industry.*

These varied scientific investigations require the coordinated efforts of scientists, engineers, and technical assistants from many different scientific fields. The USGS employs nearly 10,000 full- and part-time employees in some 200 field offices. It cooperates with other Federal agencies and with more than 900 State, county, and municipal agencies, as well as with other nations and international organizations, to accomplish its mission. Its scientific studies are conducted in the Geologic, Water Resources, and National Mapping Divisions, and the Information Systems and Administrative Divisions provide appropriate support for these activities.

USGS headquarters are located at its National Center in Reston, Virginia. Research and data-gathering programs are conducted at this center, major regional centers in Denver, *Colorado*, and Menlo Park, *California*, and at field offices located throughout the 50 States, the Commonwealth of Puerto Rico, and the Trust Territories of the Pacific.




USGS offices.

# USGS Activities

During the past 108 years, the research and fact-finding role of the USGS has grown and been modified to meet the changing needs of the Nation it serves. Today's programs serve a diversity of needs and users and include assessing the Nation's energy and mineral resources; providing information to enable society to mitigate the impacts of earth-science hazards, such as floods, earthquakes, and volcanoes; evaluating and monitoring the quantity, quality, and distribution of surface- and ground-water resources; operating the national mapping program; and providing detailed and innovative map products, such as computer-generated data for a variety of mapping and planning needs.

Along with its continuing commitment to meet the earth-science needs of the Nation, the USGS remains dedicated to its original mission to collect, analyze, interpret, publish, and disseminate information about the natural resources of the Nation. Specific responsibilities and programs are carried out by the Geologic, National Mapping, and Water Resources Divisions of the USGS.

San Andreas fault crossing the Carrizo Plain, Central Valley, California.

Geologist conducting field mapping study.

# Geologic Studies

Americans are becoming increasingly aware of our dependence on finite, nonrenewable natural resources for our economic well being and national defense and of our vulnerability to hazards such as earthquakes, landslides, and volcanic eruptions. As part of basic and applied geologic research programs that provide information for managing these resources and for reducing the destructive effects of hazardous geologic events, the USGS assesses the Nation's energy, land, and mineral resources and studies geologic features and processes through both field surveys and laboratory research.

## Major Geologic Activities

- *Mineral resources. The USGS assesses the distribution of the mineral resources of the United States, especially strategic and critical commodities, and studies the processes that control the occurrence of mineral deposits. New techniques and methods useful in the search for these resources are continually being developed.*
- *Energy resources. Investigations of the nature, extent, and origin of the Nation's coal, oil and gas, oil shale, uranium, and geothermal resources are a basic part of USGS research. Acquired data are placed in computerized data bases, such as the National Coal Resources Data System.*

Marine geologists deploying rock dredge to sample cobalt crusts.

- *Land resource surveys. The USGS conducts geologic mapping and gathers other basic information about the Nation's geologic framework and the processes that have shaped it. The USGS also determines the age and distribution of the different types of rocks, climatic changes and their effect on land and water resources, and variations in the Earth's gravity and magnetic field.*

- *Astrogeology surveys. The USGS conducts systematic geologic mapping and other scientific studies of the planets, their moons, and the other bodies of our solar system, supported principally by the National Aeronautics and Space Administration.*

Rock sampling for the Trans-Alaska Crustal Transect, Chugach Mountains, Alaska.

- *Geologic hazards. The USGS investigates hazards resulting from earthquake and volcanic activity, landslides, and subsidence, predicts hazardous geologic events, studies the Earth's internal structure, and identifies engineering problems created by geologic processes, including problems in the selection of sites for power stations, highways, bridges, dams, and hazardous waste disposal.*

- *Offshore geologic resources. Using remotely sensed data, including sidescan sonar and other geophysical surveys, and direct sampling, the USGS studies the geology and assesses the potential mineral and energy resources of the continental margins and the Exclusive Economic Zone of the United States and its territories. The USGS also identifies geologic features that must be considered in the selection of sites for offshore drilling platforms and pipelines.*

Volcanologists measuring changes in shape of the dome, Mount St. Helens, Washington.

Color-infrared photograph of Point Reyes National Seashore, California *(courtesy of NASA).*

# National Mapping Activities

Accurate topographic maps, which show the location and the measurable elevation of natural and manmade fatures, are needed not only for the study of geologic and hydrologic features, but also for local and regional planning, especially for planning and building highways, dams, and large structures. As part of its National Mapping Program, the USGS compiles, updates, and prints topographic maps as well as thematic maps that combine topographic data with other spatial data such as geology, hydrology, rainfall, land use, and population. Four regional Mapping Centers—at Reston, Virginia, Rolla, Missouri, Denver, Colorado, and Menlo Park, California—are responsible for map production and for coordinating joint mapping activities with other Federal and State agencies. Maps are sold through sales offices, State agencies, and thousands of private map dealers. Maps are also available for inspection at over 800 depositories and almost 100 map reference libraries across the country.

Personnel use electronic distance-measuring equipment near Death Valley National Monument.

## Major Mapping Activities

- *Topographic mapping and revision. The USGS produces topographic maps at various scales for various purposes and updates them as required. Most of the Nation is mapped at a scale of 1:24,000 and these maps are published in 7.5-minute quadrangle units. At this scale, 1 inch on the map represents 2,000 feet on the ground. The USGS has about 60,000 different topographic map titles.*

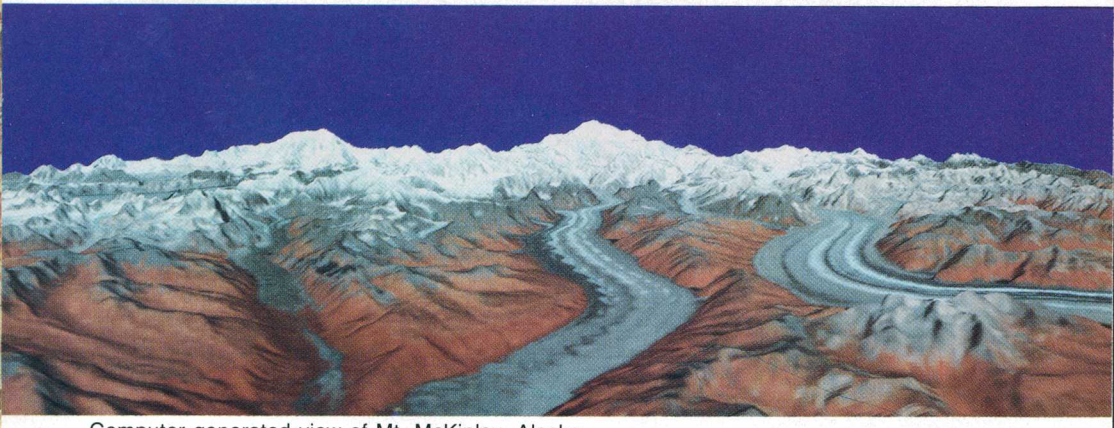
- *Research and development. The USGS studies ways to improve the quality of map products, to lower costs, to improve productivity, and to develop or acquire innovative equipment. USGS cartographers also study techniques to devise new map products, to modify other products to better meet the needs of users, and to develop new systems to speed the mapping process.*

Cartographer inputs commands to Scitex Edit Station.

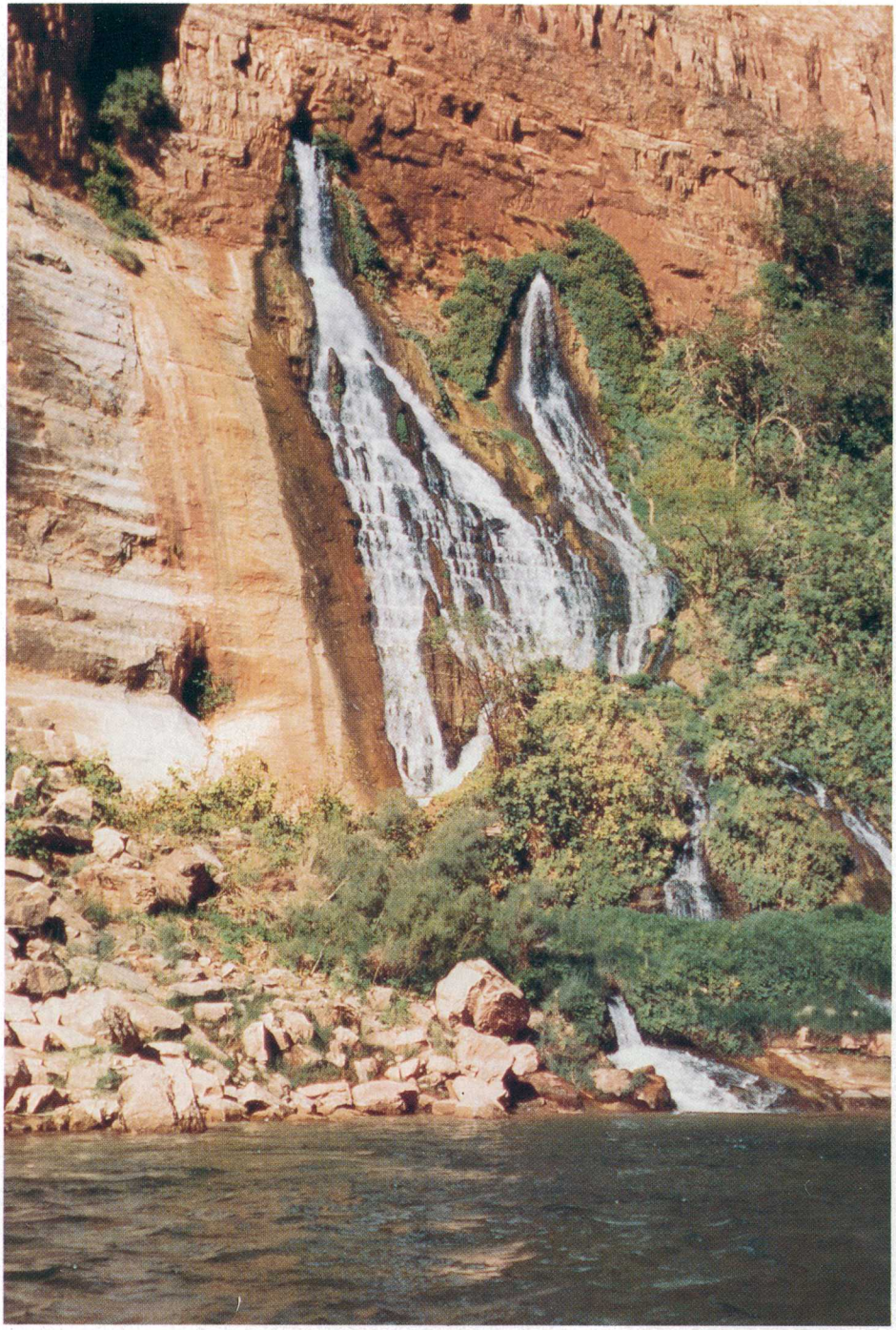
- *Cartographic and geographic research. The USGS acquires, stores, and uses geographic data in studies that combine geographic analyses with new cartographic concepts and techniques. These studies result in new types of cartographic data products and experimental maps that can be used as tools to investigate and solve environmental problems and to aid resource management.*

Geographers discuss data display in the Geographic Information System (GIS) Laboratory.

- *Digital cartography. The USGS is building a national digital cartographic data base, experimenting with digitized cartographic data and using other digitized spatial data sets in geographic information systems. The USGS coordinates digital cartographic activities for the Federal Government.*
- *Applications of remotely sensed data. The USGS explores new techniques for using data gathered by aircraft and satellites in earth-science research, resource management, and mapmaking. An example of a system used by the USGS for gathering remotely sensed data is side-looking airborne radar on aircraft. The most common remotely sensed data are aerial photographs which support the mapping process.*



Computer generated view of Mt. McKinley, Alaska.



Ground water discharges from Redwall Limestone at Vasey's Paradise, Arizona.

# Water Resources Investigations

The USGS has the major responsibility within the Federal Government for assessing the Nation's water resources. The availability of plentiful supplies of higher quality water is an important consideration in all problems of managing natural resource. The growing and conflicting demands for water from a variety of users require planners and resource managers at Federal, State, and local levels to establish, and frequently reevaluate, priorities for use. Sound judgment in establishing such priorities depends on access to accurate hydrologic information.

Streamflow data being collected via GOES satellite.

## Major Water Resources Activities

- *Water resource investigations and data collection. As the Nation's largest water resources information agency, the USGS conducts investigations on lakes, streams, reservoirs, river basins, estuaries, aquifer systems, and glaciers. These activities include operating more than 40,000 stations that measure the amount and quality of surface and ground water.*

- *Hydrologic research. The USGS studies the hydrologic processes to increase our understanding of surface- and ground-water resources. This research focuses on chemical and biological processes affecting water quality; on the movement of water through surface-water bodies; on the movement of fluids through aquifer systems; and on the source, transport, and deposition of sediment and contaminants in surface-water bodies.*

Quality of water is analyzed at the WRD laboratory in Arvada, Colorado.

- *Cooperative projects. In cooperation with more than 900 State and local agencies, the USGS conducts investigations for evaluating, developing, and managing the Nation's water resources. In addition to data collection, the investigations may include site-specific or regional studies on the availability and uses of water and the impact of human activities on the hydrologic environment. In addition, emergency situations such as droughts or floods are monitored and analyzed.*

- *Work for other Federal agencies. The USGS investigates water-resources problems of local, regional, and national interest for many other Federal agencies. For example, the USGS conducts studies for the Department of Energy at both operating and potential nuclear waste-disposal sites.*

- *Coordination of water-data acquisition. The USGS coordinates the data-acquisition activities of 32 Federal agencies to eliminate duplication of effort, to standardize data, and to provide a central source of hydrologic data.*

Interior of mobile water testing laboratory.



Hydrologists drilling a well for on-site sampling and study of ground-water contamination.

Flags of the Antarctic treaty nations fly at the ceremonial South Pole.

Working and living quarters at a South Pole station. ►

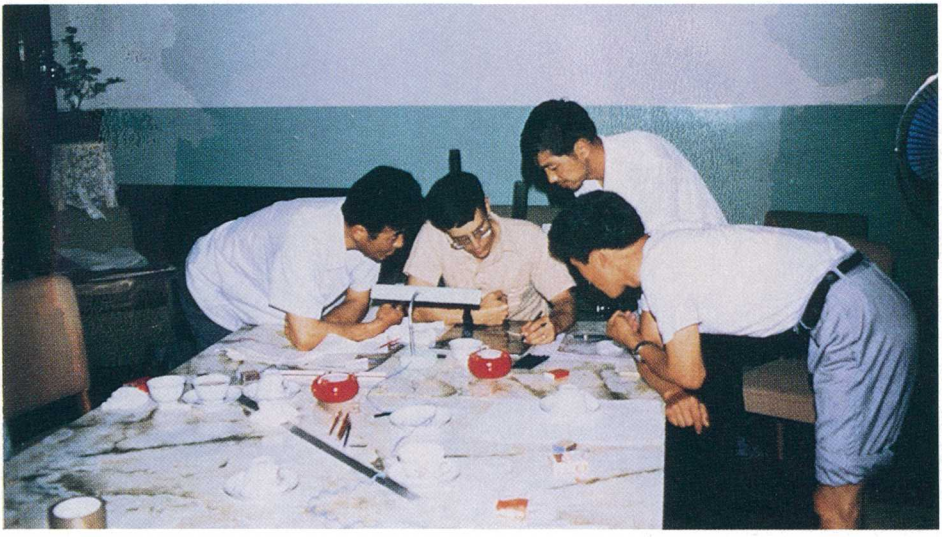
# International Activities

Although the primary responsibility of the USGS is to conduct investigations within the limits of the United States and its territories, international activities have been an important component of USGS operations for more than four decades. Such activities include technical assistance to other countries and international organizations, scientific cooperation with earth-resources agencies abroad, exchange and training of participating scientists, representation of the USGS or the U.S. Government in international commissions and associations, and assessment of mineral and energy resources of foreign countries.

In undertaking international activities, the USGS has four principal objectives:

- *To help achieve domestic research objectives through the comparative study of scientific phenomena abroad and in the United States.*
- *To contribute toward foreign policy objectives and to provide support for the international programs of other Federal agencies.*
- *To develop and maintain contacts with counterpart institutions and programs to facilitate scientific cooperation and exchange.*
- *To obtain information about existing and potential foreign resources of interest to the United States.*

USGS technical assistance and cooperative scientific studies—such as regional topographic and geologic mapping, mineral and energy resource surveys, hazards reduction, hydrologic studies, remote sensing for cartographic and geographic applications—are currently underway in 30 countries.



Chinese and USGS geologists conduct joint project.

# Sources of Information

The results of USGS investigations are published in scientific reports and in topographic, geologic, and hydrologic maps. A series of general-interest publications is available to inform the public about USGS activities. Research results and investigations are also published in journals of technical and scientific organizations and in publications of cooperating Federal and State agencies.

The following offices can provide information about the USGS, its publications and maps, and its programs and activities:

Public Inquiries Office
U.S. Geological Survey
503 National Center
Reston, VA 22092
703-648-6892

Geologic Inquiries Group
U.S. Geological Survey
907 National Center
Reston, VA 22092
703-648-4383

Hydrologic Information Unit
U.S. Geological Survey
419 National Center
Reston, VA 22092
703-648-6817

Public Affairs Office
U.S. Geological Survey
119 National Center
Reston, VA 22092
703-648-4460

National Cartographic Information Center
U.S. Geological Survey
507 National Center
Reston, VA 22092
703-860-6045

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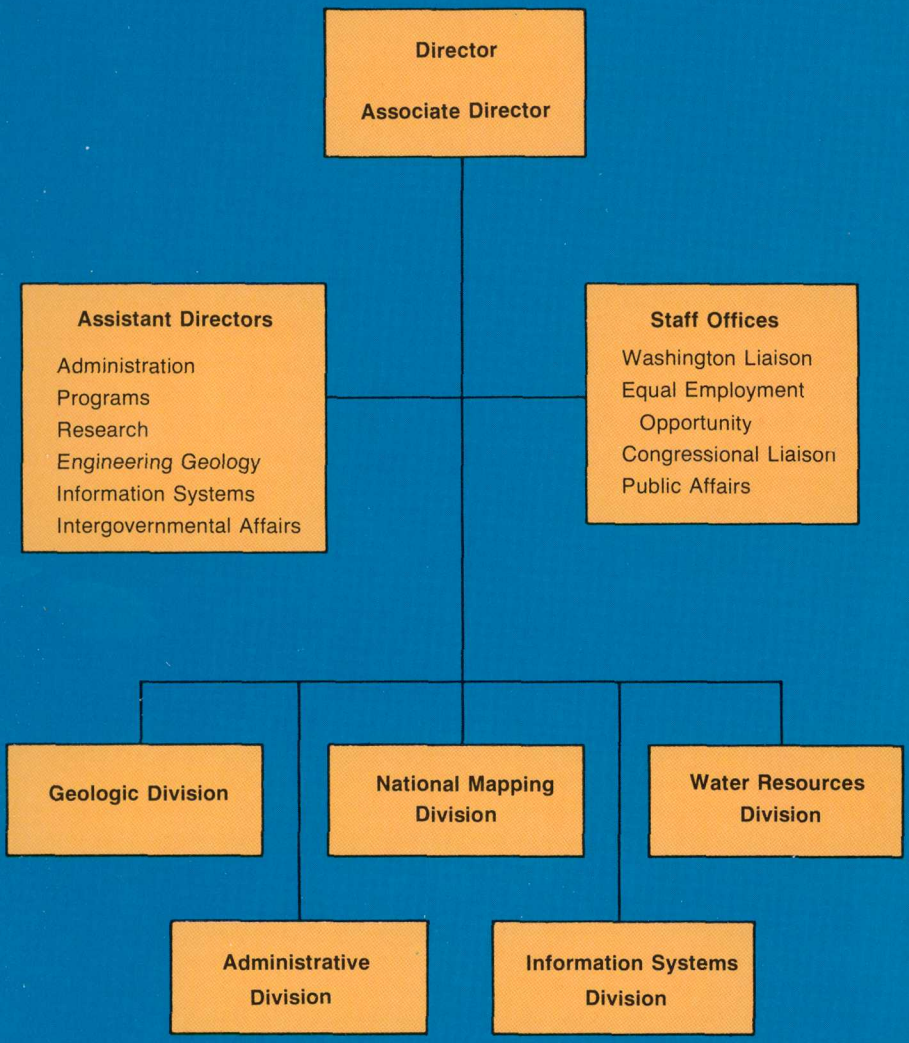
## USGS Organization Chart




As the Nation's principal conservation agency, the Department of the Interior has responsibility for most of our nationally owned public lands and natural resources. This includes fostering the wisest use of our land and water resources, protecting our fish and wildlife, preserving the environmental and cultural values of our national parks and historical places, and providing for the enjoyment of life through outdoor recreation. The Department assesses our energy and mineral resources and works to assure that their development is in the best interests of all our people. The Department also has a major responsibility for American Indian reservation communities and for people who live in Island Territories under U.S. administration.