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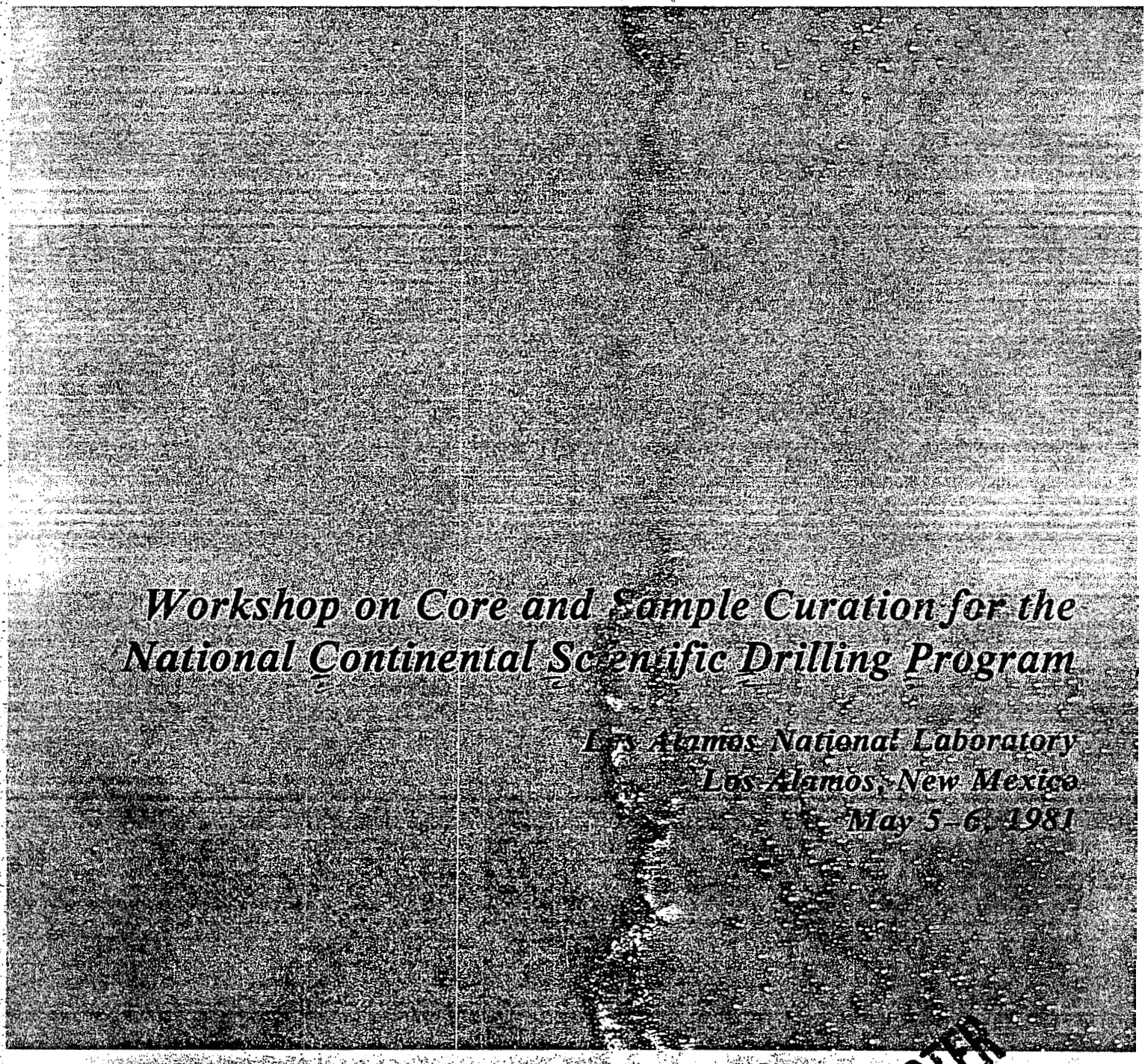

Workshop on Core and Sample Curation for the National Continental Scientific Drilling Program

Los Alamos National Laboratory
Los Alamos, New Mexico
May 5-6, 1981

Los Alamos
Los Alamos National Laboratory
Los Alamos, New Mexico 87545

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WORKSHOP ON CORE AND SAMPLE CURATION FOR THE NATIONAL CONTINENTAL SCIENTIFIC DRILLING PROGRAM

Los Alamos National Laboratory
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Editors

Sue Goff and Grant Heiken

ABSTRACT

The Workshop on Core and Sample Curation was held to discuss the best means of handling, distributing, and advertising samples and data collected during a Continental Scientific Drilling Program (CSDP) and to establish better communication between sample curators regarding common problems. It was generally agreed that CSDP samples should be handled, on a regional basis, by existing data systems and sample repositories judged to have adequate staff and support. Repository design, sample handling procedures, and sample accounting systems were discussed. Across North America, support for curation of geological samples was varied, but it was strongest within states or regions with well-established energy and mineral industries. A well-supported repository pays for itself through the circulation and preservation of samples and stratigraphic information. A national CSDP must have a well-established curatorial policy and system of regional repositories to circulate information and samples throughout the scientific community. Well-curated samples and data are a national resource with considerable benefits for industry and academia. Attendees agreed to form a Society of Geoscience Curators to maintain communication between curators from private, government, and university repositories and core research laboratories.

I. INTRODUCTION

The Workshop on Core and Sample Curation for the Continental Scientific Drilling Program (CSDP) was held at the National Security and Resources Study Center, Los Alamos National Laboratory, Los Alamos, New Mexico, May 5-6, 1981. This report summarizes the discussions held at the meeting of 30 curators and other interested persons from state, federal, and private institutions.

Why a workshop? To circulate and yet protect cores, cuttings, and other samples produced during a CSDP, proper curation will be necessary. The Office of Basic Energy Sciences (OBES) of the Department of Energy (DOE) agreed to support a meeting of curators and other interested persons to consider the problems of handling samples from the CSDP. The idea for a workshop on core and sample curation came out of a CSDP investigation last year of core and sample repositories around the United States and Canada and of state laws dealing with the preservation of rock materials (Heiken and Goff, 1981). While talking to many of the meeting attendees during the course of the investigation, it became obvious that there was a real need to bring together people interested in curation to discuss mutual successes and problems and to establish a communication network of people concerned with the care and handling of rock material of continental origin, in much the same way the Deep Sea Drilling Project has done.

The first day of the workshop concentrated on curation and the CSDP. On the second day, discussions dealt with curation and curatorial problems of a general nature. Sections were organized and opened by a discussion leader who made introductory remarks and moderated the sessions. A list of attendees and material distributed at the workshop make up Appendixes A and B. This final report differs from the agenda (Appendix C), as an additional section on the CSDP Drill-Hole Data Base has been included and precedes the other data management session.

II. NATIONAL CONTINENTAL SCIENTIFIC DRILLING PROGRAM--STATUS AND GOALS (Charles Mankin, Oklahoma Geological Survey and Member of the Continental Scientific Drilling Committee; Robert Andrews, Staff Officer, Continental Scientific Drilling Committee, National Research Council)

The workshop opened with a report to the participants on the Continental Scientific Drilling Committee (CSDC). This report served as a review for some and an introduction to the CSDC for others. The objectives and a brief chronology of continental drilling for scientific purposes were presented, as well as a summary of the organization and activities of the CSDC.

The basic objectives of a national continental scientific drilling program are to:

(1) gain greater knowledge of the earth's continental crust,

(2) maximize the scientific value of drilling activities of government and industry through investigations added to these activities,

(3) plan for dedicated drilling to address broad scientific objectives,

(4) conduct basic scientific research related to societal problems, and

(5) provide a mechanism for effective communications, cooperation, and advice.

The concept of a drilling program for scientific purposes began evolving in the early 1960s. A workshop held at Ghost Ranch, New Mexico (Shoemaker, 1975), supported by the Carnegie Institution of Washington, recommended a systematic drilling program in three areas: the state and structure of the continental crust, mechanisms of faulting and earthquakes, and hydrothermal systems and active magma chambers. By 1977 it was recognized that both the DOE and the US Geological Survey (USGS), as well as other federal agencies, had existing elements of a continental drilling program. The Workshop on Continental Drilling for Scientific Purposes held in Los Alamos, New Mexico, in July 1978 (US Geodynamics Committee, 1979) addressed the scientific value of current and planned efforts of federal agencies and industry and how to supplement these efforts with holes drilled solely for scientific purposes.

Four major scientific objectives were addressed by panels.

(1) Basement structures and deep continental basins--broad and specific questions related to understanding the earth's continental crust.

(2) Thermal regimes--basic understanding of geothermal systems.

(3) Mineral resources--basic understanding of ore-forming processes.

(4) Earthquakes--basic understanding of earthquake and faulting mechanisms.

Participants of the workshop at Los Alamos recognized the need for curation and called for an early commitment by the national CSDP to curation, especially because of the multidisciplinary nature of many potential projects.

Recommendations on sample and core repositories made at the workshop include the following.

(1) Establishment of a unified, coordinated system of regional archives.

(2) Establishment of standard operating procedure for participating agencies.

(3) Provision for federal support to existing state archives to upgrade service and ensure conformance with established procedures.

In 1979 the DOE OBES established a CSDP and the Workshop on Core and Sample Curation was funded under this program. The National Academy of Sciences--National Research Council established the CSDC with E. M. Shoemaker as chairman in December, 1979. The purposes of this committee are to:

(1) interface with the scientific community,

(2) identify drill holes of opportunity for the scientific community,

(3) receive interests and objectives in drilling into the earth's crust from the scientific community,

(4) provide broad policy guidance to the national CSDP, and

(5) review, on request, agency CSDP programs.

Three panels (thermal regimes, basement structures and deep continental basins, and mineral resources) identify significant scientific objectives for drilling.

Activities of the Continental Scientific Drilling Committee include the following.

(1) Illinois Deep Hole Project.

(2) De facto coordination group comprised of federal agency liaison representatives from the DOE, USGS, National Science Foundation (NSF), and Office of Naval Research (ONR).

(3) Drilling Early Warning System.

(4) Symposium on Continental Scientific Drilling, American Association of Petroleum Geologists 1980 Meeting, Denver, Colorado.

(5) Review of DOE/OBES, CSDP: drill-hole information and data management, hydrothermal-magma systems comparative site assessment, and drilling sample curation.

(6) Symposium on Hydrothermal-Magma Systems (Models and Drilling Sites), American Geophysical Union 1980 Fall Meeting, San Francisco, California. The review was conducted at the request of the US DOE.

(7) Valles Caldera, New Mexico, hydrothermal-magma systems study.

During the discussion, definition of the continent was questioned. Suggestions were made that the continental regions of Canada and Mexico should be included in the national CSDP.

III. CONTINENTAL SCIENTIFIC DRILLING PROGRAM--CURATORIAL NEEDS (Grant Heiken, Sue Goff, Los Alamos National Laboratory, Los Alamos, New Mexico)

The purpose of this meeting was twofold: (1) recommend ways to handle, distribute, and advertise samples and information from a CSDP, and (2) to communicate with each other on common problems in curation of continental materials.

Heiken and Goff briefly discussed their recent report to the CSDC on the curatorial needs of the CSDP. Copies of this report had been distributed to all attendees before the meeting. The recommendations from this report formed the basis for most of the discussion sections at the meeting or served as debating points.

Before dedicated holes are drilled, there must be an established curatorial policy. Problems addressed included curators' responsibilities, legal questions, standard field and laboratory descriptions, handling procedures, sample accounting systems, establishing regional repositories, data management, publicity, and a curation budget.

The final products of the workshop were to include a report summarizing the proceedings of the discussion sections, and the formation of an ad hoc committee to establish a Society of Geoscience Curators.

IV. CONTINENTAL SCIENTIFIC DRILLING PROGRAM DRILL-HOLE DATA BASE (Nancy Howard, Lawrence Livermore National Laboratory, Livermore, California)

With funding from the DOE/OBES, Lawrence Livermore National Laboratory has contributed to the CSDP by collecting data on existing and planned continental drill holes to make it easier for scientists to use the holes and the data obtained from them. The project involves the establishment of a data base that includes as many planned and existing drill holes as possible (to promote multiple use).

The CSDP data base is a comprehensive collection of data and information on US drilling activities past and present. It should help scientists make efficient use of the limited funds available for drilling new deep holes. Given knowledge of the existing and planned deep holes, investigators may either use an existing hole for new experiments, use the information already gathered from an existing hole, or propose experiments for planned holes that will provide the needed data with perhaps only a little extra expense.

Information for the CSDP data base is obtained from many sources. The DOE provides valuable information on deep drilling activities conducted in connection with its programs, such as fossil and geothermal energy, petroleum storage, mineral resources, nuclear waste isolation, and national defense.

The CSDP data base also contains information on about 600 holes planned or drilled in 1979-81 by the USGS, on drill holes listed in the Lawrence Berkeley National Laboratory Geothermal Resource information data base, and on scientifically interesting geothermal holes referenced in the USGS GEOTHERM data base. In April 1980, Livermore specifically solicited the assistance of state geologists, who are in a position to inform them of current and proposed drilling activities in their areas. When alerted, Livermore will obtain information about scientifically interesting drilling projects from the closest source.

To date, the CSDP data base contains information on 1900 drill holes. Data are categorized by record number (assigned by Livermore), hole designation (supplied by contributor), purpose, surface elevation, depth, location, start and completion dates, geologic setting, drilling and casing stages, logging and sample types, funding agency, principal investigator, costs, etc.

The data base is maintained on the Livermore Computer Center CDC-7600s by the Master Control Program (MCP). The MCP was chosen as the data base

program because its data search capabilities are more than adequate for Livermore needs and because it can produce reports in page format as well as simple tabular listings.

The group at Livermore is writing a computer program to generate US and state maps showing drill-hole locations. The map-generating program will process data directly from MCP tabular reports; the maps will be highly detailed.

In February 1980, the Geophysics Research Board of the National Research Council advertised the Livermore report listing DOE and other drill holes. More than 150 laboratories, federal agencies, and industries responded with requests for copies of the listing. Many individuals also stated their research interests and the types of drill holes they needed for their work. Livermore continues to receive requests for special listings to be used, for example, in NSF research proposals, a Berkeley search for a deep waste repository, federal and industrial geothermal explorations, or the cooperative DOE-industry ocean-margin drilling program.

V. THE INDEX TO MARINE GEOLOGICAL SAMPLES DATA BASE (Carla Potter, National Geophysical and Solar-Terrestrial Data Center, Boulder, Colorado)

In May of 1977, a meeting of marine core curators was held in La Jolla, California. The National Geophysical and Solar-Terrestrial Data Center (NGSDC) was asked to participate and to help develop a computer-compatible format to be used in the construction of a digital data base. The curators decided that the file needed to contain basic station, collection, and standardized descriptive information for each marine sediment and rock sample curated in a major US repository. Ideas from each of the institutions involved were integrated into a draft format by NGSDC, then circulated for review, redrafted, and recirculated. The format was finalized by the curators' group at a second meeting in Seattle, Washington, in October 1977.

Coding forms with instructions were printed by NGSDC early in 1978, and NGSDC began software development on systems to quality-control incoming data and select/retrieve data from the file. By the fall of 1978, all systems were operational, and construction of the data base had begun with over 1000 entries received at NGSDC. By the next meeting of the Marine Core Curators in San Diego in the fall of 1979, the data base had grown to over 8000 records and remote access to the file was available to participants. Since that time, the file has grown to over 35 000 lines of coded information, with approximately 58 000 lines in processing soon to be added. Use of the data base by participants and other users began slowly, but is growing steadily as the file nears completion.

By far the most difficult part of this project has been the coding of data from large historical collections of samples into the file. Some curating facilities have completed their backlogs, however, and are now routinely coding information from new samples into the format as they are collected. For institutions with giant backlogs, work has begun on new samples as they are collected, with skeletal information from past samples being added as possible to be fleshed out later.

The advantages of having a central data center handling the Marine Core Curators' data base are very real. With reduced funding at most institutions including staff cut-backs, much information that was coded into the file before the cuts is now available that otherwise would have been inaccessible. Some institutions are referring users with questions to NGSDC to lighten their own

work loads. As the file becomes more complete, many researchers from participating institutions are using it in their own research projects, sometimes for information contained in the data base, and sometimes to find which institutions to contact for further information.

The Central Marine Core Curators' data base archived at NGSDC contains what the curatorial representatives decided was the minimum information necessary to adequately document marine samples. The data base also contains many more detailed sample descriptions where individual facilities have chosen to enter them. It replaces internal detailed data bases maintained at each curating facility only if the individual facility chooses to use it in that way. One summary line of information may be entered per sample, or a core may be described to the level of several lines per 1-cm interval. Once information is received at NGSDC, it is placed into an internal NGSDC format that adds extra documentation.

Information contained in the Marine Core Curators' data base can be broken down into three main categories: sample identification, station/collection information, and standardized description of sample material curated.

Sample identification is necessary to give the file user enough information to accurately communicate to curating facilities exactly which piece of material is of interest. The minimum identification necessary for marine samples is curating facility, collecting ship, a unique cruise/sample combination assigned by the curatorial facility, and interval of interest. Enough space was allowed in the cruise/sample fields to use the curatorial facilities' own identification schemes to avoid wasting staff time and funds in a renumbering effort. The unique cruise/sample identifier is not only useful in directing users to sample material, but also helps link multiple analyses performed on a single sample. Some facilities have asked investigators to reference this unique identifier in published works to keep track of analyses performed.

Station/collection information allows data base users to search the file by area of interest or sampling methodology, as well as to receive valuable station location plots. In the case of marine samples, the type of sampling device used (core, dredge, etc.) affects the usefulness of resulting sample material for certain types of analysis. Perhaps a corresponding piece of

information for CSDP purposes might be whether the sample exists as a whole core, slab, chip, etc.

Standardized description of the sample material itself, perhaps including age dates with depth in sample, is a useful way for file users to find samples with lithologies/ages of potential interest without contacting all curating facilities. Inclusion of this sort of standardized descriptive information in a central data base will lessen the burden on curating facilities in hauling out samples of little interest, as well as allow computer sorts, selections, and graphic representations based on sample contents.

To ensure that a data base will be accepted in the scientific community, allow users better access to samples, and ease the data information burden on curating facilities without imposing unreasonable new requirements, the curating facilities must have a significant part in data base design. The data base must be tailored to the needs of the curating facilities and to those of the scientific and industrial users (present and future), as well as those of the funding agencies. Development of a thoughtful data management plan before collection, curation, and sample analysis is the only way to ensure that maximum knowledge will be gained from samples collected, with minimum expenditure by funding agencies.

It is well accepted that a principal investigator (P.I.) must have an intact, properly handled sample to produce good results. Irregularities in collection that make a sample unusable by the project P.I. are clearly recognized as a waste of money. The same philosophy should be adopted toward sample material and analytical data curated for use by future investigators. If this material or data is not kept in good physical condition with full annotation and documentation, it becomes unreliable and therefore useless for future projects. Previous money and staff time have been wasted.

Interpretations derived from sample analysis are the end product for which most scientific projects are funded. Not only should samples be held in trust for reanalysis if necessary, but raw numbers (and enough documentation to show how they were derived) must be preserved to allow intelligent review of interpretive, published results, through reanalysis, reinterpretation in the light of new information or techniques, or to allow more extensive analyses to be performed. Data must be preserved and placed in a coherent, accessible, well-documented network in order to prevent duplication of effort and allow

the later development of compilations, syntheses, and statistical studies of a broader scope that would otherwise be economically unfeasible.

The whole is definitely worth more than the sum of the parts, but a given data base is no more useful than the documentation that accompanies each analysis placed in it. Enactment of a good data management plan before analyses are performed is the only way to ensure maximum long term returns on a funding investment.

VI. REGIONAL VS CENTRAL REPOSITORIES FOR THE CONTINENTAL SCIENTIFIC DRILLING PROGRAM (C. K. Fisher, Panhandle Eastern Pipe Line Company, Denver, Colorado)

The purpose of this section was to discuss and comment on the proposal in Heiken and Goff (1981) to use existing facilities for CSDP samples, establishing three regional centers, while keeping only representative samples in state repositories as backup collections.

A curatorial system for the CSDP earth sample materials, composed of a single facility located near the center of the contiguous 48 states, has limited advantages. In a central repository, all CSDP material would be received, handled, catalogued, etc. in a consistent and uniform manner. In short, the supervision and use would be under one set of rules and "one roof."

A prime disadvantage is the shipping distance from east and west portions of the United States. Long shipping distances and excessive handling are high risk factors in maintaining core/sample integrity. Secondly, users interested only in their part of the country must travel long distances to study the materials. Thirdly, large volumes of material would create an excessive backlog for processing and slow down the material availability for study.

The Heiken and Goff report recommends the three-repository approach that would separate the United States into Eastern, Mid-Continent/Rocky Mountain, and Western divisions (boundaries to be defined). The Eastern area would be served by the Lamont-Doherty Geological Observatory of Columbia University; the Mid-Continent/Rocky Mountain area by the USGS Energy Resources Core Repository in Denver, Colorado; and the Western division by the California Well Sample Repository of the California State College, Bakersfield. These repositories fit the needs of the CSDP. This three-division repository system would be workable; however, opinions indicate that this approach needs to be expanded to permit individual states the option of providing good storage facilities for material obtained in their state.

At the present time, there are many states that have adequate repository facilities at the state Survey or university level. Several of these have expressed a desire to be involved in the preservation of CSDP material. This can be accomplished by giving those states with adequate facilities the first right to provide the curatorial service. Material from those states with no desire to participate or inadequate facilities would be handled by a regional repository previously discussed. In all cases the curatorial facility

(regional or state) would be required to function under the same set of requirements for handling, processing, and use. A system of this type would create a unified grid work of libraries within the lower 48 states.

A recommendation was put forth to establish a curatorial needs committee within the CSDC so that a unified repository grid work can be established. This committee would:

(1) open communications with all existing state, USGS, and university repositories of the United States. Commercial facilities should not be included.

(2) decide from the data received, which facilities could provide adequate processing, storage, and user handling of the sample/core materials.

(3) define the boundaries of responsibility for the three regional repositories based on the pattern indicated by participating states.

(4) define and distribute to the participating repositories a set of requirements for uniform handling, processing, and use of the CSDP material.

(5) act as a governing or regulatory body for the overall curatorial program to ensure uniformity in the network of repositories.

VII. POLICIES AND PROCEDURES FOR PUBLIC USE OF CORE -- CURATORS' RESPONSIBILITIES (F. W. McCoy, Jr., Lamont-Doherty Geological Observatory, Columbia University, Palisades, New York)

In all cases except the National Aeronautics and Space Administration (NASA) lunar cores, the judgment on who has access to samples is the curator's. Curators reported a variety of methods for handling public use of core. Any reasonable request is filled. Some repositories charge a users' fee, whereas others require copies of chemical analyses and thin sections or citing in the literature. There are generally limits to how much can be sampled at all facilities.

Security problems were also discussed. Abuse of privileges usually results in restrictions on further usage. Curators' responsibilities were summarized.

- Protect samples (cores, chips, etc.) and ensure the rights of the samplers (scientists, engineers, etc.) in a reasonable but equitable manner.

- Maintain reasonable but controlled public access.

- Define and adhere to guidelines that are openly published.

  Standardization is most helpful as has been demonstrated by the Marine Curators Group.

  Organization and/or group contact with good organization is advantageous as shown by the success of the Marine Curators Group.

- Evaluate and judge requests by researchers (samplers).

  Professional peer review of science, through research grants or economic realities in exploration, provide the best and initial evaluation.

  Control within and during sampling programs remains necessary and important.

- Public use, however, must be constrained by evaluation, provided this evaluation is professional and fair.

VIII. COOPERATION BETWEEN THE CONTINENTAL SCIENTIFIC DRILLING PROGRAM AND FEDERAL, STATE, AND PRIVATE REPOSITORIES--LEGAL QUESTIONS (Matt Walton, Minnesota Geological Survey, St. Paul, Minnesota)

The group agreed that as far as dedicated holes for CSDP are concerned, legalities would not hinder the removal of core and samples to a central repository. The handling of samples from piggyback holes, however, opened a can of worms.

Several of the states are dealing with the problems of confidentiality and ownership of samples. In states where access to core is restricted because of confidentiality periods, is there a conflict with the Freedom of Information Act? Does a public institution have the right to restrict access? Are user fees legal? This raises the question of core ownership. The group believed that a repository must declare ownership.

In Alberta, Canada, all core taken by industry has to come to the repository within 3 months, and the Core Research Center is concerned with legal ownership of core in case of fire, etc. The Center has been told it owns the core, but they have yet to obtain this opinion in writing. Improper release of confidential material could also cause legal problems.

Another legal question is how long can a scientist maintain samples in his/her office? The Smithsonian Institution sets a 1-year limit. At Lamont-Doherty, this was a problem. Now samples are no longer given to anyone who does not publish results in a reasonable time period. Samples must be considered to be on loan - not a gift. Several institutions allow sample examination at the facility only.

Another topic that was touched on was the legal responsiblity for data obtained from samples from a repository. What if there is a great exploration loss on the basis of misidentified samples or cores? It was agreed that there are many legal questions this group could not answer; no attorneys were present.

IX. REPOSITORY LAYOUT AND DESIGN (A. H. Shepard, Core Research Center, Calgary, Alberta, Canada)

Many of the attendees distributed materials concerning the facilities they represent. A presentation on the state-of-the-art Core Research Center at Calgary, Alberta, began the discussion section.

Art Shepard, who manages the facility operated by a Board of the province of Alberta for the petroleum industry, reviewed the details of the facility. The operation is highly mechanized and includes electric fork lift trucks to transport the core between storage and examination areas, roller top tables for core examination, and sliding microscope tables to provide ease of core examination. Many of the curators present at the workshop had visited the facility to get ideas for their own operations.

With the receipt of 171 000 core boxes and 330 000 vials of cuttings in the last 12 months and 733 000 cores anticipated in the next 10 years, the Core Research Center has a space problem. Shepard has spent a year examining the sample handling situation. The improved facility will go to warehouse stacking-crane systems with a guidance system in the floor to reduce damage to box ends. Sliding aisle-saver systems have also been considered. Shepard also pointed out that suppliers tend to overmechanize and curators often have to defend themselves against the experts.

The expanded facilities will provide a more pleasant atmosphere for the users. Delivery trucks will be isolated from the users. Sixteen tables for confidential examination will be provided as well as rooms for group discussions of core. They are striving for a 7-minute turnaround time after a request to examine core.

Improvements in the method of processing drill cuttings samples are planned. These will include reduced operating costs, greater safeguards against errors, and elimination of high-heat drying. Industry will be encouraged to upgrade sample catching and tagging at the rig site. It was pointed out that this facility is so successful because it is designed around user needs and is an excellent facility in an active drilling area. Samples for purely scientific purposes would have to be curated somewhat differently.

There was a brief discussion on what type of background a curator should have. Shepard is an administrator and uses staff geologists in an advisory capacity. The consensus of the group was that a facility needs a full-time administrator with a geoscience background. Perhaps two people are needed: an administrator and a geologist working side by side.

X. SAMPLE HANDLING PROCEDURES (Cecil Boykin, Shell Oil Company, Houston, Texas)

Cecil Boykin gave a presentation on the detailed training he gives to Shell Oil Company geologists on sample handling and descriptions. Most samples are collected today by geologists who assume that they will be the only ones to use the core and cuttings they collect. This is not the case and the samples' great value for the future must be recognized. Standard procedures and descriptions are, therefore, of the utmost importance.

In the oil industry, geologic and engineering interpretations are made from the analyses obtained from various processes to which the rock samples are subjected. Paleontologic, geochemical, lithologic, fluid chemistry, stratigraphic, or diagenetic interpretations are examples of useful parameters that affect decision-making while a well is being drilled. Initial producing methods are often determined by rock type, and the samples are often used to aid in establishing secondary and tertiary recovery methods.

Improper collection, mislabeling, or incorrect handling procedures can, therefore, present interpretive problems throughout the life of a well or field. It was stressed that a bad sample is worse than no sample because erroneous data can lead to expensive decisions that have little chance for success.

Boykin identified 26 major sample handling problems.

DRILL CUTTINGS

FAILURE TO COLLECT REPRESENTATIVE SAMPLE
"BOILERHOUSING"
MISLABEL OR NO LABEL ON BAG
APPLICATION OF HEAT
TYING SAMPLE BAGS
OVERFILLING SAMPLE BAGS
SOME TAGGED - SOME NOT
OBLITERATION OF MARKINGS
POOR SHIPPING CONTAINER
WRONG OR POOR ADDRESS LABEL

CORE

UPSIDE DOWN IN BOX
OUT OF PLACE IN BOX
MARKED BEFORE CLEANING
INCORRECT MARKING
UNFILLED BOXES
CHIPS MISSING
IMPROPERLY WRAPPED
ADDRESSING
TAPING BOXES

OUTCROP SAMPLES

IMPROPER ASSIGNMENT OF SAMPLE NUMBERS
FAILURE TO MAKE GOOD LEGIBLE FIELD NOTES
FAILURE TO FILE FIELD NOTES IN DIVISION FILES

SIDEWALL CORES

SAMPLE DEPTH
BROKEN SEALS ON BOTTLES
BREAKAGE

XI. SAMPLE ACCOUNTING SYSTEMS (Jeff Warner, NASA, Johnson Space Center, Houston, Texas)

Jeff Warner opened the session with a presentation on the lunar accounting system. The unique nature and value of these samples from the moon require the attention of a highly trained curator and dedicated staff. There are visits to the facility by user, committee, and science observers as an integral part of the curation procedure. A systematic approach to description, cataloguing, and circulation of samples to investigators was developed.

Every sample from the moon has its own number; the number is a five-digit code that includes the mission number, the station on a traverse, the type of sample, and an identification number. As samples are split or separated from a sample, subsample numbers are assigned. Through the use of this system, it is now possible to determine where every gram of material is, what has been done to it, who has worked on it, and where it presently resides.

CSDP samples will be of great scientific value for tens of years after collection. Significant efforts must be invested in ensuring that CSDP samples will have adequate integrity for first-order scientific investigations. Clearly the level of integrity that is maintained for moon rocks is more than is warranted for CSDP samples. However, the general level of integrity maintained by industry-oriented core curation facilities falls short of what is warranted.

Proper curation of CSDP samples must aim at a level of integrity that may be characterized as "high." Identification of each sample and subsample must be absolute. Chemical and physical contamination must be controlled to the extent that trace element analyses, isotopic analyses, and physical property measurements are meaningful. The question is how to define specific requirements for integrity of CSDP samples? The best way to do this is by asking a working group of potential scientific users of the samples. For the case of CSDP this means sample-oriented analytical scientists.

Academic researchers typically require special consideration in sample preparation and sample conditions. Examples of special conditions of sampling might be a thermoluminence study for which the samples must be obtained in red light, or a geochemist who is interested in determining trace siderophile elements and requires that sampling tools be nonferrous. The CSDP curation

facility must be prepared to address special needs of researchers so that the best science is obtained from the samples.

This group has to help convince the committee on CSDP that it must start from scratch and establish curation procedures up front. Perhaps one way to accomplish this would be to use a scientific curation and description team at the drill site. There was some discussion whether to hire a contract curatorial team to follow procedures established by the committee wherever the samples go. Several problems relating to sample integrity with contract drilling and piggyback drilling were also discussed.

XII. FINANCIAL SUPPORT FOR REPOSITORIES--HOW MUCH AND WHERE DOES IT COME FROM? (Tom Michalski, USGS Energy Resources Core Library, Denver, Colorado)

The session began with a general discussion of the funding outlook at various types of repositories. Based on their source of funding, repositories were grouped into three general categories (federal, state, and multiple source).

Federally-funded institutions are, in general, operating presently on very tight budgets and future funding does not look bright. The USGS Core Library's operating budget for FY 1981 is down 7.5% from FY 1980. Funding for next year should be at about the same level (as inflation continues to eat away at it). The US Bureau of Mines has minimal funding this year and none for FY 1982. They hope they can convince their new director of the value of cores and thus be able to save their facility. NASA (an atypical case) seems very well funded and plans on maintaining their current level of funding. Funding for marine repositories is adequate for this year, but a decision by the ONR to withdraw financial support from all marine sample repositories will cause severe budget problems starting next year. In summary, with the exception of NASA, the future does not look rosy for federally-funded repositories.

State repositories vary greatly in their funding, but in general their future seems more stable. The state of North Dakota has recently built a new repository and does not foresee any future funding problems. The state of Wisconsin has minimal funding, but does not foresee any major cutbacks in the future. New Mexico and Minnesota seem to have adequate funding at present and don't see any major problems for the future. The state of Oklahoma is planning on building a new 50 000+ ft^2 facility and should have adequate funds to staff it. Texas is planning a new 100 000+ ft^2 facility and doesn't seem to be too worried about future funding.

The two repositories funded from multiple sources are in pretty good shape. The province of Alberta has a very well-funded and staffed facility, and is planning a major expansion in the near future. The California State Repository at Bakersfield has modest but adequate funds at present. Their plan to raise $500 000 for an endowment fund is well on its way. They have

reached half their goal so far. After they raise the remaining money they will be in a financially stable position, which will allow for modest annual budget increases.

Repositories funded by states or multiple sources vary greatly in their level of funding, but in general seem to have a stable financial future. Repositories in states experiencing intense energy development, such as North Dakota, Oklahoma, Texas, and the province of Alberta, seem to be the most financially viable.

There was some concern that it may be necessary to compare funding between different types of institutions on the basis of some common denominator. Looking at man-years, "FTEs", or "slots" or trying to normalize the numbers in terms of an input-ouput ratio may be a way of doing this. It must also be recognized that administrative costs are highly variable.

C. K. Fisher presented his plan to finance the preservation of earth science materials. The plan proposes that permanent funding for these materials could be developed based on the total federal income received annually from the energy and minerals industry. A fund with an annual budget of $4 million could result if legislation and/or regulation directs that 1/10 of 1 cent of each dollar received by the Government from the energy and mineral industry be designated to an earth sciences sample repository fund.

The general consensus was that Fisher's proposal is innovative. It was agreed, however, that it is most important to build a case to demonstrate need. A collection of photos and documents from older, inadequate curation facilities and newer, successful facilities should also help a great deal. Stressing the teaching functions of curatorial facilities as well as identifying a constituency around the country of potential users will also be very important.

XIII. ESTABLISHING A CONTINENTAL CURATORIAL COMMUNICATIONS NETWORK (E. Dow Davidson, Bureau of Economic Geology, Austin, Texas)

Before the general group discussion, Dow Davidson spoke about his interest in initiating a communication network among curators, managers, and supervisors--people who work day to day with geoscience collections. Such a network has been a thought of his for several years.

This notion occurred to Davidson soon after he became Curator of the Texas Bureau of Economic Geology's Well Sample and Core Library at the University of Texas in Austin, and he realized that there had to be someone out there who had experienced 90% of the problems he was having.

Contacts with other curators were established while picking up or delivering core at other facilities in Texas. Although these individuals had unique solutions to common curatorial dilemmas, their problem solving was in a vacuum and not available to the remainder of the community. Most curators did not even know where all of the major depositories were in the state.

Contacts made in this manner were very useful, but the total numbered only five or six. This was the extent of the network, along with an occasional call for technical guidance to some other facility.

A serious attempt to expand the communication network was made in October 1980 when the Bureau learned that there was good reason to believe it would be moving into a complex of new buildings built according to their specifications with their design input. Davidson was appointed to the Bureau planning committee and was assigned the job of designing an excellent state-of-the-art core and sample library/research facility. He needed information that related to the design and efficient administration of core and sample facilities and sent out a questionnaire to 76 well-sample and core libraries in the United States and Canada. The questionnaire dealt with general questions of facility design, materials processing, and cataloguing. The specific areas addressed by this Bureau questionnaire were: (1) facility size, by number of wells, footage represented, square footage; (2) core and sample storage methods; (3) core handling system; (4) core slabbing techniques; (5) special core processing techniques; (6) description of cataloguing and core retrieval system; (7) core photography; (8) special preservation techniques; (9) types of equipment used; and (10) solicitation of ideas on efficient core and sample management systems.

There has been good response to the questionnaire, with 74% response rate out of 76 distributed. The information gathered has been extremely helpful in the primary design stages of this project. In this situation communications between curators dictated many of the design decisions Davidson was required to make. Costly design mistakes could have been made without this valuable input.

Davidson expressed enthusiasm for an organization and offered to take on the responsibility of organizing a society to fulfill the needs discussed. He formally called for the establishment of a national geoscience curators' association or society. A motion for volunteers to serve as an ad hoc committee to assist Davidson in establishment of the organization was made and 13 persons volunteered.

The subsequent discussion centered around formulating the principles and goals of the organization, which is tentatively called Society of Geoscience Curators. Items of primary importance discussed were as follows.

- Communications.
- Data dissemination (data derived from the geoscience materials).
- Accessibility/retrievability of materials.

The geoscience community must be asked "What kinds of tasks fall under the broad heading of curation?" and, more importantly, "Are these tasks being accomplished?".

Final discussion focused on ways and means to let the geoscience community know about the curators' society.

XIV. WHAT WILL BE CARRIED BACK TO THE COMMITTEE ON THE CONTINENTAL SCIENTIFIC DRILLING PROGRAM?

Charles Mankin of the University of Oklahoma/Oklahoma Geological Survey and member of the CSDC will make the following recommendations to the committee.

(1) The CSDC should implement a panel to focus on the issues of curation and data management.

(2) Curatorial activities and data management should be integral parts of the scientific mission, not separate activities.

(3) The national CSDP should be a part of the larger question of the future of curatorial and data management in North America.

(4) The CSDC should support the idea of a group being formed on the broader concerns of curation, with the CSDP wired into this group.

Robert Andrews, Staff Officer of the CSDC, will bring to the committee the recommendations and results of the meeting. A summary of his final remarks includes the following.

(1) The issue of curation is very complex for continental drilling.

(2) There is a need to convince federal funding agencies and the scientific community that the costs of curation are necessary and important.

(3) Data management is an equal part of this system.

(4) Updating existing facilities is a good idea, but which ones? Discussion should continue on regional or state facilities. Is there a need for a new central facility, or should a system of unified, coordinated regional archives be developed?

(5) Geology has gone from local to global--international cooperation is important.

(6) Some items need specific attention: legal aspects, personnel needed, cost breakdown of program needs and standard policies and procedures for archiving and retrieval.

The final conclusions of the workshop were that drilling is at an all-time high and there is an awareness in management of the need for curation. The scientific community is recognizing the national resource of rock samples and data. Such an atmosphere should provide impetus to continue interest and participation in dealing with curatorial issues. Curators should band together to see that issues are properly addressed.

ACKNOWLEDGMENTS

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US Geodynamics Committee, 1979, "Continental Scientific Drilling Program," National Academy of Sciences, Washington, DC.

APPENDIX A

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APPENDIX B

MATERIALS DISTRIBUTED AT THE WORKSHOP ON CORE AND SAMPLE CURATION FOR THE CONTINENTAL SCIENTIFIC DRILLING PROGRAM

Copies of Vu-Graphs detailing objectives, chronology, organization, and activities of the National Continental Scientific Drilling Program.

"Continental Scientific Drilling Program Data Base," Earth Sciences (K Division), Lawrence Livermore National Laboratory.

"A plan to finance the preservation of earth sample materials" proposed by C. K. Fisher.

"The sample repository of the Wisconsin Geological and Natural History Survey."

Numerous forms from the NASA Lunar Facility that deal with security, sample processing procedures, sample control and data procedures, and sample history information.

An information packet from the North Dakota Geological Survey.

Informational pamphlets on the California Well-Sample Repository, Bakersfield, California.

"U.S. Geological Survey Core Library, Denver, CO, Administrative Report, 1980" by Thomas C. Michalski.

"Energy Resources Conservation Board Core Research Center, Calgary, Alberta, Canada."

"At Scripps; Marine Curators Gather" by Floyd W. McCoy, Lamont--Doherty Geological Observatory, Columbia University, Palisades, New York. From GEOTIMES, Dec. 1977, pp. 26-28.

"Lamont--Doherty Geological Observatory Core Laboratory policy and procedures for distribution of samples and sample information."

"An Index to Marine Geological Samples," The Core Curators' File National Geophysical and Solar-Terrestrial Data Center, Boulder, Colorado.

"World Data Center--A For Glaciology (Snow and Ice)," University of Colorado, Boulder, Colorado.

Glaciological Data Report GD-8. Ice Cores compiled by P. K. MacKinnon, World Data Center A for Glaciology (Snow and Ice), Institute of Arctic and Alpine Research, University of Colorado, Boulder, Colorado, May 1980.

"Core Handling Procedure" distributed by C. E. Boykin, Shell Oil Company, Houston, Texas.

APPENDIX C

AGENDA

Tuesday, May 5, 1981

9:00 am	*Welcome*	*John Whetten, Assistant Division Leader* *Basic and Applied Geosciences* *Los Alamos National Laboratory*
9:10 am	*Introduction*	*Grant Heiken, Sue Goff* *Los Alamos National Laboratory*
9:30 am	*Continental Scientific Drilling Program—Status and Goals*	*Charles Mankin* *Oklahoma Geological Survey* *Robert Andrews, Staff Officer* *Continental Scientific Drilling Program* *National Research Council*
10:30 am	*Coffee Break*	
10:50 am	*Continental Scientific Drilling Program—Curatorial Needs*	*Grant Heiken, Sue Goff* *Los Alamos National Laboratory*
11:15 am	*Regional vs. Central Repositories for CSDP*	*Discussion Leader: C. K. Fisher* *Panhandle Eastern Pipe Line Co.*
12:15 pm	*Lunch*	
1:30 pm	*Policies and Procedures for Public Use of Core. Curators' Responsibilities*	*Discussion Leader: F. W. McCoy, Jr.* *Lamont-Doherty Geological Observatory*
2:30 pm	*Cooperation Between CSDP and Federal, State, and Private Repositories. Legal Questions*	*Discussion Leader: Matt Walton* *Minnesota Geological Survey*
3:30 pm	*Coffee Break*	
4:00 pm	*A Central CSDP Data Center*	*Discussion Leaders: Nancy Howard* *Lawrence Livermore National Laboratory* *Carla Potter* *NOAA-NGSDC*

AGENDA

Wednesday, May 6, 1981

9:00 am	*Repository Layout and Design* *Discussion Leader: A. H. Shepard* *Core Research Center* *Calgary, Alberta*
10:00 am	*Core Descriptions, Handling, Storage at the Well and in the Laboratory: Discussion on "Shell's Training System for Geologists"* *C. E. Boykin* *Shell Oil Company*
10:30 am	*Coffee Break*
10:50 am	*Discussion continued*
11:30 am	*Sample Accounting Systems* *Discussion Leader: Jeff Warner* *NASA, Johnson Space Center*
12:15 pm	*Lunch*
1:30 pm	*Financial Support for Repositories: How Much and Where Does It Come From?* *Discussion Leader: Tom Michalski* *USGS, Energy Resources Core Library* *Denver, Colorado*
2:15 pm	*Establishing a Continental Curatorial Communications Network: How Do We Stay in Touch? Topics: Formal organizations, newsletters, meetings, standardizing descriptions, National Data Base* *Discussion Leader: Dow Davison* *Bureau of Economic Geology* *Austin, Texas*
3:15 pm	*Coffee Break*
3:40 pm	*What Will be Carried Back to the Commitee on the CSDP? What More Can We Give CSDP?* *Discussion Leaders: Charles Mankin* *Oklahoma Geological Survey* *Robert Andrews, Staff Officer* *Continental Science Drilling Program* *National Research Council*

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