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NATIONAL GEOSCIENCE DATA REPOSITORY SYSTEM

Final Report

By
Craig M. Schiffries
Marcus E. Milling

March 1994

Performed Under Contract No. DE-FG22-93BC14968

American Geological Institute
Alexandria, Virginia

Bartlesville Project Office
U. S. DEPARTMENT OF ENERGY
Bartlesville, Oklahoma

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Prepared for
U.S. Department of Energy
Assistant Secretary for Fossil Energy

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The American Geological Institute (AGI) has completed the first phase of a study to assess the feasibility of establishing a National Geoscience Data Repository System to capture and preserve valuable geoscience data. The study was conducted through the support of the U.S. Department of Energy's Office of Fossil Research.

AGI's feasibility study was coordinated by a Steering Committee composed of the presidents of the American Association of Petroleum Geologists, American Institute of Professional Geologists, and Geological Society of America; senior executives from major oil companies; independent petroleum producers; and representatives from oil service companies, state geological surveys, universities, and the National Research Council. Steering Committee liaisons included representatives from federal agencies and nongovernmental organizations.

AGI is a nonprofit federation of 24 geoscientific and professional associations that represent more than 80,000 geologists, geophysicists, and other earth scientists. In addition, 115 colleges and universities are AGI Academic Associates, and 30 private companies are AGI Corporate Members. Founded in 1948, AGI provides information services to geoscientists, serves as a voice for shared interests of the profession, plays a major role in strengthening geoscience education, and strives to increase public awareness of the vital role the geosciences play in mankind's use of resources and interaction with the environment.

National Geoscience Data Repository Steering Committee

James A. Gibbs, Committee Chairman
Five States Energy Company

John H. Barwis
Shell Offshore, Inc.

Paul H. Benson III
Mobil Exploration and Production U.S. Inc.

Edward G. Casteel
University of Texas at Dallas

William L. Fisher
University of Texas at Austin

Robert J. Graebner
Halliburton Geophysical Services

Robert D. Gunn
Independent Petroleum Geologist

Robert D. Hatcher, Jr.,
University of Tennessee

James E. Hooks
Chevron U.S.A. Production Co.

Joel H. Marks
Texaco U.S.A.

John H. Miers
Amoco Production Company

Jonathan G. Price
National Research Council

Harrison Townes
Independent Petroleum Geologist

H. Baird Whitehead
Cabot Oil and Gas Corporation

Perry B. Wigley
Nebraska State Geological Survey

Colin D. Wilkinson
Phillips Petroleum Company

AGI Member Societies

♦ American Association of Petroleum Geologists ♦ American Association of Stratigraphic Palynologists ♦ American Institute of Hydrology ♦ American Institute of Professional Geologists ♦ Association for Women Geoscientists ♦ Association of American State Geologists ♦ Association of Earth Science Editors ♦ Association of Engineering Geologists ♦ Council on Undergraduate Research, Geology Division ♦ Geological Society of America ♦ Geoscience Information Society ♦ Mineralogical Society of America ♦ National Association of Black Geologists and Geophysicists ♦ National Association of Geology Teachers ♦ National Earth Science Teachers Association ♦ National Speleological Society ♦ Paleontological Society ♦ Seismological Society of America ♦ SEPM (Society for Sedimentary Geology) ♦ Society for Mining, Metallurgy, and Exploration ♦ Society of Economic Geologists ♦ Society of Exploration Geophysicists ♦ Society of Independent Professional Earth Scientists ♦ Society of Vertebrate Paleontology

EXECUTIVE SUMMARY

Goals and Objectives. The American Geological Institute (AGI) has completed the first phase of a study to assess the feasibility of establishing a National Geoscience Data Repository System to capture and preserve valuable geoscientific data. The study was initiated in response to the fact that billions of dollars worth of domestic geological and geophysical data are in jeopardy of being irrevocably lost or destroyed as a consequence of the ongoing downsizing of the U.S. energy and minerals industry. This report focuses on two major issues. First, it documents the types and quantity of data available for contribution to a National Geoscience Data Repository System. Second, it documents the data needs and priorities of potential users of the system.

A National Geoscience Data Repository System would serve as an important and valuable source of information for the entire geoscience community for a variety of applications, including environmental protection, water resource management, global change studies, and basic and applied research. The repository system would also contain critical data that would enable domestic energy and minerals companies to expand their exploration and production programs in the United States for improved recovery of domestic oil, gas, and mineral resources.

Data Contributions. The results of the initial phase of the feasibility study are extremely positive. Major oil companies, large independent petroleum producers, and minerals companies have indicated they would consider contributing vast amounts of data to a National Geoscience Data Repository System.

The total amount of seismic data identified in the table below is conservatively estimated to represent more than 15 million line miles, which constitute a substantial fraction (perhaps 25 percent) of all seismic data collected in the United States since 1950. The rock core and cuttings identified in the table below are estimated to represent a significant fraction (perhaps 10 percent) of the core and cuttings held by the major oil and gas companies. Companies participating in the study have indicated that they would substantially increase their data contributions after a National Data Repository System was established.

Major Contributions of Data from Industry

Seismic and Related Data

1,285,000	2D Line Miles (paper)
936,000	2D Line Miles (digital)
22,000	3D Square Miles (digital)
1,011,000	Seismic Films
3,607,800	Magnetic Tapes
419,000	Reports & Maps
553,800	Boxes Geophysical Data

Well and Drill-Hole Data

373,900	Boxes Rock Core
369,800	Boxes Well Cuttings
4,000,000	Well Logs (paper)
900,000	Well Logs (microfiche)
125,400	Well Logs (digital)
2,300,000	Scout Tickets
540,000	Geochemical Analyses

The proposed industry contributions represent billions of dollars worth of geological and geophysical data that were collected at no expense to the federal government. In some cases, the data are unique and cannot be replaced because of urban development and new restrictions that place land off limits to resource exploration and development activities. All material placed in a National Geoscience Data Repository System would enter the public domain and become available to all users. State and federal agencies have indicated that large amounts of geoscientific data already in their possession would be made available through a National Geoscience Data Repository System.

There is an excellent match between the types of geoscience information that companies would be willing to contribute to a National Geoscience Data Repository System and the types of data that are of greatest interest to independent petroleum producers and other potential users of the repository system.

Establishing a Repository System. Potential data contributors and data users agree that the most important issues and recommendations regarding the establishment of a National Geoscience Data Repository are the following:

- Establish a national repository system composed of an integrated network of data centers, rather than a single, centralized facility.

- Build upon existing state and regional data centers as a starting point for developing a distributed national repository system.

- Ensure that researchers can effectively use the data by placing ease of data access at the heart of the data management system.

- Establish a national directory of data centers that includes information about data holdings and guidance for locating and obtaining data.

- Ensure full and open sharing of all data in the repository system.

- Establish procedures and criteria for setting priorities for data acquisition, retention, and purging to ensure preservation of the most important and highest quality data and to maximize cost-effectiveness.

- Develop a plan and mechanism for efficiently transferring massive amounts of private-sector data to a public repository system.

- Adopt national standards for storing, processing, and distributing data in order to reduce costs and increase productivity.

- Act quickly to capture large volumes of data in jeopardy of being lost.

- Develop a plan for long-term funding, including adequate support from federal and state agencies and the user community.

Repository Payout. A National Geoscience Data Repository System would play a critical role in achieving key objectives of the *Domestic Natural Gas and Oil Initiative*, and addressing major needs outlined in the *National Energy Act of 1992*, *U.S. Global Change Research Program*, and *High Performance Computing and Communications Act of 1991*, as well as technology transfer,

environmental protection, and defense conversion programs. It would help to reduce U.S. vulnerability to oil supply disruptions by increasing domestic oil production and reducing our dependence on unstable sources of foreign oil. It would help improve the competitiveness of the domestic energy and minerals industries, create high-quality jobs for American workers, and reduce the U.S. balance of trade deficit. In the long run, other uses of the preserved data, including environmental protection, water resource management, reducing risks from earthquakes and other geologic hazards, waste disposal planning, global change studies, and basic scientific research, may be as important as energy and minerals applications of the data.

The federal government has the opportunity to help facilitate the largest scientific data rescue operation in the history of the nation. The concept of establishing a data repository system has received broad interest and support in both the private and public sectors. There is a narrow window of opportunity to act before valuable data are irrevocably lost. The data truly represent a national treasure and immediate steps must be taken to assure their preservation and future access.

AGI's feasibility study was coordinated by a Steering Committee composed of the presidents of three national professional associations, senior executives from major oil companies, independent petroleum producers, and representatives from oil service companies, state geological surveys, the National Research Council, and the academic community. Representatives from four federal agencies served as liaisons to the Steering Committee. AGI distributed more than 1,100 questionnaires to a broad spectrum of geoscience organizations in all 50 states, and conducted 53 site visits in 10 cities.

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INTRODUCTION AND BACKGROUND

Goals and Objectives

The American Geological Institute (AGI) has completed the first phase of a study to assess the feasibility of establishing a National Geoscience Data Repository System to capture and preserve valuable geoscientific data. The study was initiated in response to the fact that billions of dollars worth of domestic geological and geophysical data are in jeopardy of being irrevocably lost or destroyed as a consequence of the ongoing downsizing of the U.S. energy and minerals industry. Preservation and access to domestic geological and geophysical data are critical to the energy security and economic prosperity of our nation. There is a narrow window of opportunity to act before valuable data are irrevocably lost. The data truly represent a national treasure and immediate steps must be taken to assure their preservation.

A National Geoscience Data Repository System would serve as an important and valuable source of information for the entire geoscience community for a variety of applications, including environmental protection, water resource management, global change studies, and basic and applied research. The Repository System would also contain critical data that would enable domestic energy and minerals companies to expand their exploration and production programs in the United States for improved recovery of domestic oil, gas, and mineral resources.

A National Geoscience Data Repository System would play a critical role in achieving key objectives of the *Domestic Natural Gas and Oil Initiative*, *National Energy Act of 1992*, *U.S. Global Change Research Program*, and *High Performance Computing and Communications Act of 1991*, as well as technology transfer, environmental protection, and defense conversion programs. It would help to reduce U.S. vulnerability to oil supply disruptions by increasing domestic oil production and reducing our dependence on unstable sources of foreign oil. It would help improve the competitiveness of the domestic energy and minerals industries, create high-quality jobs for American workers, and reduce the U.S. balance of trade deficit.

This report focuses on two major issues. First, it documents the types and quantity of data available for contribution to a National Geoscience Data Repository System. Second, it documents the data needs and priorities of potential users of the system.

Data Rescue and National Energy Security

In the course of their exploration and development activities over the past several decades, major U.S. oil and gas companies have acquired enormous amounts of domestic geological and geophysical data. As major oil and gas companies downsize their operations and focus their attention on foreign ventures, they have less need for domestic geological and geophysical data. Literally billions of dollars worth of subsurface geoscientific information stored in companies offices, warehouses, and other repositories is in jeopardy of being lost due to the severe decline in private sector support for exploration and production activities

in the United States.

In addition to data centers maintained by major oil and gas companies, a variety of public and private regional collections of geoscience data exist to serve the needs of industry and academia. In the past, many of these collections received financial support — directly or indirectly — from major oil and gas companies, but company support has decreased significantly or terminated in the last few years. As a result, some of these facilities have closed or have significantly reduced their operations. A National Geoscience Data Repository System would be a logical recipient of data from those facilities that are near closure or are no longer operational.

During the course of this study, AGI has documented that industry is willing to contribute billions of dollars worth of inactive domestic company data files to a National Geoscience Data Repository System. The data files contain unique and detailed information on numerous localities throughout the United States. The data are in a variety of formats, ranging from digital well logs and seismic reflection data tapes, to paper and film records, to rock core and cuttings samples. The diversity of data types and formats poses significant data management challenges, but a failure to rescue the data would represent a major economic and scientific loss to the nation and have grave consequences for our national energy security.

A central goal of both the *Domestic Natural Gas and Oil Initiative* and the *National Energy Act of 1992* is to reduce U.S. vulnerability to oil supply disruptions by increasing domestic oil and gas production and reducing our dependence on unstable sources of foreign oil. In announcing the *Domestic Natural Gas and Oil Initiative*, Secretary of Energy O'Leary said, "Domestic production increases the world supply and reduces the ability of foreign suppliers to manipulate the price and create economic hardship in the United States and for our allies. A viable domestic industry reduces the effectiveness of oil as a political weapon." The loss of billions of dollars worth of domestic geoscience data would have a negative impact on future domestic production, increase U.S. dependence on foreign oil, increase U.S. vulnerability to oil supply disruptions, and threaten our national and economic national security.

In announcing the *Domestic Natural Gas and Oil Initiative*, President Clinton expressed the need to undertake "a determined effort to find and produce more domestic energy, with an industry-led solution that especially recognizes the role of independent drillers and producers." According to many independent oil and gas producers, the establishment of a National Geoscience Data Repository System would do more to aid the future search and development of domestic petroleum resources than most current or proposed programs or facilities. Such a data repository system could provide critical and hard-to-obtain information that would prevent premature abandonment of producing fields, and assist domestic producers in their evaluation of geologic trends, development of new plays, and assessment of remaining resources in existing fields.

A growing number of professional, industrial and state organizations have gone on record in support of establishing a National Geoscience Data Repository System. On a national level the American Association of Petroleum Geologists, American Institute of Professional Geologists, Geological Society of America, Independent Petroleum Associa-

tion of America, Interstate Oil and Gas Compact Commission, Society of Exploration Geophysicists, and the Society of Independent Professional Earth Scientists are among the organizations that support the concept of establishing a National Geoscience Data Repository System.

Crisis in the Oil and Gas Industry

The American petroleum industry is facing one of the greatest crises in its history. Domestic crude oil production is at its lowest level in 30 years. Oil imports account for almost 50 percent of domestic consumption and represent the largest component of our balance of trade deficit. The U.S. drill rig count, an indicator of industry activity, has declined by 86 percent from a high of over 4,500 rigs in 1981 to a historic low of less than 650 active rigs in 1992. In the past decade the industry has lost more than 400,000 jobs, including 45,000 jobs lost in the last year, through forced terminations, enhanced retirement packages, and other attrition. The decline in domestic exploration and development activities is continuing.

The downsizing of the U.S. oil and gas industry has been accompanied by profound changes in the basic structure and operating strategies of the industry. For the first time in their history, the major domestically-based international oil and gas companies are committing the majority of their operating budgets to foreign ventures. The major integrated oil and gas producing companies are selling many of their producing properties, relinquishing leases, consolidating their U.S. operations, and focusing their upstream investments in overseas opportunities. Future exploration and development of domestic oil and gas resources will be conducted increasingly by independent companies. The basic foundation and organization of the U.S. oil and gas industry are undergoing profound changes.

Historically, independent oil and gas producers have played a vital role in the nation's domestic energy and economic stability. After the embargo and price shocks of the 1970's, independent operators played a key role in halting the decline in domestic oil production and reserves through expanded exploration and increased development drilling. In 1990 independent producers accounted for more than 43 percent of the oil production in the lower 48 states, and nearly 60 percent of the total U.S. natural gas production. Additionally, independent operators drill more than 85 percent of all wells, both onshore and offshore, in the lower 48 states and Alaska. The role of independent oil and gas producers may become even more important as the major oil and gas companies shift their emphasis to foreign investment opportunities, as the potential for discovery of large new domestic oil and gas fields declines.

Technology Transfer

Traditionally, major oil companies operated research laboratories that developed more efficient methods of petroleum exploration and production. Advances in petroleum technology, first utilized by major companies, ultimately were transferred to small companies and independent producers. The historic symbiotic relationship between major oil companies and independents has largely disappeared. Both major companies and independent operators would benefit by continuation of research and information efforts performed in major company research facilities that have been severely downsized. The *National Energy Act* calls on the federal

government to increase its participation in technology transfer, and to be more responsive to the needs of industry and the public. Considering the important role that independent operators play in domestic oil and gas production, their needs deserve careful attention. According to a survey of over 400 independent oil and gas producers in Texas (TIPRO, 1992), one of their highest priority technology transfer needs is improved access to "critically compiled oil and gas data." Of particular importance is the need for increased access to geological and geophysical information on heterogeneity of complex reservoirs and subsurface fluid properties derived from well logs, cores, seismic reflection data, and integrated geoscientific databases for improved play and trend evaluation.

A new national network has been established to disseminate oil and natural gas technology to domestic producers. The Petroleum Technology Transfer Council (PTTC), which will receive part of its funding from the Department of Energy, will be in place by early 1994. It will serve as an effective national clearinghouse for information that is made available through the National Geoscience Data Repository System. These two efforts have been closely coordinated to take advantage of potential synergies that can benefit the U.S. petroleum industry.

A National Geoscience Data Repository System would benefit all elements of the geoscience profession, including the major oil and gas companies that would contribute much of the data. The cyclical history of the exploration and production business argues that major oil and gas companies will use and benefit from the preserved industry data sets.

Applications of a Geoscience Data Repository System

The primary motivation for establishing a National Geoscience Data Repository System is to protect a national treasure that is in jeopardy of being irrevocably lost or destroyed. A National Geoscience Data Repository System would serve as an important source of information for university researchers, state and federal agencies, and private companies in addressing a broad range of issues including

- Planning for environmental protection
- Managing and evaluating water resources
- Exploring for energy and mineral resources
- Reducing risks from earthquakes and other geologic hazards
- Screening sites for municipal, toxic, and nuclear waste disposal
- Siting and designing highways, bridges, dams, and utility lifelines
- Advancing the U.S. Global Change Research Program
- Supporting the needs of university-based research
- Providing improved support for precollege earth science education

Relationship to Other National Policies and Programs

The proposed National Geoscience Data Repository System would simultaneously address and complement the goals of several national policies and programs including

- Domestic Natural Gas and Oil Initiative
- National Energy Act of 1992
- U.S. Global Change Research Program
- National Earthquake Hazards Reduction Program
- High Performance Computing & Communications Act of 1991
- DOE technology transfer programs
- NASA's Mission to Planet Earth
- NOAA's National Geophysical Data Center
- U.S. Geological Survey's Core Research Center
- EPA research, assessment, and mapping programs
- DOD defense conversion programs

STUDY PLAN AND STEERING COMMITTEE

Outline of Phase I Study

AGI envisions a multiphase process to study and implement a National Geoscience Data Repository System. This report presents the results of Phase I of the feasibility study. The most important goals of Phase I are to document the types and quantity of data available for contribution to a National Geoscience Data Repository System and to determine the needs and priorities of potential users of the system. The major components of the Phase I study are listed below:

1) Establish a Steering Committee representative of all major geoscience sectors of the industrial, academic, and governmental communities.

2) Develop and distribute a survey questionnaire to assess the quantity and quality of geological and geophysical data available for transfer to a National Repository System.

3) Conduct site visits of oil and gas producers, log libraries, state and federal geoscience data repositories, and other organizations interested in participating in a National Geoscience Data Repository System.

4) Document the user priorities of the geoscience community and potential applications of data housed in a National Repository System.

5) Analyze the survey results to quantify the volume, location and types of data available for transfer to a National Repository System.

6) Facilitate the Steering Committee's review of survey results and focus their evaluation and recommendations.

7) Prepare a summary report of Phase I for submittal to the Department of Energy documenting the availability of data for transfer, data applications, user priorities, and outlining requirements for establishing a National Repository System.

The second phase of the study would be proposed pending positive findings and acceptance of Phase I. The Phase II study would address specific organizational and operational requirements for establishing a National Geoscience Data Repository System. A working plan and budget for siting, implementing, and operating the repository system would be developed in Phase II.

Steering Committee

AGI's feasibility study was coordinated by a Steering Committee composed of the presidents of the American Association of Petroleum Geologists, American Institute of Professional Geologists, and Geological Society of America; senior executives from major oil companies; independent petroleum producers; and representatives from oil service companies, information brokers, state geological surveys, universities, and the National Research Council. Steering Committee liaisons included representatives from the Department of Energy, U.S. Geological Survey (Department of the Interior), Minerals Management Service (Department of the Interior), and NOAA (Department of Commerce); as well as representatives of the

Independent Petroleum Association of America, and the American Mining Congress. Steering Committee members and liaisons are listed in Table 1. The Steering Committee held four meetings during the course of Phase I of the feasibility study. A synopsis of each meeting is given below.

- **Washington, D.C., March 8, 1993** — Organizational meeting; roundtable discussion of the needs and requirements of a National Geoscience Data Repository System; develop a plan of action for Phase I of the feasibility study; design and discuss a survey of data contributors and users.

- **New Orleans, April 26, 1993** — Review and revise survey questionnaire. Presentation by Dr. David W. Houseknecht, Associate Chief of Energy Programs, Office of Energy and Marine Geology, U.S. Geological Survey, regarding CD-ROMs produced by the USGS containing a digital rock core library, a seismic library, and related pilot products.

- **Dallas, July 14, 1993** — Review status of feasibility study progress and results. Analysis of 276 responses to the survey questionnaire and discussion of the first 38 site visits in 7 cities. Presentation by Dr. Herbert Meyers, Solid Earth Geophysics Division Chief, NOAA National Geophysical Data Center, regarding the scope and coverage of NOAA's data center and discussion of any potential overlap with the proposed National Geoscience Data Repository System.

- **Boston, October 25, 1993** — Review preliminary draft of Phase I feasibility study report. Discussion and review of data retention priorities presented by Dr. Jonathan Price, Staff Director, Board on Earth Sciences, National Research Council. Presentation by Dr. Glenn Breed, Vice President, Petrotechnical Open Software Corporation on database standards.

Survey Distribution and Response Rate

AGI distributed over 1,100 questionnaires to a broad spectrum of geoscience organizations in all 50 states in order to estimate the quantity and types of data that would be contributed to a National Data Repository System and to determine the data needs and priorities of potential users of the system. Table 2 shows the number of surveys distributed and the response rate for different sectors of the geoscience community. Questionnaires were distributed to major oil companies, independent petroleum producers, oil service companies, environmental and water resource consulting firms, information brokers, private and public log and sample libraries, mining and minerals companies, universities, research institutions, state and federal agencies, and other organizations.

The overall response rate for the survey was 28 percent, which is considered high for a survey of this type. The response rate among firms selected for site visits was 96 percent, including a nearly complete canvas of all major oil companies. We obtained a statistically significant sample of most sectors of the geoscience community and most geographic regions of the country. The results indicate that the survey achieved a representative sample and that the responses are representative of the geoscience community.

Of the 305 organizations that returned the questionnaire, 197 or 65 percent indicated that they would consider contributing data to the repository system. Among the major oil companies and large independent producers, 94 percent indicated that they would contribute data to the system. Most organizations provided estimates of the quantity and type of information that would be contributed. Certain consulting firms indicated they could not contribute data primarily because their clients own most of the data in their files.

A central goal of the survey was to determine the order of magnitude of potential data contributions. For example, it is important to know whether the amount of 2D seismic data that would be contributed to the repository system is on the order of tens of thousands, hundreds of thousands, millions, or tens of millions of line miles. A detailed analysis of the survey results are provided in a following section of this report.

Site Visits

A major component of the data repository study involved site visits to the larger data contributors, especially the major domestic oil and gas producing companies. Site visits were also conducted at a number of smaller independent producers, state geological surveys, federal agencies, and public log sample libraries. Site visits were conducted at a total of 53 organizations in 10 cities (Table 3). The organizations selected for site visits were based on recommendation and review of the Steering Committee established to coordinate this study.

The primary purpose of the site visits was to review the goals and objectives of the Data Repository System study firsthand with the major data contributors, and to solicit their participation. All organizations selected for site visits were contacted and prearranged visits were scheduled. Company contacts were primarily targeted at the vice-president level. The visits provided an opportunity to introduce the concept of a National Data Repository System to the top management of the companies and to learn about their data management needs and concerns.

The site visits allowed discussion of specific questions regarding the companies' data curation policies, including such items as:

- Size, number, and location of company repositories
- Remaining storage capacity available
- Data types and geographic coverage
- Approximate repository operating costs
- Future data management plans

During each visit the survey questionnaire was presented and discussed. Each component of the questionnaire was reviewed to clarify our request for specific information. A copy of the questionnaire and letter of explanation was left with each company requesting that it be completed in a timely fashion and returned to AGI.

The response rate among firms selected for site visits was very high. Of the 53 organizations visited, 45 were requested to complete the data repository survey questionnaire. We received 43 returns out of the 45 requested for a response rate of 96 percent, including nearly all of the major oil companies and larger independent producers.

TABLE 1. AGI STEERING COMMITTEE MEMBERS & LIAISONS

COMMITTEE MEMBERS

James A. Gibbs, Committee Chairman
Five States Energy Company

John H. Barwis
Shell Offshore, Inc.

Paul H. Benson III
Mobil Exploration and
Production U.S., Inc.

Edward G. Casteel
University of Texas at Dallas

William L. Fisher
University of Texas at Austin

Robert J. Graebner
Halliburton Geophysical Services

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Texaco U.S.A.

John H. Miers
Amoco Production Company

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National Research Council

Harrison Townes
Independent Petroleum Geologist

H. Baird Whitehead
Cabot Oil and Gas Corporation

Perry B. Wigley
Nebraska State Geological Survey

Colin D. Wilkinson
Phillips Petroleum Company

COMMITTEE LIAISONS

Edith C. Allison
U.S. Department of Energy

Glenn R. Breed
Petrotechnical Open Software Corporation

David W. Houseknecht
U.S. Geological Survey

Michael C. Hunt
Minerals Management Service

Herbert Meyers
National Oceanic & Atmospheric Admin.

Marcus E. Milling
American Geological Institute

Alma Hale Paty
American Mining Congress

Deborah Rowell
Independent Petroleum
Association of America

Craig M. Schiffries
American Geological Institute

Harold D. Shoemaker
U.S. Department of Energy

Thomas C. Wesson
U.S. Department of Energy

Table 2. Survey Distribution and Response Rate

Organization Type	Mailings	Returns	Response Rate (percent)	Contributors
Major Oil Companies & Large Independent Producers	46	31	67	29
Independent Producers	734	146	20	83
Mining and Minerals Companies	160	38	24	30
Universities and Research Institutions	44	22	50	8
Consulting and Service Companies	33	11	33	2
Log and Sample Libraries	30	15	50	6
State and Federal Agencies	56	42	77	39
TOTAL	1,103	305	28	197

Note: Data in this table are based on information gathered for the purposes of mailing the questionnaire, and there may be slight discrepancies between this data and the organizational profile based information provided by organizations responding to the questionnaire.

TABLE 3. ON-SITE VISITS FOR NATIONAL GEOSCIENCE DATA REPOSITORY SYSTEM SURVEY

Amoco Production Co., Houston, TX
Apache Corp., Houston, TX
Arco Oil and Gas Co., Dallas, TX
Arco Oil and Gas Co., Houston, TX
Ashland Exploration, Inc., Houston, TX
Atwater Consultants, Ltd., New Orleans, LA
Bass Enterprises Production Co., Fort Worth, TX
Chevron U.S.A. Production Co., Houston, TX
CLK Co., New Orleans, LA
CNG Producing Co., New Orleans, LA
Columbia Gas Development Corp., Houston, TX
Conoco, Houston, TX
Cox Exploration, Inc., Dallas, TX
Dantex Oil & Gas, Inc., Dallas, TX
Delaware Geological Survey, Newark, DE
Denver Earth Resources Library, Denver, CO
Enserch Exploration, Inc., Dallas, TX
Exchange Oil & Gas Co., New Orleans, LA
Exxon Exploration Co., Houston, TX
Geological Information Library, Dallas, TX
GeoMap Co., Plano, TX
Globex, Dallas, TX
Hunt Oil Co., Dallas, TX
Hunt Petroleum Corp., Dallas, TX
Hunter Exploration Co., Fort Worth, TX
International Sample Library, Midland, TX
Iowa Geological Survey, Iowa City, Iowa
Kentucky Geological Survey, Lexington, KY
Kerr-McGee Corp., Houston, TX
Marathon Oil Co., Houston, TX
Maxus Energy Corp., Dallas, TX
Midland Energy Library, Midland, TX
Mitchell Energy Corp., Houston, TX
Mobil Exploration & Producing U.S. Inc., Dallas, TX
National Geophysical Data Center, Boulder, CO
Nerco Oil & Gas, Houston, TX
Orxy Energy Co., Dallas, TX
Pennzoil Exploration & Production, Houston, TX
Petroleum Information Corp., Denver, CO
Petrotechnical Open Software Corporation, Houston, TX
Phillips Petroleum Co., Houston, TX
Santa Fe Resources, Inc., Houston, TX
Shell Offshore, Inc., New Orleans, LA
Shell Oil Co., Houston, TX
Texaco USA, Denver, CO
Texaco USA, New Orleans, LA
TGB, Inc., Midland, TX
The Louisiana Land and Exploration Co., New Orleans, LA
Thomasson Partner Associates, Denver, CO
U.S. Geological Survey, Denver, CO
Union Pacific Resources, Fort Worth, TX
Union Texas Petroleum, Houston, TX
Unocal Corp., Houston, TX
Utah Geological and Mineral Survey, Salt Lake City, UT
Wagner & Brown Ltd., Midland, TX
Westport Technology Center Intl., Houston, TX

AGI SURVEY OF DATA CONTRIBUTORS AND USERS: RESULTS AND ANALYSIS

Survey Overview

In order to assess the needs and requirements of a National Geoscience Data Repository System, AGI distributed more than 1,100 questionnaires to a broad spectrum of geoscience organizations in all 50 states. Appendix 1 contains a copy of the survey questionnaire, and Appendix 2 contains supplemental figures and tables that summarize results of the survey.

The survey asked for information covering 5 major categories:

- **Organization Profile** — Determines basic information about the size and type of organization and geographic areas of operation.
- **Data Availability and Contributor Priorities** — Addresses the types of geoscience data the organization uses and the types of data it would consider releasing to the repository system.
- **Data User Priorities** — Assesses the priorities the organization places on the types of data and information it would request from the repository system.
- **Data Quantity and Geographic Coverage** — Determines the quantity, types and geographic coverage of data the organization would consider contributing to the repository system.
- **Data Repository System Operations** — Requests recommendations for establishing and operating a nationally based repository system.

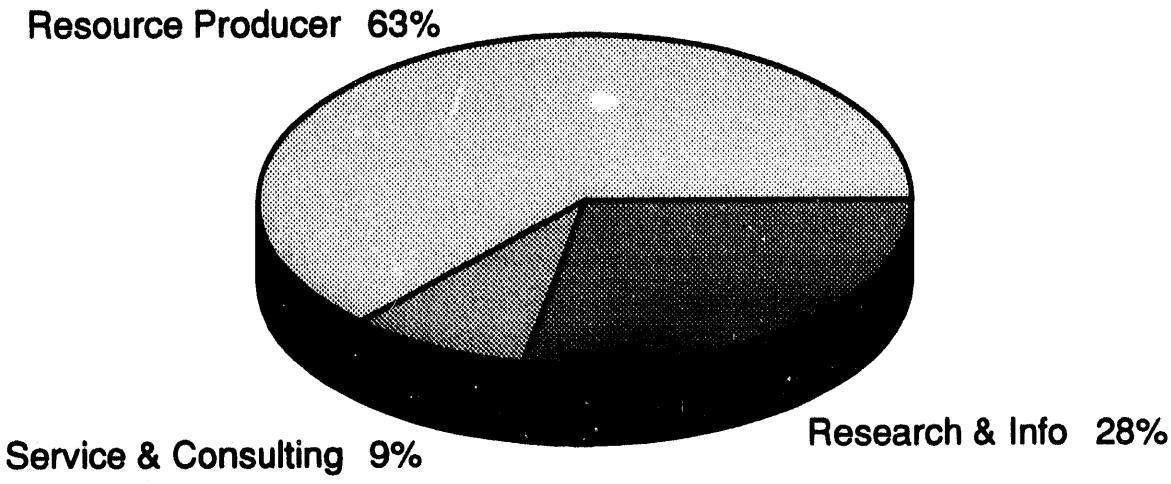
Organization Profile

Types of Organizations. The sample set consists of 305 organizations, of which 63 percent are resource producers, 9 percent are service and consulting firms, and 28 percent are research and information organizations (Fig. 1). Appendix 2.1 contains supplemental tables and figures that provide a breakdown of each sector. Among the resource producers, 77 percent are oil and gas producers, 13 percent are metals producers, and the remaining 9 percent include coal, industrial minerals, and other resource producers. In the service and consulting sector, oil and gas firms comprise 52 percent of the sample, seismic and geophysical firms account for 29 percent, environmental and hydrology firms comprise 10 percent, and core, log, assay and other firms account for 10 percent. In the research and information sector, state geological surveys comprise 40 percent of the sample set, log and sample libraries comprise 25 percent, universities comprise 22 percent, federal agencies comprise 6 percent, and information brokers and other organizations comprise 7 percent.

Geographic Distribution. The organizations in the sample set operate or have data for properties in all regions of the United States. The western and central states were the most commonly cited regions, with 44 percent and 30 percent of the responses, respectively. Offshore areas account for 15 percent of the responses, and the eastern states comprise 10 percent of the responses (Fig. 2). Appendix 2.2 contains supplemental figures and tables that provide a breakdown of each region. Organizations operating in the western states are divided as

National Geoscience Data Repository

Survey of Data Contributors and Users



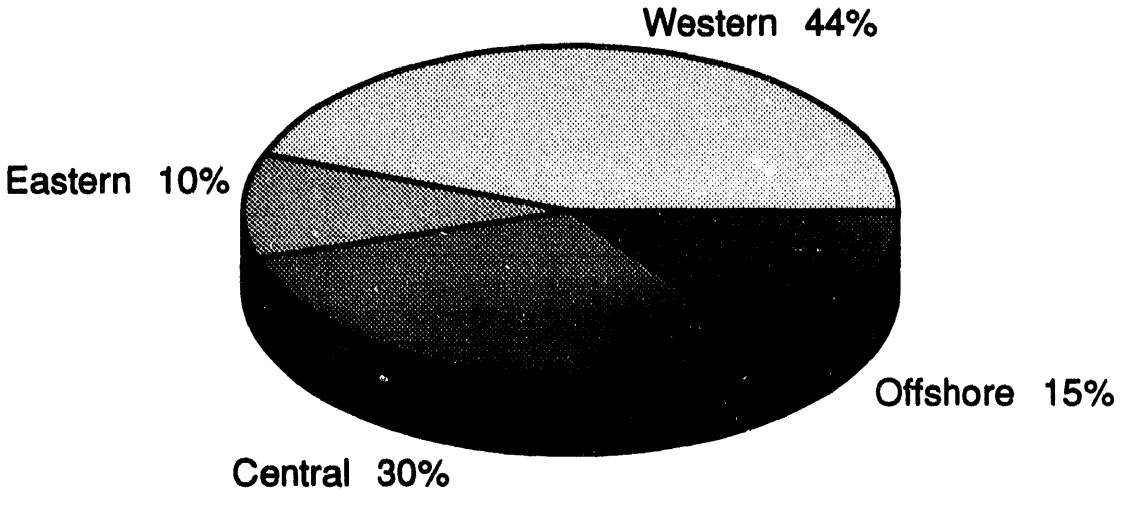
Organization Profile

	Number	Percent
Resource Producer	216	63
Service & Consulting	31	9
Research & Info.	96	28
TOTAL	343	100

Figure 1. Organization Profile

National Geoscience Data Repository

Survey of Data Contributors and Users



Geographic Distribution

	Number	Percent
Western	421	44
Eastern	97	10
Central	287	30
Offshore	144	15
TOTAL	949	100

Figure 2. Geographic Distribution

follows: West Texas and New Mexico, 28 percent; Rocky Mountains, 27 percent; Basin and Range 15 percent; West Coast, 15 percent; Alaska, 12 percent; and other areas 3 percent. Offshore areas have the following frequencies: Gulf of Mexico, 41 percent; California, 17 percent; Atlantic, 16 percent; Alaska, 17 percent; and other, 9 percent. The central states are nearly evenly divided between the Gulf Coast, 48 percent, and the mid-continent, 46 percent, with the remaining 6 percent in other areas. The eastern states are dominated by the Appalachian Basin, 71 percent, with other areas accounting for 29 percent.

Organization Size. The survey includes data from firms with a single employee to some of the largest, multinational corporations in the world. Figure 3 shows the frequency distribution of firms of various size, where the number of geoscientists employed by a firm is used as a proxy for the size of a firm. The data show a monotonic decrease in the number of firms of progressively larger size. The vast majority of firms employ fewer than 50 geoscientists, and only a handful of firms employ more than 400 geoscientists.

Data User Priorities

A key element of the feasibility study is to determine whether there is a strong correspondence between the types of data that would be contributed to the system and the types of data that are of highest priority among users of the system. We asked potential data users to rate the priority (high, moderate, low, none) they place on 28 specific types of data. A histogram of the responses was generated for each type of data. The 28 histograms are grouped into three categories — geophysical data, well or drill-hole data, and other data — and the results are shown in Figures 4, 5, and 6.

The survey yielded a highly consistent set of data user priorities. For many types of data, the histogram shows a monotonic increase in the frequency of responses at progressively higher priority ratings. In other cases the histogram approximates a normal distribution centered around an intermediate priority rating. The highly consistent set of user priorities enable us to rank the relative priority of various data types. The rankings can be used during the implementation phase of a National Geoscience Data Repository System in order to ensure that there is a close match between the types of data accepted by the repository and the types of data that are of highest priority to users of the repository system.

Geophysical Data. Histograms of the priority ratings for eight types of geophysical data are shown in Figure 4. The following list ranks the relative priority, from highest to lowest, of the eight types of geophysical data:

Highest Priority

1) 3D seismic
2) 2D seismic

High to Moderate Priority

3) Velocity surveys
4) Gravity data
5) Magnetic data

Moderate to Low Priority

6) Refraction seismic
7) Electromagnetic data
8) Induced polarization

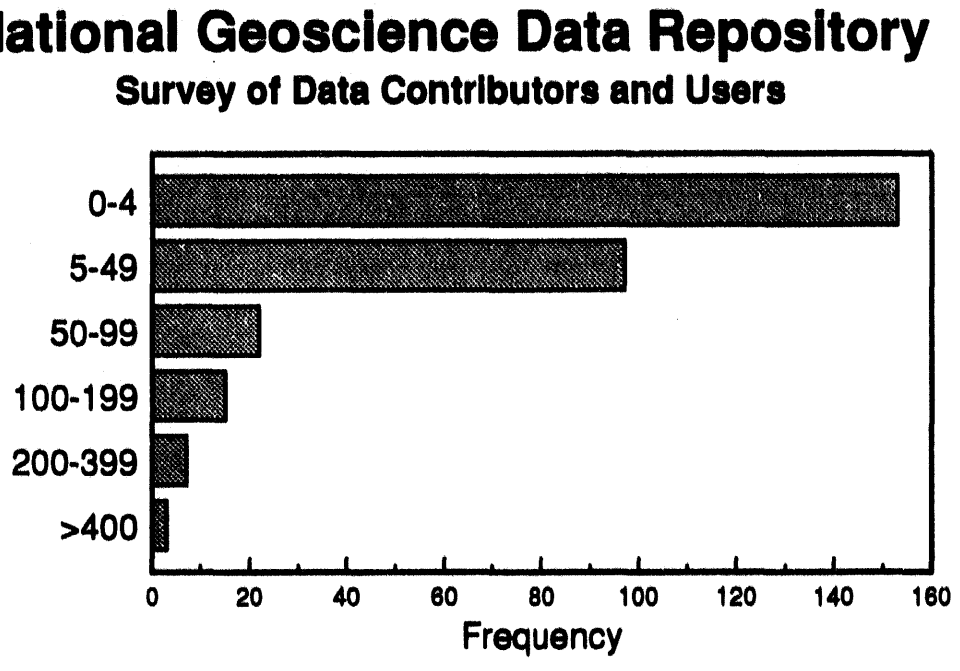


Figure 3. Organization Size

The priority ranking can be divided into three groups. The survey clearly shows that data users place the highest priority on 2D and 3D seismic data. There is a large gap between priority placed on 2D and 3D seismic data, and the priority placed on the next three types of data -- velocity surveys, gravity data, and magnetic data -- which have a high to moderate priority. There is another significant gap between the priority users place on those types of data, and the priority they place on the remaining three types of data, namely refraction seismic, electromagnetic data, and induced polarization data.

It should be noted that electromagnetic and induced polarization data are of much greater interest to minerals exploration than to oil and gas exploration. The number of oil and gas producers sampled in the survey is much larger than the number of independent minerals producers, and therefore the low priority on induced polarization and electromagnetic data may simply reflect the relative sample size of the two industries.

Well or Drill-Hole Data. Histograms of the priority ratings for twelve types of well or drill-hole data are shown in Figure 5. The following list ranks the relative priority, from highest to lowest, of the twelve types of well or drill-hole data:

High to Moderate Priority

1) Geophysical well logs
2) Completion data
3) Lithological/sample logs
4) Production records
5) Drill stem tests
6) Scout data
7) Rock cores

Moderate to Low Priority

8) Sample cuttings
9) Geochemical core analyses
10) Petrophysical core tests
11) Paleontological data
12) Fluid samples

The first seven types of data have the highest priority rating. In each case, the number of high ratings is greater than or approximately equal to the number of moderate ratings, and the number of moderate ratings is larger than the number of low ratings. The last five types of data have a moderate to low priority rating. For the last group of data types, the number of moderate and low ratings exceeds the number of high ratings.

Other Data. Histograms of the priority ratings for eight types of other data are shown in Figure 6. The following list ranks the relative priority, from highest to lowest, of the eight types of data:

Highest Priority

1) Structural data/maps
2) Geologic/geophysical maps

High Priority

3) Technical reports
4) Digital databases

Moderate Priority

5) Remote sensing

Moderate to Low Priority

6) Geochemical/assay
7) Paleontological collections
8) Lithologic hand samples

Two types of data stand out as the highest priority, namely structural data/maps and geologic/geophysical maps. The next two types of data, technical reports and digital databases, also have high priority. For each

National Geoscience Data Repository

Data User Priorities: Geophysical Data

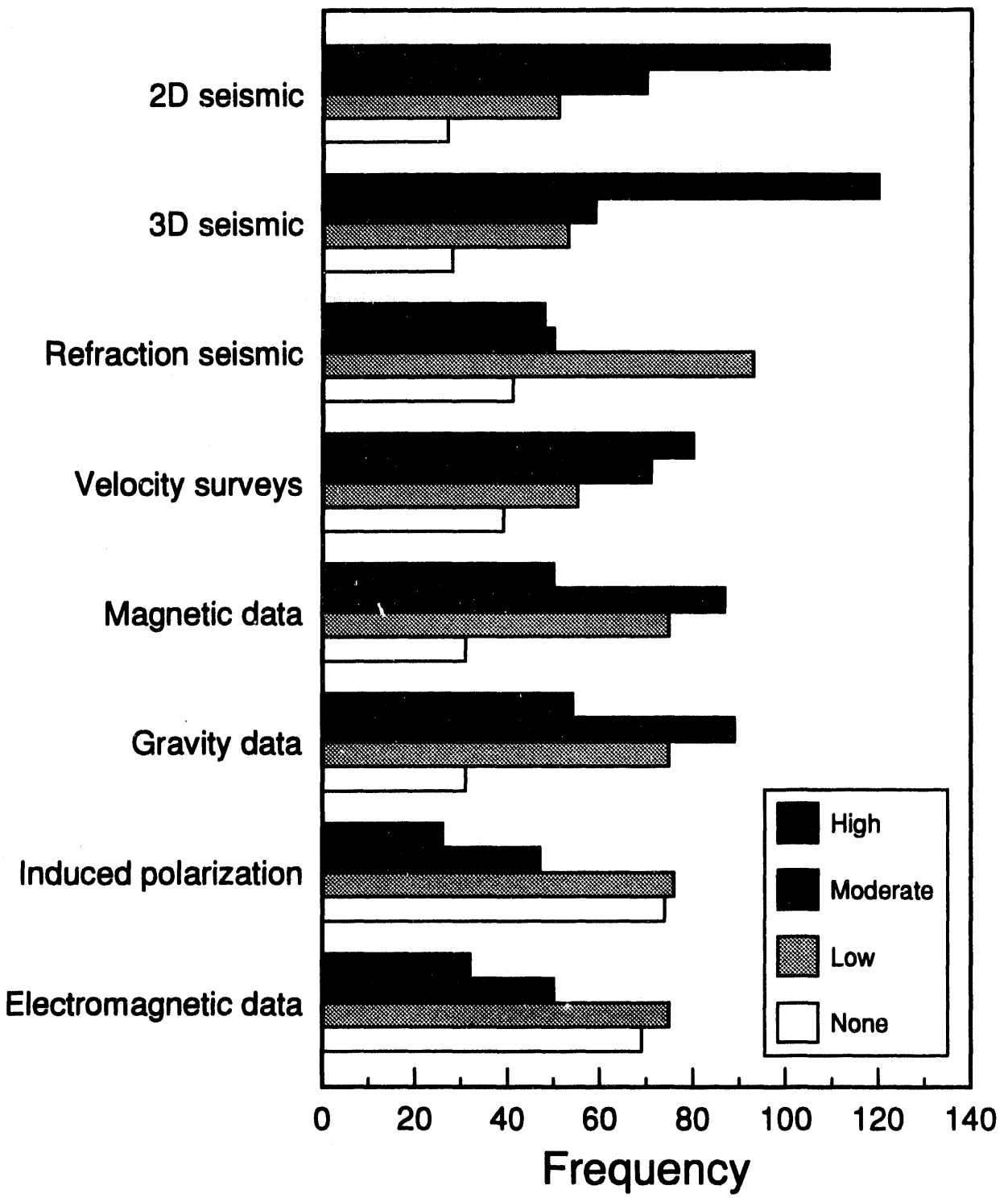


Figure 4. Data User Priorities: Geophysical Data

National Geoscience Data Repository

Data User Priorities: Well or Drill Hole Data

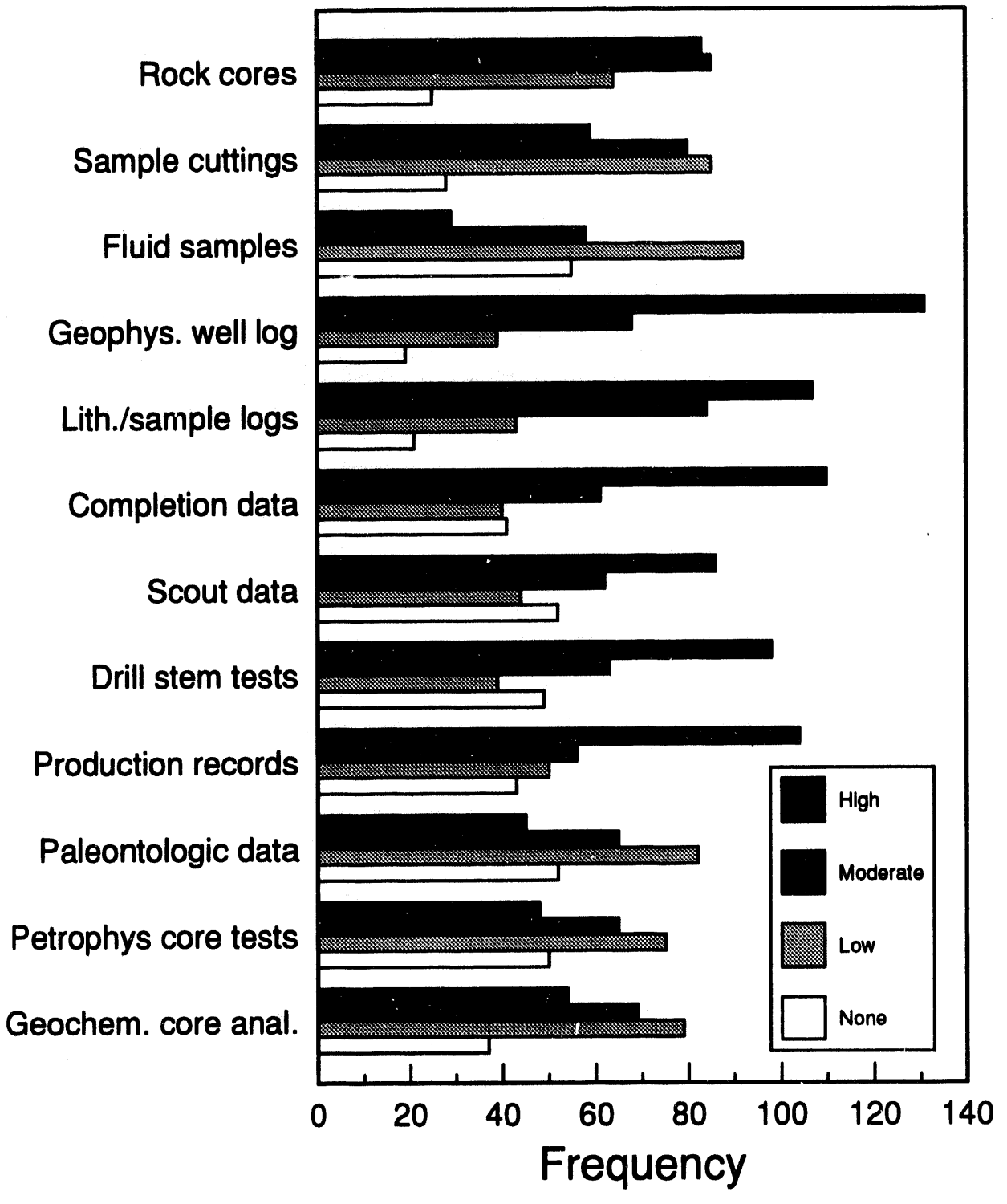


Figure 5. Data User Priorities: Well or Drill-Hole Data

National Geoscience Data Repository

Data User Priorities: Other Data

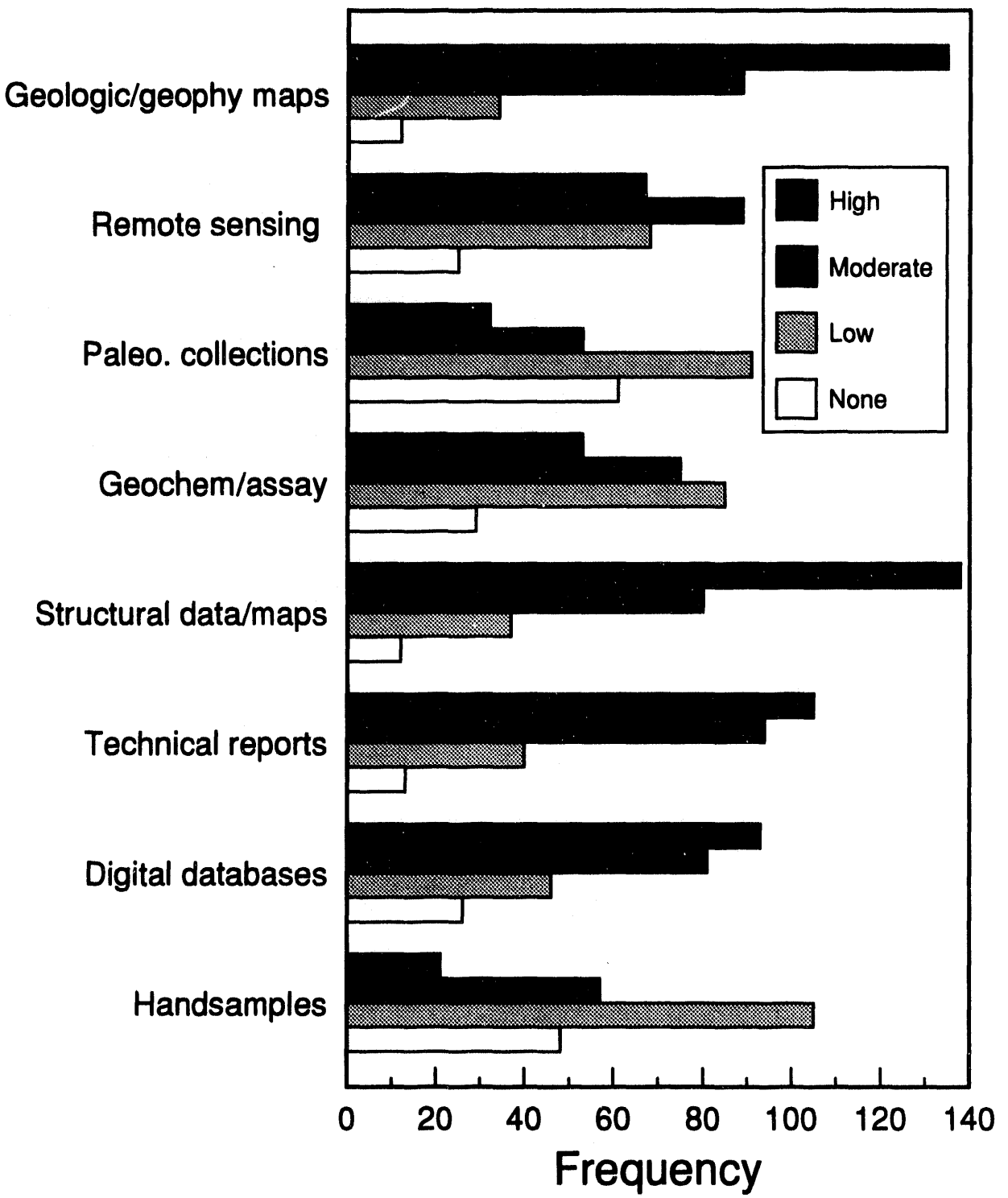


Figure 6. Data User Priorities: Other Data

of the first four types of data, there is a monotonic decline in the frequency of responses at progressively lower ratings. Remote sensing data has a moderate priority. The last three types of data have a low priority.

Data Contributions

Overview. The most important goal of Phase I of the feasibility study is to determine the types and quantities of geoscience data that organizations would be willing to contribute to a National Geoscience Data Repository System. The response to this aspect of the feasibility study has been overwhelmingly positive. The private sector contributions represent billions of dollars worth of geological and geophysical data. Table 4 summarizes major contributions of data that private companies have indicated that they would consider transferring to a National Geoscience Data Repository System.

Based on site visits to most of the large potential contributors, the above figures appear to represent conservative estimates. Companies participating in the study have indicated that they would substantially increase their data contributions after a National Geoscience Data Repository System was established.

The vast majority of the data listed above was acquired by the private sector, at no expense to the federal government. All material placed in a National Geoscience Data Repository System would be in the public domain. State and federal agencies have indicated that large amounts of geoscientific data already in their possession would be made available through a National Geoscience Data Repository System.

Geophysical Data. Contributions of geophysical data are listed in Table 5. Among the most valuable contributions are the vast amounts of domestic 2D seismic data. Because organizations reported their contributions in a variety of different units and media (line miles, seismic films, paper records, and magnetic tapes), it is difficult to compile a precise aggregate. Nevertheless, the contributions are extremely large. Table 5 shows that contributions from major oil companies and large independent producers include 1,285,000 line miles of 2D seismic data on paper records, and 936,000 line miles of digital 2D seismic data. In addition, they would contribute 1,011,000 seismic films, which probably represent about 10 million line miles of 2D seismic data.

Table 4. Major Contributions of Data from Industry

Seismic and Related Data

1,285,000	2D Line Miles (paper)
936,000	2D Line Miles (digital)
22,000	3D Square Miles (digital)
1,011,000	Seismic Films
3,607,800	Magnetic Tapes
419,000	Reports & Maps
553,800	Boxes Geophysical Data

Well and Drill-Hole Data

373,900	Boxes Rock Core
369,800	Boxes Well Cuttings
4,000,000	Well Logs (paper)
900,000	Well Logs (microfiche)
125,400	Well Logs (digital)
2,300,000	Scout Tickets
540,000	Geochemical Analyses

(R.J. Graebner estimates an average of 10 line miles of 2D seismic data per seismic film.) Major oil companies and large independent producers would also contribute 3,607,800 magnetic tapes. The magnetic tapes contain several types of data, but they are predominately 2D seismic data. (R.J. Graebner estimates an average of 1 line mile of 2D seismic data per tape.)

The total amount of seismic data identified in Table 5 is conservatively estimated to represent more than 15 million line miles, which constitutes a substantial fraction (perhaps 25 percent) of all seismic data collected in the United States since 1950. Although the exact number of line miles of 2D seismic data can not be precisely determined, it is important to emphasize that the order of magnitude has been well-established. The quantity of 2D seismic data is on the order of 15 million line miles, rather than rather than thousands, ten of thousands, hundreds of thousands, or even millions of line miles.

It is difficult at this stage to estimate the amount of duplication in the 2D seismic data, but because most of the seismic data would be contributed from company proprietary sources, there is not likely to be much duplication.

Table 5 indicates that relatively small amounts of other types of geophysical data would be contributed to the data repository system. Although smaller in quantity, some of the additional data are potentially quite valuable. For example, contributions include 22,000 square miles of 3D seismic data, 24,800 velocity surveys, and hundreds of thousands of reports, maps, and related documents. The reports and related documents may include meta-data and other information that increases the value and usefulness of the seismic data.

It should be noted that much of the geophysical data that would be contributed to a National Geoscience Data Repository System is unique. Much of the data could only be replaced at great expense, and some of the data cannot be replaced because of urban development or recent restrictions that place land off limits to seismic crews and other exploration activities. The possibility of facilitating the transfer of more than 15 million line miles of domestic 2D seismic data and large quantities of other geophysical data from the private sector to the public domain represents a unique opportunity for the federal government and the geoscience community to capture and preserve an immensely valuable national treasure.

Well or Drill-Hole Data. Contributions of well or drill-hole data are listed in Table 6. Among the most valuable contributions are the large quantities of domestic rock cores. The 373,900 boxes of rock core and the 369,800 boxes of cuttings that would be contributed by major oil companies and large independent producers include material from some of the most productive regions of the United States. The rock core and cuttings identified in Table 6 are estimated to represent a significant fraction (perhaps 10 percent) of the core and cuttings held by the major oil and gas companies. Companies participating in the study have indicated that they would substantially increase their data contributions after a National Geoscience Data Repository System was established.

Many of the rock cores and cuttings are unique, and could only be replaced at great expense. In come cases, it is no longer possible to obtain access to the land in order to drill the bore holes and reproduce the data.

Table 5. Data Contributions: Geophysical and Related Data

Organization	Seismic Hardcopy	Seismic Digital	Related Data
Majors and Large Independents	1,285,000 Line Miles 1,011,000 Films 268,500 Boxes Misc.	3,607,800 Data Reels 936,000 Line Mi 2D 22,000 Sq Mi 3D	419,000 Reports & Maps 285,300 Boxes Misc. 24,800 Velocity Surveys
Independent Producers	5,200 Line Miles 2,000 Films 600 Boxes Misc.	8,950 Data Reels 600 Line Mi 2D	603 Boxes Misc.
Mining/Minerals	5,000 Boxes Misc.	36 Data Reels	1,800 Boxes Misc.
Universities/ Research Institutions	50 Boxes Misc.	4,400 Data Reels	- - - -
Consultants and Services Companies	- - - -	50 Data Reels	1,000 Satellite Images
Log and Sample Libraries	- - - -	- - - -	- - - -
State and Federal Agencies	1,700 Boxes Misc.	25,250 Data Reels 50 Line Mi 2D 22,000 Sq Mi 3D	380 Boxes Misc.
TOTAL CONTRIBUTIONS	1,290,200 Line Miles 1,013,000 Films 275,850 Boxes Misc.	3,646,480 Data Reels 936,650 Line Mi 2D 22,010 Sq Mi 3D	419,000 Reports & Maps 288,080 Boxes Misc. 24,800 Velocity Surveys

Table 6. Data Contributions: Well and Drill-Hole Data

Organization	Rock Core & Cuttings	Well Logs	Related Data
Majors and Large Independents	373,900 Boxes Core 369,800 Boxes Cuttings 100,000 PVT Tests	4,000,000 Paper Logs 900,000 Microfiche 125,400 Digital Logs	2,300,000 Scout Tickets 540,000 Geochem Anal. 44,000 Paleo Well Data
Independent Producers	2,600 Boxes Core 2,930 Boxes Cuttings	315 Data Reels	3,470 Boxes Misc.
Mining/Minerals	64,160 Boxes Core 15,990 Boxes Cuttings	60 Data Reels	730 Boxes Misc.
Universities/ Research Institutions	975 Boxes Core 1,800 Boxes Cuttings	150 Data Reels	- - - -
Consultants and Services Companies	- - - -	10,000 Microfiche	1,000 Boxes Misc.
Log and Sample Libraries	7,100 Boxes Core 523,860 Boxes Cuttings	500 Well Files	6,870 Boxes Misc.
State and Federal Agencies	708,800 Boxes Core 624,350 Boxes Cuttings	485,000 Digital Logs 981,720 Paper Logs	30,000 Thin-sections 6,000 Boxes
TOTAL CONTRIBUTIONS	1,157,535 Boxes Core 1,538,730 Boxes Cuttings 100,000 PVT Tests	4,981,720 Paper Logs 910,000 Microfiche 500 Well Files 610,925 Digital Logs	2,300,000 Scout Tickets 540,000 Geochem Anal. 30,000 Thin-sections 44,000 Paleo Well Data

Rock cores provide fundamental "ground truth" for subsurface geology. Such information is required for many applications beyond the energy and minerals industries. Subsurface geologic information is essential for municipal and hazardous waste disposal, ground water management, environmental protection, geologic hazards assessments, and siting of utility lifelines, critical facilities, and transportation infrastructure.

Table 6 indicates that major oil companies and large independent producers would contribute large quantities of well logs and related information. The data include 4,000,000 paper well logs, 900,000 microfiche well logs, 125,400 digital well logs, 2,300,000 scout tickets, and 540,000 geochemical analyses, 100,000 PVT tests, and 44,000 paleontological well studies.

It is likely that some of this data, particularly certain well logs, are already in the public domain. Some states require disclosure of various types of well data, but in many cases it is possible for companies to satisfy disclosure requirements by providing a small amount of low quality data. However, data contributed to a National Geoscience Data Repository System may be substantially more complete and of higher quality than data already in the public domain.

Establishing and Operating a Repository System

Features and Services. The survey and site visits included a number of general questions designed to determine the most important features and services of a National Geoscience Data Repository System. An overwhelming majority of respondents said that they would use a well-designed and efficiently operated National Geoscience Data Repository System (Fig. 7). That conclusion is reinforced by the ranking of current data sources shown in Figure 8. Log and sample libraries ranked as the second most important or frequently used source of geoscience data. Only internally generate information ranked ahead of log and sample libraries.

The need to act quickly to establish a National Geoscience Data Repository System is reinforced by the fact that most existing facilities have little remaining storage capacity (Fig. 9). As the oil and gas industry has downsized, many organizations are closing internal storage facilities, reducing support to jointly operated storage facilities, and attempting to donate material to state-operated facilities that are already at or near capacity.

Figure 10 shows that the most important features and services are data access, data indexing and cataloging, information retrieval, geographic location, and cost of data. These are the same types of features cited by users of other data information systems.

Recommendations. Based on general responses from the survey questionnaire, site visits, and steering committee meetings, the most important issues and recommendations regarding the establishment of a National Geoscience Data Repository System are the following:

- Establish a national repository system composed of an integrated network of data centers, rather than a single, centralized facility.

- Build upon existing state and regional data centers as a starting point for developing a distributed national repository system.

- Ensure that researchers can effectively use the data by placing ease of data access at the heart of the data management system.

- Establish a national directory of data centers that includes information about data holdings and guidance for locating and obtaining data.

- Ensure full and open sharing of all data in the repository system.

- Establish procedures and criteria for setting priorities for data acquisition, retention, and purging to ensure preservation of the most important and highest quality data and to maximize cost-effectiveness.

- Develop a plan and mechanism for efficiently transferring massive amounts of private-sector data to a public repository system.

- Adopt national standards for storing, processing, and distributing data in order to reduce costs and increase productivity.

- Act quickly to capture large volumes of data in jeopardy of being lost.

- Develop a plan for long-term funding, including adequate support from federal and state agencies and the user community.

The positive response to the Phase I study clearly indicates the need to proceed expeditiously to the Phase II study, which would address specific organizational and operational requirements of establishing a National Geoscience Data Repository System.

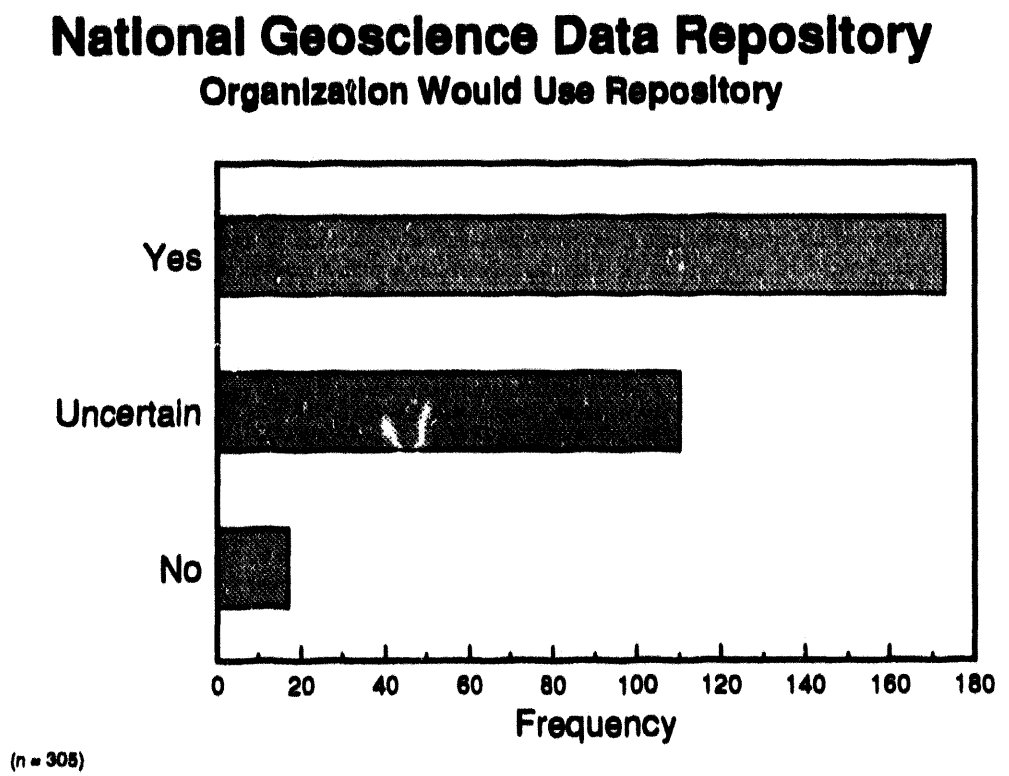


Figure 7. Organization Would Use Repository System

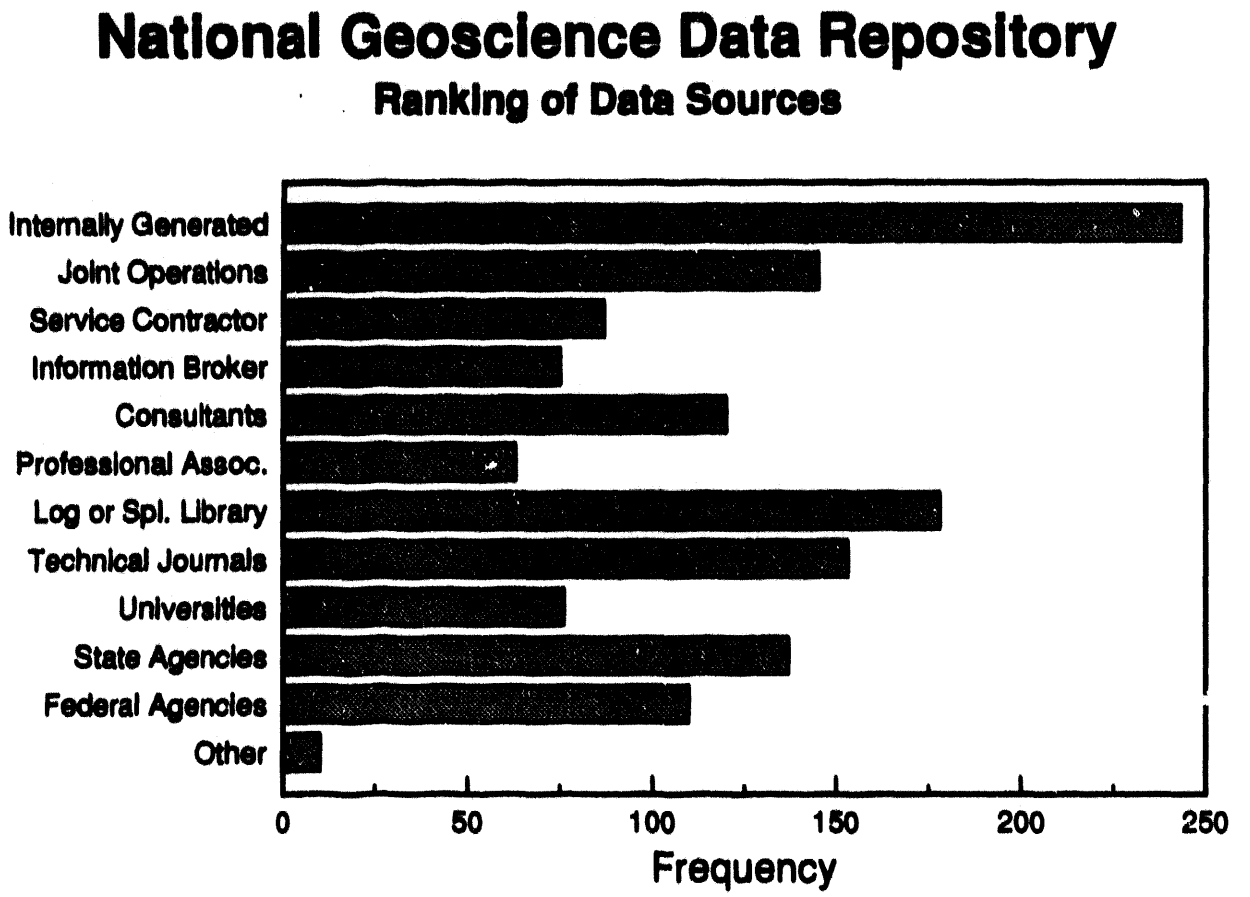


Figure 8. Ranking of Data Sources

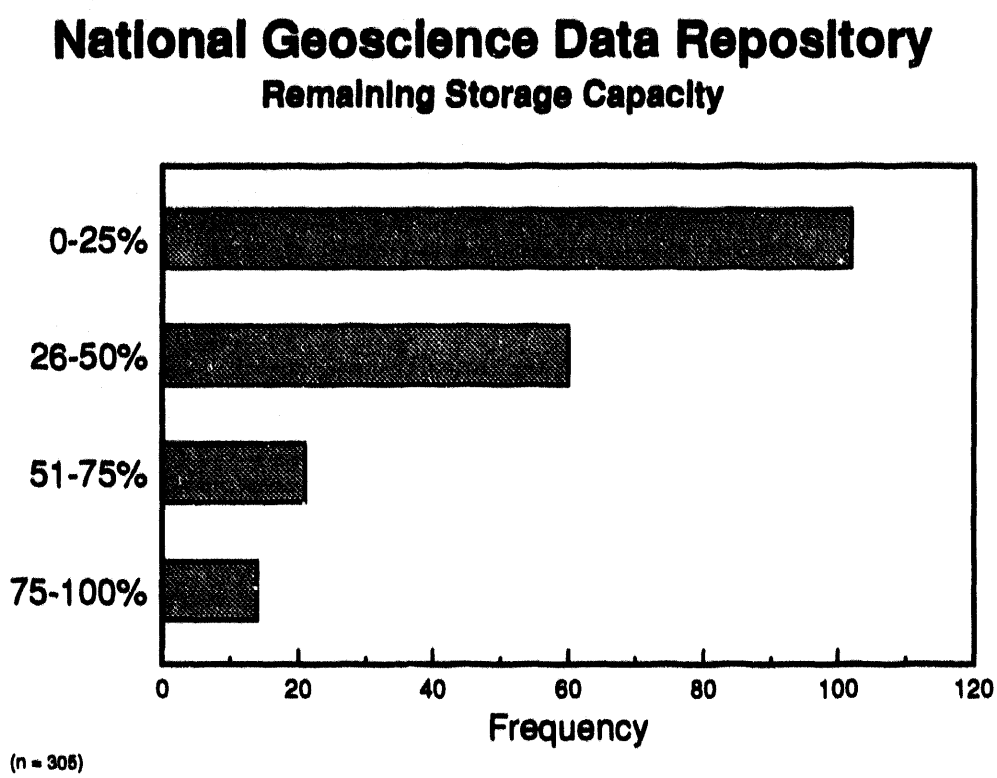


Figure 9. Remaining Storage Capacity

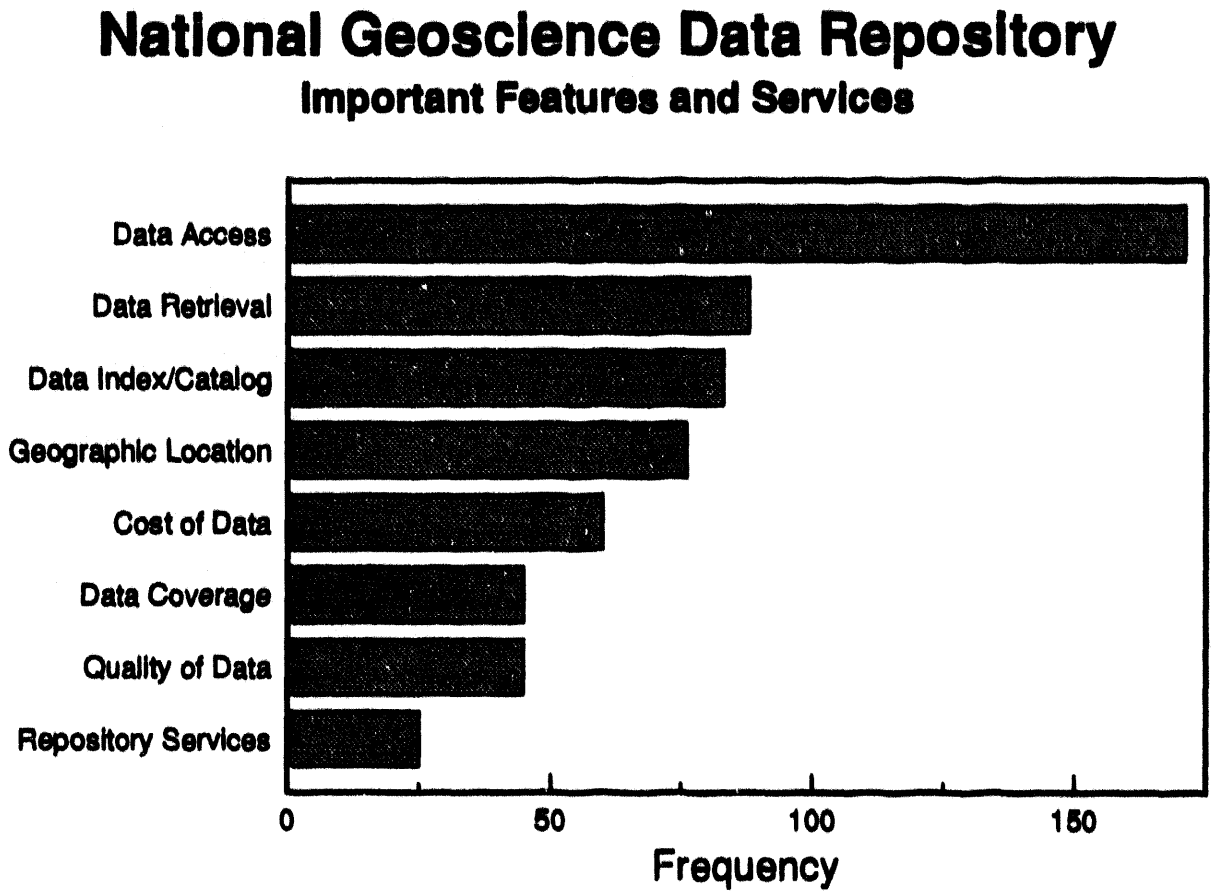


Figure 10. Important Features and Services

NATIONAL DATA MANAGEMENT ISSUES

U.S. Geoscience Data Policy

Geoscience research and development requires massive quantities of highly diverse data and information. Geoscience data management issues have been addressed in several recent reports by the National Academy of Sciences, the Office of Science and Technology Policy, and other organizations. During the past several years, attention has been focused on data management issues for the U.S. Global Change Research Program. Many of the data management principles established for the Global Change Program and other geoscience data sets are applicable to a National Geoscience Data Repository System.

In 1991, the Office of Science and Technology Policy issued the "Data Management for Global Change Research Policy Statements." The policy statements, are listed below:

- The U.S. Global Change Research Program requires an early and continuing commitment to the establishment, maintenance, validation, description, accessibility, and distribution of high-quality, long-term data sets.

- Full and open sharing of the full suite of global data sets for all global change researchers is a fundamental objective.

- Preservation of all data needed for long-term global change research is required. For each and every global change data parameter, there should be at least one explicitly designated archive. Procedures and criteria for setting priorities for data acquisition, retention, and purging should be developed by participating agencies, both nationally and internationally. A clearinghouse process should be established to prevent the purging and loss of important data sets.

- Data archives must include easily accessible information about the data holdings, including quality assessments, supporting ancillary information, and guidance and aids for locating and obtaining the data.

- National and international standards should be used to the greatest extent possible for media and for processing and distributing global data sets.

- Data should be provided at the lowest possible cost to global change researchers in the interest of full and open access to data. The cost should, as a first principle, be no more than the marginal cost of filling a specific user request. Agencies should act to streamline administrative arrangements for exchanging data among researchers.
- For those programs in which selected principal investigators have initial periods of exclusive data use, data should be made openly available as soon as they become widely useful. In each case the funding agency should explicitly define the duration of any exclusive use period.

Many of the policy statements are directly applicable to a National Geoscience Data Repository System, especially if the phrase "U.S. Global Change Research Program" is replaced by the phrase "U.S. energy security."

In 1992, the Office of Science and Technology Policy (OSTP) released a report, *The U.S. Global Change Data and Information Management Program Plan*, prepared by the Interagency Working Group on Data Management for Global Change for the Committee on Earth and Environmental Sciences (CEES), of the Federal Coordinating Council for Science Engineering, and Technology (FCCSET). According to the OSTP report, data rescue is one of the areas receiving "special emphasis in the near term." The report states (p. 34), "Important data and information are at risk of being lost forever." It elaborates as follows (p. 37): "A significant amount of data and information is threatened with loss unless action to assure its retention and stewardship are taken. A process for identifying such data and information will be established by the data and information management program. Both digital and nondigital data will need to be addressed."

The OSTP report was significantly influenced by the 1991 National Academy of Sciences report *Solving the Global Change Puzzle: A U.S. Strategy for Managing Data and Information.* The National Academy of Sciences report provides six strategic recommendations, which are listed below with slight modifications:

1) Link data and information management activities to the scientific goals of the program, so as to create a partnership between active data users and data centers.

2) Adequately support the data system.

3) Use the present system of data centers as a starting point.

4) Design an evolving data and information system serving an expanding user base.

5) Ensure that researchers can effectively use the data, now and in the future, by placing quality assurance and documentation at the heart of a data management system supporting the global change program.

6) Establish issue-oriented information services in addition to discipline-oriented data services as a function of the data and information management system.

The Global Change Program provides an interesting and useful case study for a National Geoscience Data Repository System. Many of the conclusions and recommendations of the National Academy of Sciences report and the OSTP report are applicable to a National Geoscience Data Repository System.

Cost of Global Change Data Management

The budget of the U.S. Global Change Program provides useful information about the cost of data management and the federal government's commitment to allocate funds for geoscience data management. Table 7 shows the budget of the U.S. Global Change Research Program for fiscal 1991 to 1993. The cost of data management ranges from $170 million in 1991 to $295 million in 1993. Data management represents a significant portion of the total Global Change Research Program budget, ranging from 18 to 24 percent of the total budget. From 1991 to 1993, the budget for data management is larger than the budget for global change predictions. In 1992, the budget for

data management is also larger than the budget for observation (data collection). According to the OSTP report, the data and information management component of the Global Change Program was highlighted in the fiscal 1993 budget plan as one of the areas requiring special emphasis. The report says, "Unless there are major budget increases for data and information management the agencies will not be able to achieve the program's objectives."

An analysis of the budget of the U.S. Global Change Research Program establishes the following points:

- The federal government has a clear role in providing large-scale funding for geoscience data management.
- The cost of current federal geoscience data management programs is in the multi-hundred million dollar range.
- The cost of data management is a significant fraction of the total cost of large-scale geoscience research programs.

Table 7. U.S. Global Change Research Program

Budget by Science Objective
(Millions of Dollars)

Science Element	1991 (actual)	1992 (est.)	1993 (request)
Data Management	170	270	295
Observation	259	254	329
Understanding	457	468	606
Prediction	68	118	143
TOTAL	954	1110	1372

Source: *The U.S. Global Change Data and Information Management Program Plan*, Office of Science and Technology Policy, 1992.

CONCLUSIONS AND RECOMMENDATIONS

The results of Phase I of AGI's study to assess the feasibility of establishing a National Geoscience Data Repository System are extremely positive. The survey and site visits have documented that enormous quantities of extremely valuable data would be contributed to a National Geoscience Data Repository System. The proposed industry contributions represent billions of dollars worth of geological and geophysical data that were collected at no expense to the federal government. In some cases, the data are unique and cannot be replaced because of urban development and new restrictions that place land off limits to resource exploration and development activities.

Much of the data that would be contributed to a National Geoscience Data Repository System is in jeopardy of being discarded or lost as the oil and minerals industries continue to downsize their domestic activities and focus their remaining resources on overseas opportunities. All material placed in a National Geoscience Data Repository System would enter the public domain and become available to all users. State and federal agencies have indicated that large amounts of geoscientific data already in their possession would be made available through a National Geoscience Data Repository System.

The survey and site visits have clearly established that there is a close correspondence between the types of data that companies would contribute to a National Geoscience Data Repository System and the types of data that are most useful to potential users of the repository system. The most important features and services that must be addressed in order to develop a data repository system that is successful from the users' perspective are data access, data indexing and cataloging, information retrieval, geographic location, and cost of data.

Both data contributors and data users agree that the most important issues and recommendations are the following:

- Establish a national repository system composed of an integrated network of data centers, rather than a single, centralized facility.
- Build upon existing state and regional data centers as a starting point for developing a distributed national repository system.
- Ensure that researchers can effectively use the data by placing ease of data access at the heart of the data management system.
- Establish a national directory of data centers that includes information about data holdings and guidance for locating and obtaining data.
- Ensure full and open sharing of all data in the repository system.
- Establish procedures and criteria for setting priorities for data acquisition, retention, and purging to ensure preservation of the most important and highest quality data and to maximize cost-effectiveness.
- Develop a plan and mechanism for efficiently transferring massive amounts of private-sector data to a public repository system.

- Adopt national standards for storing, processing, and distributing data in order to reduce costs and increase productivity.

- Act quickly to capture large volumes of data in jeopardy of being lost.

- Develop a plan for long-term funding, including adequate support from federal and state agencies and the user community.

The positive response to Phase I clearly indicates the need to proceed expeditiously to Phase II, which would address the specific organizational and operational requirements for establishing a National Geoscience Data Repository System. A working plan and budget for siting, implementing, and operating the Repository System would be developed in Phase II.

A National Geoscience Data Repository System would help achieve key objectives of the *National Energy Act of 1992*, *Domestic Natural Gas and Oil Initiative*, *U.S. Global Change Research Program*, and *High Performance Computing and Communications Act of 1991*, as well as technology transfer and defense conversion programs. It would help to reduce U.S. vulnerability to oil supply disruptions by increasing domestic oil production and reducing our dependence on unstable sources of foreign oil. It would help improve the competitiveness of the American energy and minerals industries, create high-quality jobs for American workers, and reduce the U.S. balance of trade deficit.

The federal government has the opportunity to facilitate the largest data rescue operation in the history of the energy industry. There is a narrow window of opportunity to act before valuable data are irrevocably lost. The data truly represent a national treasure and immediate steps must be taken to assure their preservation and future access.

BIBLIOGRAPHY

National Research Council, Board on Earth Sciences (1991). *Undiscovered Oil and Gas Resources*, National Academy Press, Washington, D.C., 108 pp.

National Research Council, Committee on Geophysical Data (1988). *Geophysical Data: Policy Issues*, National Academy Press, Washington, D.C., 40 pp.

National Research Council, Committee on Geophysical Data (1991). *Solving the Global Change Puzzle: A U.S. Strategy for Managing Data and Information*, National Academy Press, Washington, D.C., 52 pp.

National Research Council, Committee on Geophysical and Environmental Data (1992). *Data Forum: A Review of a Federal Plan for Managing Global Change Data and Information*, National Academy Press, Washington, D.C., 59 pp.

Office of Science and Technology Policy (1992). *The U.S. Global Change Data and Information Management Program Plan*, Committee on Earth and Environmental Sciences, Federal Coordinating Council for Science, Engineering and Technology, Washington, D.C., 94 pp.

Office of Science and Technology Policy (1992). *Our Changing Planet: The FY 1993 U.S. Global Change Research Program*, Committee on Earth and Environmental Sciences, Federal Coordinating Council for Science, Engineering and Technology, Washington, D.C., 79 pp.

Office of Science and Technology Policy (1992). *Grand Challenges 1993: High Performance Computing and Communications*, Committee on Physical, Mathematical, and Engineering Sciences, Federal Coordinating Council for Science, Engineering and Technology, Washington, D.C., 68 pp.

Petroleum Technology Transfer Council (1993). *Technology Transfer to U.S. Oil and Natural Gas Producers: A Report to the United States Department of Energy*. Independent Petroleum Association of America, Washington, D.C., 56 pp.

Texas Independent Producers and Royalty Owners Association, and the Texas Bureau of Economic Geology (1992). *Technology Transfer Needs and Requirements for Texas Independent Oil and Gas Producers*, University of Texas at Austin, 33 pp.

U.S. Department of Energy (1991). *National Energy Strategy, First Edition*. Washington, D.C., 217 pp.

U.S. Department of Energy (1992). *National Energy Strategy, One Year Later*. Washington, D.C., 66 pp.

U.S. Department of Energy, Office of Energy Research (1993). *The DOE Program in High Performance Computing and Communications.* Washington, D.C., 99 pp.

U.S. Geological Survey (1984). *Nonprofit Sample and Core Repositories Open to the Public in the United States.* U.S. Geological Survey Circular 942, 102 pp.

Appendix 1. Survey Questionnaire

The following survey questionnaire, *National Geoscience Data Repository System: Survey of Data Contributors and Users* (May 1993), was distributed to 1,103 geoscientific organizations throughout the United States.

AMERICAN GEOLOGICAL INSTITUTE
4220 King Street, Alexandria, VA 22302-1507

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Executive Director
Marcus E. Milling, Ph.D.

Celebrating 45 years of service in the geosciences

NATIONAL GEOSCIENCE

DATA REPOSITORY SYSTEM

SURVEY OF DATA CONTRIBUTORS & USERS

Conducted By
AMERICAN GEOLOGICAL INSTITUTE

May 1993

NATIONAL GEOSCIENCE DATA REPOSITORY SYSTEM

Survey Background and Rationale

The American Geological Institute is conducting a study to assess the feasibility of establishing a National Geoscience Data Repository System. The study is being coordinated by a Steering Committee composed of representatives from professional societies, industry, academia, and federal and state agencies. The concept of establishing a nationally based data repository system has received broad interest and support in both the private and public sectors. Such a system would most likely be developed around existing state and regional repositories. The repository system would serve as an important source of information for the geoscience community for use in energy and mineral exploration as well as other types of investigations, including environmental assessments, water resource studies, and basic research at our universities.

The survey questionnaire asks you to provide information covering 5 major categories:

- **Organization Profile** — Determines basic information about your organization and geographic areas of operation.
- **Data Availability and Contributor Priorities** — Addresses the types of geoscience data your organization uses and the types of data it would consider releasing to a national repository system.
- **Data User Priorities** — Assesses the priorities your organization places on information it would request from the repository system.
- **Data Quantity and Geographic Coverage** — Determines the quantity, types and geographic coverage of data your organization would consider contributing to the repository system.
- **Data Repository Operations** — Requests your recommendations for establishing and operating a nationally based repository system.

Your input is important to us. We are surveying only a limited number of individuals and organizations. The survey is being sent to only one individual in each organization. We need your recommendations and suggestions to assess the feasibility of establishing a National Geoscience Data Repository System.

Please complete and return the survey in the enclosed envelope to:

National Geoscience Data Repository System
American Geological Institute
4220 King Street
Alexandria, VA 22302-1507

ORGANIZATION PROFILE

1) What best describes your organization? (check only one)

Resource Producer
- ☐ oil and gas
- ☐ coal
- ☐ metals
- ☐ industrial minerals
- ☐ other _____

Research and Information
- ☐ log and sample library
- ☐ information broker
- ☐ university or research institute
- ☐ state geological survey
- ☐ federal agency or national laboratory
- ☐ other _____

Service and Consulting Companies
- ☐ seismic or other geophysical
- ☐ core, log, or assay
- ☐ oil and gas
- ☐ mining and minerals consulting
- ☐ environmental and hydrology
- ☐ other _____

2) In what geographic areas of the U.S. does your organization operate and/or have geoscience data? (check all that apply)

Western
- ☐ West Texas/New Mexico
- ☐ Rocky Mountains
- ☐ Basin and Range
- ☐ West Coast
- ☐ Alaska
- ☐ Other _____

Eastern
- ☐ Appalachian
- ☐ Other _____

Central
- ☐ Gulf Coast
- ☐ Mid-Continent
- ☐ Other _____

Offshore
- ☐ Gulf of Mexico
- ☐ California
- ☐ Atlantic
- ☐ Alaska
- ☐ Other _____

3) How many geoscience professionals (geologists, geophysicists, geochemists, etc.) are employed in your organization's U.S. operations:

- ☐ < 5
- ☐ 5-49
- ☐ 50-99
- ☐ 100-199
- ☐ 200-399
- ☐ > 400

DATA AVAILABILITY AND CONTRIBUTOR PRIORITIES

	Availability My organization possesses the following types of data:		**Contributor Priorities** If a Data Repository System were established, we would contribute the following types of data: (1) Yes, data available now (2) Yes, pending internal authorization (3) Possibly, further evaluation needed (4) No, data confidential (check all that apply)			
	Yes	No	Yes	Pending	Possibly	No
Well or Drill Hole Data						
Rock cores	☐	☐	(1)	(2)	(3)	(4)
Sample cuttings	☐	☐	(1)	(2)	(3)	(4)
Fluid samples	☐	☐	(1)	(2)	(3)	(4)
Geophysical well logs	☐	☐	(1)	(2)	(3)	(4)
Lithologic/sample logs	☐	☐	(1)	(2)	(3)	(4)
Completion data	☐	☐	(1)	(2)	(3)	(4)
Scout data	☐	☐	(1)	(2)	(3)	(4)
Drill stem tests	☐	☐	(1)	(2)	(3)	(4)
Production records	☐	☐	(1)	(2)	(3)	(4)
Paleontologic data	☐	☐	(1)	(2)	(3)	(4)
Petrophysical core tests	☐	☐	(1)	(2)	(3)	(4)
Geochemical core analysis	☐	☐	(1)	(2)	(3)	(4)
Other _____	☐	☐	(1)	(2)	(3)	(4)
_____	☐	☐	(1)	(2)	(3)	(4)
Geophysical Data						
2D seismic	☐	☐	(1)	(2)	(3)	(4)
3D seismic	☐	☐	(1)	(2)	(3)	(4)
Refraction seismic	☐	☐	(1)	(2)	(3)	(4)
Velocity surveys	☐	☐	(1)	(2)	(3)	(4)
Magnetic data	☐	☐	(1)	(2)	(3)	(4)
Gravity data	☐	☐	(1)	(2)	(3)	(4)
Induced polarization	☐	☐	(1)	(2)	(3)	(4)
Electromagnetic data	☐	☐	(1)	(2)	(3)	(4)
Other _____	☐	☐	(1)	(2)	(3)	(4)
_____	☐	☐	(1)	(2)	(3)	(4)
Other Data						
Geologic/geophysical maps	☐	☐	(1)	(2)	(3)	(4)
Remote sensing imagery	☐	☐	(1)	(2)	(3)	(4)
Paleontologic collections	☐	☐	(1)	(2)	(3)	(4)
Geochemical/assay analysis	☐	☐	(1)	(2)	(3)	(4)
Structural data & maps	☐	☐	(1)	(2)	(3)	(4)
Technical reports	☐	☐	(1)	(2)	(3)	(4)
Digital databases	☐	☐	(1)	(2)	(3)	(4)
Hand samples	☐	☐	(1)	(2)	(3)	(4)
Other _____	☐	☐	(1)	(2)	(3)	(4)
_____	☐	☐	(1)	(2)	(3)	(4)

DATA USER PRIORITIES

User Priorities

If a Data Repository System were established, my organization would place the indicated priorities on the use of data from the system:

(1) High, primary data source
(2) Moderate, secondary data source
(3) Low, would use if available
(4) None, not used

	(check only one)			
	High	Moderate	Low	None
Well or Drill Hole Data				
Rock cores	(1)	(2)	(3)	(4)
Sample cuttings	(1)	(2)	(3)	(4)
Fluid samples	(1)	(2)	(3)	(4)
Geophysical well logs	(1)	(2)	(3)	(4)
Lithologic/sample logs	(1)	(2)	(3)	(4)
Completion data	(1)	(2)	(3)	(4)
Scout data	(1)	(2)	(3)	(4)
Drill stem tests	(1)	(2)	(3)	(4)
Production records	(1)	(2)	(3)	(4)
Paleontologic data	(1)	(2)	(3)	(4)
Petrophysical core tests	(1)	(2)	(3)	(4)
Geochemical core analysis	(1)	(2)	(3)	(4)
Other _____	(1)	(2)	(3)	(4)
_____	(1)	(2)	(3)	(4)
Geophysical Data				
2D seismic	(1)	(2)	(3)	(4)
3D seismic	(1)	(2)	(3)	(4)
Refraction seismic	(1)	(2)	(3)	(4)
Velocity surveys	(1)	(2)	(3)	(4)
Magnetic data	(1)	(2)	(3)	(4)
Gravity data	(1)	(2)	(3)	(4)
Induced polarization	(1)	(2)	(3)	(4)
Electromagnetic data	(1)	(2)	(3)	(4)
Other _____	(1)	(2)	(3)	(4)
_____	(1)	(2)	(3)	(4)
Other Data				
Geologic/geophysical maps	(1)	(2)	(3)	(4)
Remote sensing imagery	(1)	(2)	(3)	(4)
Paleontologic collections	(1)	(2)	(3)	(4)
Geochemical/assay analysis	(1)	(2)	(3)	(4)
Structural data & maps	(1)	(2)	(3)	(4)
Technical reports	(1)	(2)	(3)	(4)
Digital databases	(1)	(2)	(3)	(4)
Hand samples	(1)	(2)	(3)	(4)
Other _____	(1)	(2)	(3)	(4)
_____	(1)	(2)	(3)	(4)

DATA QUANTITY AND GEOGRAPHIC COVERAGE

If a National Geoscience Data Repository System were established, my organization would consider contributing the following types and quantity of data covering the indicated geographic areas (please add additional pages if necessary). Your best order of magnitude estimate will be sufficient.

WELL AND DRILL HOLE DATA

	Quantity or Volume	Covering Indicated U.S. Areas	Is this material in jeopardy of being discarded? Yes	No
Rock Cores *(number of core boxes)*	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
Sample Cuttings *(number of boxes)*	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
Digital Records *(number of tape reels)*	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
Paper Records *(number of boxes or file drawers)*	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
Other *(specify units)*	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐

DATA QUANTITY AND GEOGRAPHIC COVERAGE

GEOPHYSICAL DATA

	Quantity or Volume	Covering Indicated U.S. Areas	Is this material in jeopardy of being discarded? Yes	No
Paper Records *(number of boxes or file drawers)*	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
Digital Records *(number of tape reels*)*	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
Other *(specify units)*	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐

OTHER DATA

Paper Records *(number of boxes or file drawers)*	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
Digital Records *(number of tape reels)*	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
Other *(specify units)*	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐
	_____	_____	☐	☐

* For seismic lines, you may also specify 2-D km or 3-D km^2

DATA REPOSITORY OPERATIONS

A National Geoscience Data Repository System would most likely be developed around existing public and private sector data repositories at the state and regional level. The repository system would provide critical data to allow domestic energy and minerals companies to expand their exploration programs in the United States. It would also serve as an important and valuable source of information for the entire geoscience community for application in a variety of other types of investigations including, environmental protection evaluations, water resource assessments, and global change studies. To increase operating efficiency of the repository system standards for curating, digitizing and indexing data would be established. A catalog documenting and describing the types and locations of data would be developed and distributed to users. Data would be available for onsite inspection as well as on CD-ROMs and through remote computer access.

1) **If a National Geoscience Data Repository System were established along the lines described above, would your organization use it?**

☐ Yes ☐ Uncertain ☐ No

2) **How would you rate the usefulness of a high-quality National Geoscience Data Repository System in meeting the informational needs of your organization?**

☐ Very High ☐ High ☐ Moderate ☐ Low ☐ Very Low

3) **How important is it to your organization that the repository provide remote computer access to data files?**

☐ Very High ☐ High ☐ Moderate ☐ Low ☐ Very Low

4) **What are the FIVE most important or frequently used sources of geoscience data your organization currently depends on? (rank 1-Highest to 5-Lowest)**

__ Internally Generated
__ Joint Operations with Other Companies
__ Service Contractor
__ Information Broker
__ Consultants
__ Professional Associations
__ Log and Sample Libraries
__ Technical Journals
__ Research Universities
__ State Agencies
__ Federal Agencies
__ Other _____

5) **If your organization maintains a geoscience data storage facility, what is the remaining capacity of the facility?**

☐ 0-25% (nearly full)
☐ 26-50%
☐ 51-75%
☐ 76-100% (nearly empty)

6) **In order to best meet the needs of your organization, what are the three most important features that should be considered in establishing and operating a Geoscience Data Repository System?**

a) _____

_____

_____

b) _____

_____

_____

c) _____

_____

_____

7) **Please provide any additional comments or recommendations that should be addressed in assessing the feasibility of a National Geoscience Data Repository System.**

a) _____

_____

_____

b) _____

_____

_____

c) _____

_____

_____

Thank you for assisting AGI in this study — your input is important. Individual survey responses will be held confidential. However, we would appreciate knowing who to contact in your organization in case we have any questions related to your survey response.

Contact person: _____
Organization: _____
City, State, ZIP: _____
Phone Number: _____

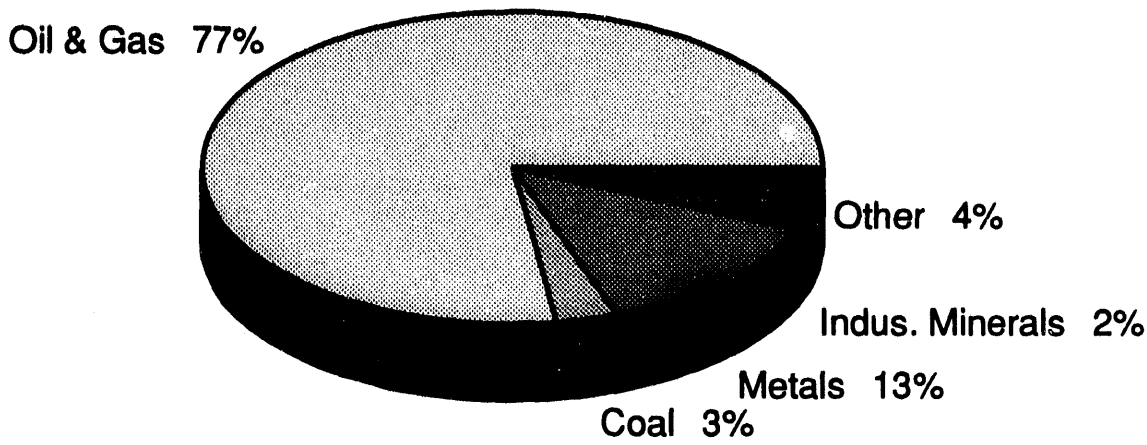
Would you like to receive a complimentary copy of AGI's Executive Summary of the Geoscience Data Repository Survey Report on completion of the study? ☐ **Yes** ☐ **No**

Appendix 2. Supplemental Figures and Tables

The following figures and tables provide additional information about the 305 organizations that responded to the survey questionnaire. The total number of responses to some questions is greater than 305 because multiple responses were entered on some questionnaires.

National Geoscience Data Repository

Survey of Data Contributors and Users



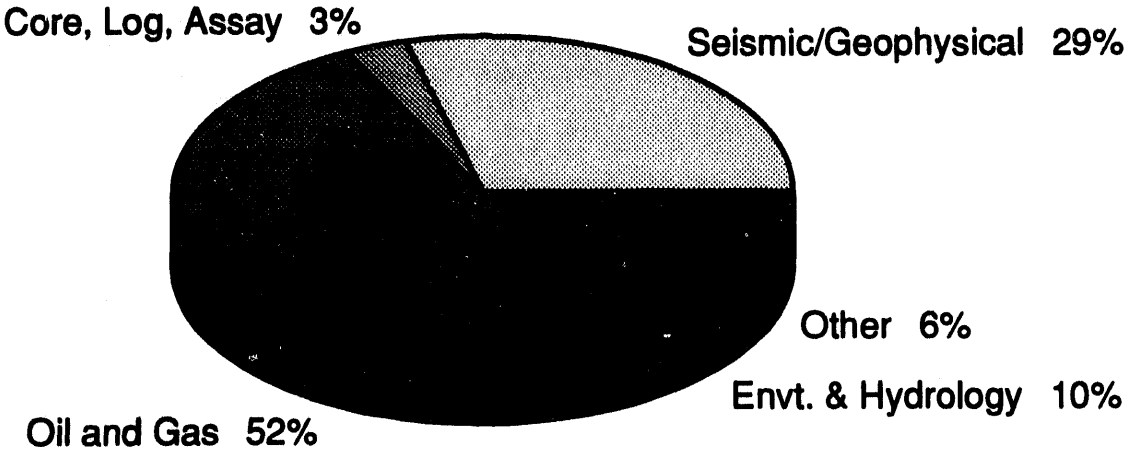
Organization Profile: Resource Producers

	Number	Percent
Oil and Gas	167	77
Coal	7	3
Metals	28	13
Industrial Minerals	5	2
Other	9	4
TOTAL	216	100

Appendix 2.1 — Organization Profile: Resource Producers

National Geoscience Data Repository

Survey of Data Contributors and Users



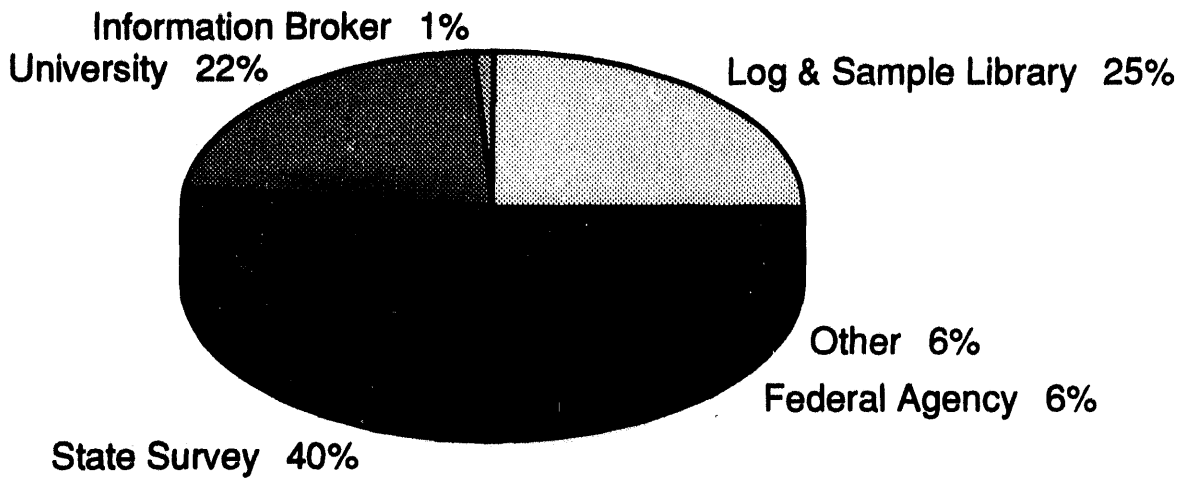
Organization Profile: Service & Consulting

	Number	Percent
Seismic/Geophysical	9	29
Core, Log, Assay	1	3
Oil and Gas	16	52
Mining/Minerals	0	0
Envt. & Hydrology	3	10
Other	2	7
TOTAL	31	100

Appendix 2.2 — Organization Profile: Service and Consulting

National Geoscience Data Repository

Survey of Data Contributors and Users



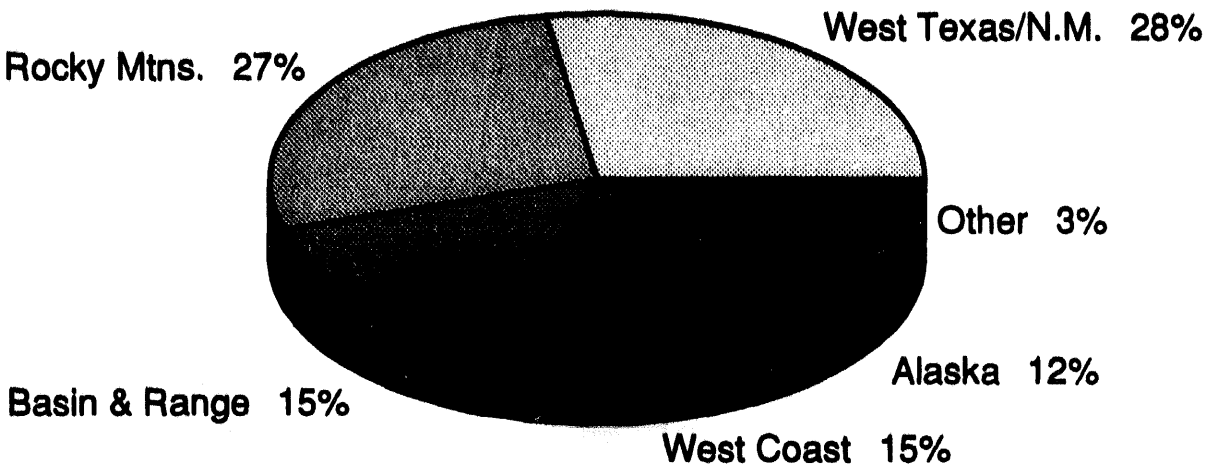
Organization Profile: Research & Information

	Number	Percent
Log & Sample Library	24	25
Information Broker	1	1
University/Research	21	22
State Survey	38	40
Federal Agency	6	6
Other	6	6
TOTAL	96	100

Appendix 2.3 — Organization Profile: Research and Information

National Geoscience Data Repository

Survey of Data Contributors and Users



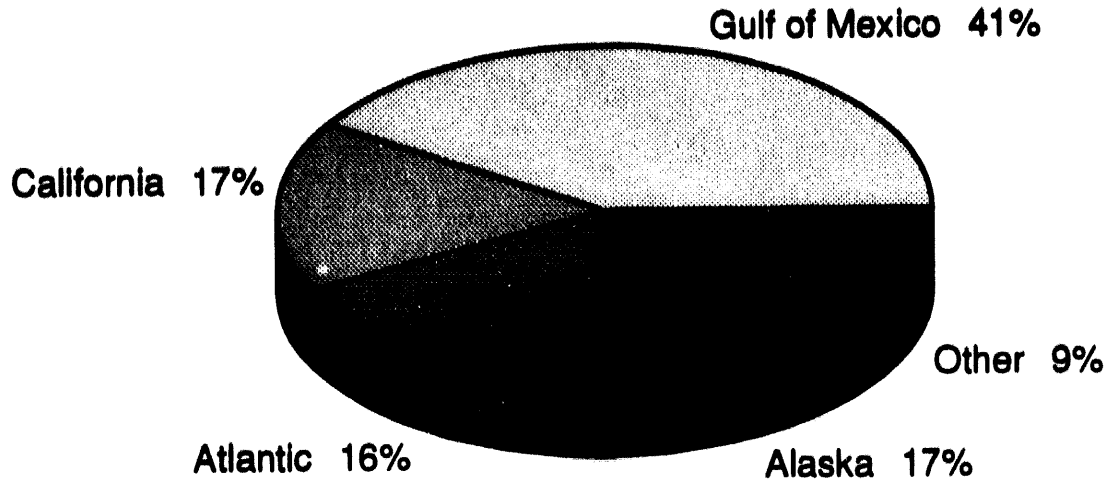
Geographic Distribution: Western States

	Number	Percent
W. Texas/New Mexico	116	28
Rocky Mountains	115	27
Basin & Range	63	15
West Coast	65	15
Alaska	51	12
Other	11	3
TOTAL	421	100

Appendix 2.4 — Geographic Distribution: Western States

National Geoscience Data Repository

Survey of Data Contributors and Users



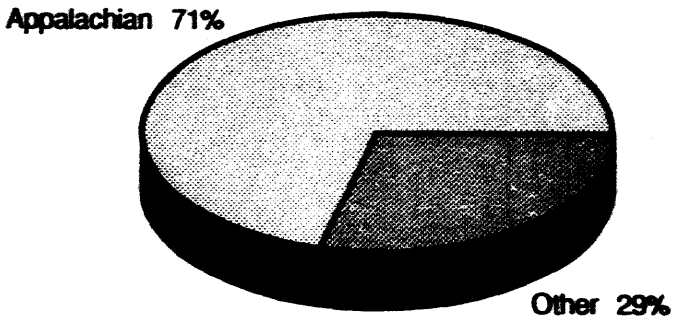
Geographic Distribution: Offshore Areas

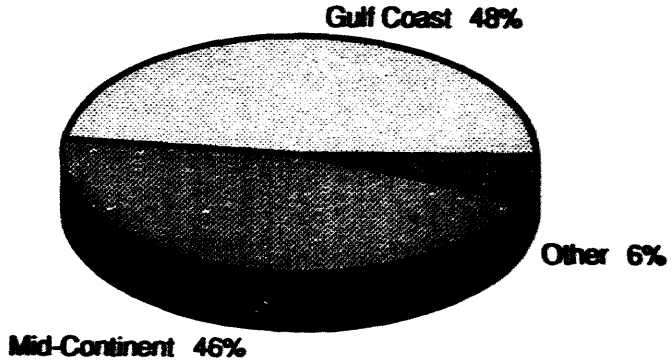
	Number	Percent
Gulf of Mexico	59	41
California	24	17
Atlantic	23	16
Alaska	25	17
Other	13	9
TOTAL	144	100

Appendix 2.5 — Geographic Distribution: Offshore Areas

National Geoscience Data Repository

Survey of Data Contributors and Users





Geographic Distribution: Eastern States

	Number	Percent
Appalachian	69	71
Other	28	29
TOTAL	97	100

Geographic Distribution: Central States

	Number	Percent
Gulf Coast	138	48
Mid-Continent	132	46
Other	17	6
TOTAL	287	100

Appendix 2.6 – Geographic Distribution: Central and Eastern States

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