HANDLING, STORAGE, AND RETRIEVAL OF PETROLEUM DATA IN CCOP COUNTRIES

(Revised)

By

Allen L. Clark, Jennifer L. Cook

and

Richard Sinding-Larsen

OPEN FILE REPORT 81-662

1981

CONTENTS

ILLUSTRATIONS

HANDLING, STORAGE, AND RETRIEVAL OF PETROLEUM DATA IN CCOP COUNTRIES

By

Allen L. Clark, Jennifer L. Cook

and

Richard Sinding-Larsen 1/

EXECUTIVE SUMMARY

An analysis of petroleum data storage and retrieval programs within the member countries of the Committee for Coordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP) demonstrated that this is an area of both great interest and great problems. Specifically the major problem areas are (5):

1. Data archives.
2. Data files.
3. Data processing hardware and software.
4. Geophysical data.
5. Automatic Data Processing (ADP) management.

The resolution of many of the existing problems lies in their recognition and the implementation of a sequential development program to meet the need for data storage and retrieval. This begins with a systematic procedure for data acquisition and archiving and proceeds to an integrated system for the storage, retrieval, and analysis of

1/ Norwegian Geological Institute.

petroleum data. Corresponding to the sequential development of the system is the transition from manual handling of data to the development of main frame and mini-micro computer process activities.

To effectively address the petroleum data storage and retrieval problems of the CCOP member countries and implement a sequential development program, three major areas require immediate consideration:

1. Authorization by senior-level management to expand data storage and retrieval programs with both monies and personnel.
2. Development of an agency-specific sequential development program.
3. Availability of technical consultants in the areas of data archiving, data base development, and hardware and software systems.

No manual or machine shortcuts exist or should be attempted for the development of an adequate storage and retrieval program. Only through time and effort will truly integrated multipurpose systems be developed.

INTRODUCTION

Project initiation

The annual sessions of the Committee for Coordination of Joint Prospecting for Mineral Resources in Asian Offshore Areas (CCOP) of 1973, 1974, and 1975, repeatedly stressed the importance of establishing national centers in each of the member countries for the storage and retrieval of the proprietary petroleum data and the geological samples that each country has received following the increased regulation and operations of petroleum activity. To this end, the Committee arranged a seminar in Bundung, Indonesia, in April 1976 on "Data collection, storage and retrieval," with particular reference to hydrocarbon exploration and development.

The 15th session of CCOP in 1978, held in Singapore, acted on the recommendation of its Technical Advisory Group and in early 1979 established an Ad Hoc working group on petroleum data collection, storage, and retrieval. The working group consisted of Dr. Richard Sinding-Larsen (Chairman of COGEODATA, the Committee on Storage, Automatic Processing and Retrieval of Geological Data, of the International Union of Geological Sciences (IUGS)), Dr. Allen L. Clark (Chairman of the COGEODATA Working Group on Data Capture), and one member from each of the CCOP countries. In January 1979, the CCOP project office was delegated the support monies given by the Government of Norway to finance the travel expenses of the working group. Two contracts between IUGS and the Economic and Social Economic Commission for Asia and Pacific (ESCAP) were then set up covering the time period January 1 to October 15, 1979. This report was prepared for the CCOP member countries under the auspices of COGEODATA, of IUGS, under Contract CAP/79/01/061/Con/79-01/ESCAP/CCOP.

Purpose

According to the contracts, COGEODATA should perform:

a) An appraisal and evaluation of the national needs of the CCOP countries concerning petroleum data collection, storage, and retrieval. This should be understood as involving the whole aspect of identification, indexing, storage, retrieval, dissemination, and utilization either in a wholly manual mode, partly by the use of computer technology, or by means of comprehensive incorporated data systems.

b) Evaluate existing governmental and commercial data systems in North America and Europe suitable for petroleum data collection, storage, and retrieval.

c) In light of the individual needs of the CCOP countries, discuss the usefulness of available data systems for the petroleum-data activities of the member countries.

d) Prior to the 16th annual session of CCOP, arrange a meeting with the designated CCOP representatives and recommend a plan of action for subsequent discussion at the 16th annual session of CCOP.

Scope

The 11 CCOP countries (Japan, Korea, Philippines, the Trust Territory of the Pacific Islands, Japan, Papua New Guinea, Indonesia, Singapore, Malaysia, Thailand, Kampuchea, and Vietnam) have each reached different levels of petroleum development and accordingly have a variety of problems and corresponding needs. The present study attempts to address the full spectrum of the more important problems and provide recommendations for dealing with the overall range of problems.

Implementation

Jan. 12-Jan. 28: Reconnaissance visit to Malaysia, Indonesia, Philippines, and Thailand by R. Sinding-Larsen, Norway, and O. Kvig, Norway.

March 30-April 4: Meeting at the Norwegian Petroleum Directorate by R. Sinding-Larsen, O. Kvig, A. L. Clark (USA) and J. Cook (USA).

April 5-April 23: Reconnaissance visit to Korea, Japan, and follow-up visit to Philippines by A. L. Clark.

June 6-July 8: Follow-up visit to Indonesia, Malaysia, and Thailand by A. L. Clark and J. Cook, with subsequent reporting of results in cooperation with R. Sinding-Larsen.

June/July: Review of North American data systems by G. Gabert (Germany) and S. Bie (Norway).

August: Final visit to the CCOP countries by A. L. Clark and R. Sinding-Larsen to make recommendations on how to meet national needs for petroleum data storage and retrieval.

September: Meeting of the Ad Hoc working group September 5-8 to formulate recommendations to the 16th session in Bandung, Indonesia.

PROBLEM AREA OVERVIEW

The majority of oil and gas agencies receiving data in Southeast Asia are performing mandated archiving activities in support of national oil and gas programs. However, in most of the organizations, this activity has not held a very high priority for many reasons, among the most significant of which are:

1. The oil and gas agencies are only recently established and emphasis

has been placed on priorities other than data management.

2. There was an initial lack of need for data management because the volume of data was very small.
3. Recent activities in exploration and development, coupled with increased analyses and national mandates for data submittals has resulted in a rapid increase in data.
4. There has been a general lack of trained personnel, particularly information specialists, to develop data management procedures.
5. Upper level management has failed to recognize the need to improve data management procedures, and as a result, programs have not been developed in this area.

These information sources in the oil and gas agencies represent a variety of forms ranging from core samples, tapes, reports, maps, telex, and microfilm, all of which must be identified, catalogued, and indexed in a standardized procedure. Indeed, in Southeast Asia as more and more data are generated and information developed and collected, there is an ever increasing need for adequate bibliographic control and archiving. It is essential that the general problems of data management defined and described in this respect be addressed and that all oil and gas data that are worth preserving be placed under some form of bibliographic control.

It is rapidly becoming recognized that there is a very critical need to better organize and handle oil and gas data to support better decision making throughout an organization. This activity is leading to the need for a new type of specialist, the "information" or "data base" administrator.

This individual is charged with knowing, or being able to find out, exactly what is in his or her file, where each item of information is stored, how frequently it has been updated and the implications of changing the present routines for bibliographic control and archiving of the data. As a part of this pattern it is also being recognized that information is not static, but is normally in a transition phase between its use in a dynamic process (exploration) and its longer-term storage as part of a national oil and gas archive.

Evaluation procedure

In order to conduct the proposed program in a systematic manner, a standardized procedure was adopted and applied to each country. Although the procedure was as inclusive as possible, it was not always possible to apply the procedure entirely because of the varying levels of data management in the respective countries. Nevertheless, the "petroleum data problems" of each country were assessed utilizing the following procedure:

1. Initial definition of present data problems such as data volumes, user environment, organizational environment, physical environment, and national and agency needs for data management.
2. Definition and assessment of existing practices in the handling, storage and retrieval of petroleum data.
3. Detailed definition of present data types, data volumes, reporting and acquisition procedures, data completeness, and data integrity.

4. Development of a short to intermediate analysis of data problems and an assessment of short to long range plans for data handling, storage, retrieval, and analysis.

5. Development of alternate solutions to effectively and efficiently manage petroleum data to meet present and anticipated needs.

A standard form was utilized for each country to acquire and evaluate the above data and alternatives and is presented in Appendix 1.

Problem areas

In addition to the general problems listed at the beginning of this section, the detailed evaluation procedure also identified several specific problem areas which are common, to varying extents, in all the oil and gas agencies. The extent of the problems is primarily a function of the stage of oil and gas development, the volumes of data, existing and past data administration practices, and new needs for data and analyses.

The major problem areas, which are dealt with in detail in the following sections of this report, can be summarized in five main areas: 1) physical archiving, 2) data files, 3) geophysical data, 4) data processing, and 5) ADP administration, where specific needs are identified and action is called for to improve existing and future systems.

DATA ARCHIVING

Data acquisition

The physical storage and retrieval of oil and gas data in national archives and the internal systems of indexing and classification are

critical to the efficient use of data by the petroleum professional. The need for management to be able to monitor data flow and know archive content cannot be overstressed for the following reasons:

1. Data loss from an ill-managed or unmanaged system is generally unrecoverable (indeed, if even realized).
2. Professional time spent in data search and retrieval must be optimized. Most large oil companies have instituted data management systems for this reason.
3. Data duplication/preservation techniques (e.g., micro-filming) require an organized archiving system before being undertaken (insuring the organization of the resultant microfilm file).
4. The task of creating specialized data files (computer or manual) requiring large amounts of integrated data from varied sources is eased with a systemized, cross-referenced archive.
5. Each country organization has been trusted with the national oil and gas data repository where sufficient steps must be taken to insure data integrity, credibility, and security.

Standard procedures exist that can be implemented to acquire, classify, index, key word/abstract, and store documents, maps, and other data. These procedures can be implemented manually or with computers, depending on number of skilled personnel and present or future access to computer facilities.

The general procedures in data archiving, which are discussed in the following sections, are shown in figure 1.

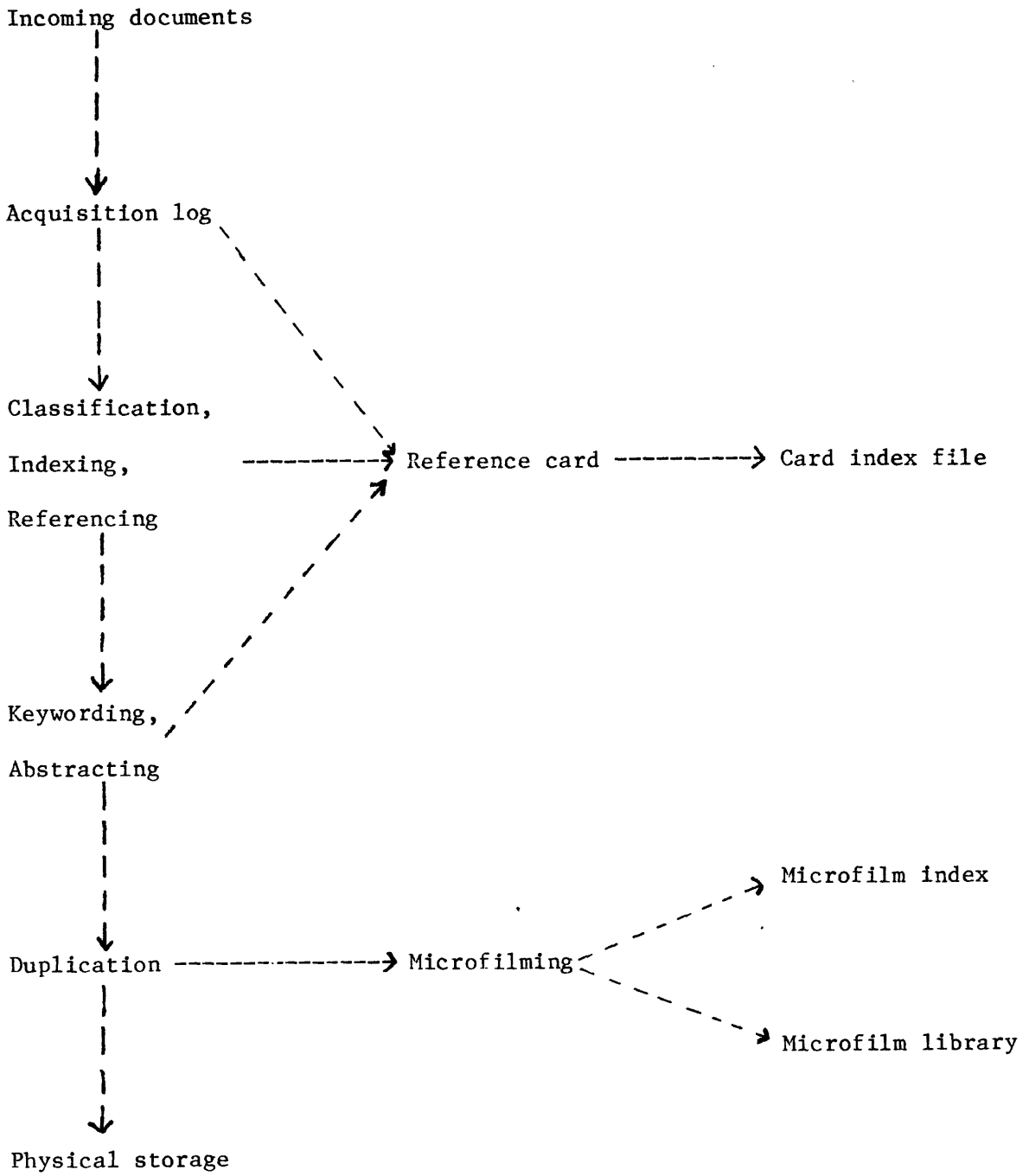


Figure 1. Data archival flow diagram.

Acquisition logs

The initial step in the development and maintenance of a national archive is to institute a master acquisition log. It is absolutely essential that the receiving organization record each and every document as it is received. The responsibility lies with the archive management to ensure that all data required of petroleum companies is recorded before storage in the archive. The archive management should also assume responsibility for any duplication and distribution of incoming material to professional personnel after official acquisition.

The primary use of an acquisition log is simply to provide an official record of receipt of a document, but it can and should serve other important purposes. Among the most significant are:

a) to record time and date of acquisition

b) to classify a document as to type (e.g., map, report, log)

c) to classify a document as to general subject matter and/or area

d) to assign a unique number to the document for later retrieval purposes or until assignment of an archive number

e) to serve as a primary bibliographic citation for entry into a data base.

It is therefore recommended that a master data acquisition catalog be instituted and a sincere effort made to list all present and future acquisitions. For each item received, the minimum data items should be:

Date of Acquisition:	Submitted by (Author/Composer):
Unique Identifier:	Title:

Other Identifier: Data type:

Enclosures:

The acquisition log should be maintained daily, documents being recorded immediately upon receipt. The time necessary to maintain the acquisition log depends on the volume of incoming documents, but appropriate personnel should be assigned so all data can be logged the day they are received.

The acquisition log should be a hard-bound book with a strong binding so that pages do not tear loose with wear.

There are several ways to organize the acquisition catalog, each depending on the future indexing/classification schemes to be utilized.

a) If little or no classification and indexing will take place after acquisition, then the acquisition log should be organized to derive maximum benefits. A chronological sequence of entries is not as desirable as receipt acknowledged by document type, subject, or area.

b) If good indexing, classification, and keywording are undertaken the items can be easily cross referenced after acquisition, and if accession lists reflect the acquisition by type, it is less necessary to organize the acquisition log by criteria other than date of receipt.

Classification indexing

Classifying and indexing documents in a structured approach is the key to the efficient storage and retrieval of documents in an archive.

Many efficient archival systems are in operation currently and most concerning oil and gas data are variations based on a hierarchial, structured subject breakdown. Within the current operating petroleum data systems the major breakdown commonly is:

1. Exploration data
2. Development data
3. Drilling and production data

This breakdown gives the logical division points according to time sequences and the differing types and applications of data gathered within each phase. Within these three classes, further structural breakdowns are necessary by subject:

1. Exploration data
    - 1.1 Exploration geology
    - 1.2 Exploration geophysics
    - 1.3 Exploration geochemistry
    - 1.4 Exploration drilling
    - 1.5 Well logging
    - 1.6 Other

Each of the above subfields can be treated in the same manner and should be designed to collectively exhaust the subfield. For example:

1. Exploration data
    - 1.2 Exploration geophysics
        - 1.21 Gravimetry
        - 1.22 Magnetometry

1.23 Seismology

1.24 Down hole geophysics

1.24.1 Electric logs

1.24.2 Radioactivity logs

1.24.3 Lateral logs

1.24.4 Other

The overall classification system should be standard within the organization and able to handle all types of incoming data. Each organization, however, functions differently, and receives different types and forms of data, so each should be designed to suit the specific need.

Examples of current classification schemes are provided in the appendices (under specific secondary services, i.e., those commercial bibliographic systems that deal exclusively with geological or petroleum data).

Once the classification scheme is set up and the decision is made to index the archive accordingly, each document can be analyzed for position within the classification, and assigned a classification number.

After the document is logged properly in the acquisition catalog and assigned its relative place in the classification scheme, it is necessary to record the reference in a standard format for use in the archive's master index file (manual or computer). For each document the minimum data items are:

Unique number: (assigned in acquisition catalog)

Classification number:

Cross-reference numbers: (to be discussed)

Other identification number: (any internal numbers of submitting agency)

Date: (from publication/document)

Author: (from acquisition log)

Company: (from acquisition log)

Title: (from acquisition log)

Enclosures: (any separate maps, logs, or tables enclosed with a report are to be listed completely)

Location: (physical location/address within archive)

Cross-referencing

An important function of the indexing and classification system is the ability to accomodate cross-referencing and the creation of ancillary files to help the professional search for information.

Each document is placed in one position within the classification hierarchy and given the respective classification code. The keywords are then selected reflecting the content of the report. These keywords, however, often refer to subjects covered in other parts of the classification. Those that are significant should be cross-referenced. A record should be placed in the card index that is a standard, cross-reference card containing the 'header' information (bibliographic elements), location, and the original classification code. The professional searching for a topic will then be assured of finding not only major sources but also important secondary sources.

Card indexes

The internal organization of the card index file should follow the logic of a normal search. It appears that in the CCOP oil and gas agencies, the bulk of research work is performed on the basis of area, most often on the basis of contract area. The card index should reflect this by having the basic organization by area; i.e., basin or structure. Contract area should not be used as a breakdown as the boundaries are often an arbitrary grid and not static entities. If the boundaries change in the future the card index system would collapse. It is therefore important to choose an area breakdown that sufficiently divides the offshore into convenient, logical subareas, which should be able to accomodate the contract areas also.

Within each area breakdown the classification hierarchy is used. For example:

Area A:

1. Exploration

   -----
2. Development

   -----
3. Drilling and production

Area B:

1. Exploration

   ------
2. Development

   -----

3. Drilling and production

Keywording

The present reference systems operating in CCOP rely on title searches for specific data within a data type, e.g., geologic reports. Such a system will be inadequate for larger amounts of data when for a single project the professional must peruse all kinds of reports for data content. Therefore, a keywording or annotated-bibliography system should be implemented for all geologic and engineering reports by subject specialists in the data management staff.

Keywording is simply the process of extracting the pertinent subjects, geographical areas, analytical techniques, equipment, or other items that describe the content of the document. Therefore, upon review of the reference and keywords, the professional can make a better decision of whether or not the specific report is of interest to his field of research.

Keywording can be undertaken by natural language or a controlled vocabulary. It is recommended that a controlled vocabulary be used for the following reasons (Lea, 1978):

1. Retrieval success depends on the class size and composition of the document classes in the system: class size and composition depend on the vocabulary used to index the documents.
2. A controlled vocabulary is essential to avoid synonym duplication.
3. A controlled vocabulary can eliminate homonym problems, i.e., the same word having different meanings in different contexts.

Furthermore, a structured vocabulary can allow homonyms since a particular use of a homonym can be specified.

4. Semantically related terms can be linked by means of a controlled vocabulary.
5. A hierarchical structure in a controlled vocabulary allows generic searches to be undertaken.
6. Retrieval precision depends on the specificity of the controlled vocabulary.
7. A greater intellectual burden is placed on the searcher in natural language systems.
8. False coordinations and incorrect term relationships are likely to be more prevalent than they are in controlled vocabulary systems.
9. Searching stems by natural language techniques may often yield surprising results, e.g. with ANALYSIS.
10. It is true that a thesaurus can be used as an aid to natural language searching, but because there is no structure it is less successful.
11. Natural language techniques can be used in addition to controlled language techniques, but the reverse is not possible.
12. A study of retrieval success has shown that controlled language is superior in performance to all other systems.
13. Services that started without a controlled vocabulary are mostly changing to a controlled vocabulary system as their database becomes too large for good retrieval.

14. There are problems with singulars and plurals.

15. When terms are inverted there are precedence problems.

16. Variations in spelling can cause difficulty.

17. Different hyphenation practice can cause different collation after machine sorting.

18. Abbreviation practice is not standard in uncontrolled vocabularies.

19. Compound terms can cause problems in uncontrolled vocabularies.

A controlled vocabulary can be grouped in several ways in a thesaurus for use by the Data Management staff (Lea, 1978).

1. Lexicon of grouped controlled terms

2. Alphabetical thesaurus

3. Classification hierarchy

4. Thesauro-classification.

A thesauro-classification is the best way for keywording to be done because synonyms are then controllable, the subject is structurally grouped, and the classification numbers reduce spelling and language difficulties in indexing.

Initially, a commercial thesaurus is recommended for use. There are several which deal with geology and one exclusively with exploration and production of oil and gas, by Petroleum Abstracts. See Appendix 2. It is advisable to use the Petroleum Abstracts as a source of keywords as they have addressed and solved many of the problems inherent in building a thesaurus. Several topics will have to be amended by each respective

country in that areas, lithologies, and other similar topics must be listed that refer to country-specific locations.

For example, a geographic thesaurus will have to be instituted using the indigenous area names which have been agreed upon as standard and unique. The thesaurus can be built structurally in the same manner as the overall classification system, in which the largest overall area is broken into its respective sub-areas and named structures.

From the hierarchial classification it is important to make an alphabetical index which involves:

1. The terms used in the classification sequence
2. Inversion of terms used in the classified sequence
3. Synonyms of terms used in the classified sequence (e.g., Siam, Thailand)
4. More definitive terms than those used in the classified sequence.

Key data

An annotated-keyword/key data bibliography follows the same general scheme as keywording--choosing controlled vocabulary from a structured hierarchy--but makes a distinction between keywords and actual data. This scheme would be ultimately of more use as a professional would find tabulations of data more important than mere subject descriptions. Indexing and keywording would be carried out in the fundamental manner described previously using a thesaurus, but specific data would be included. Included in Appendix 2 is an article discussing the GEO-SYSTEM key data activity. Unfortunately, the process involved is

very exacting for the inclusion of data and would require a professional staff that is probably not feasible until data volumes become very much larger than the expected volumes of the respective CCOP member countries.

Abstracting

Abstracting of reports and other documents containing textual material is also a very effective manner to initially provide information regarding data sources. The same indexing and keywording process is carried out as described previously, but in addition, two to three paragraphs are written to describe the content of the report. The staff that actually abstracts the text must be subject specialists, geologists, geophysicists, or petroleum engineers to ensure that the information is abstracted from the text.

Filing of documents, reports, and magnetic tapes

Document storage

The physical storage of the data after acquisition is recognized as a major problem. Each country visited has a slightly different archiving system, none of which will be able to successfully handle, store, and retrieve their data in the future if the data volume increases as expected.

The primary storage criteria should be by area, as general divisions of the offshore by basins, structures or pools. The major consideration is that most searches for data are on the basis of an area so the structure of the archive should reflect this. Within each area designation all document types should be stored by subject, i.e., exploration, development, or production, then follow the index classification within each.

Certain document types should not be stored with the others, specifically maps, core and chip samples, and magnetic tapes should each be logged separately, and a separate index should be maintained.

Map storage

The variable physical nature of maps and explanatory texts makes it desirable to keep the collection in more than one sequence (Lea, 1978). Most explanatory texts accompanying maps are more conveniently shelvable; certain maps also arrive folded into a shelvable container. Many of these are shelved with the main serial collection, which is arranged geographically by continent,then by country, then alphabetically by the title of the serial. Certain folded maps and explanations that are not part of a series should be shelved with the reports. The majority of maps, however, are unfolded and are kept in horizontal or vertical map presses. Access to horizontal presses is more difficult because of the need to lift or remove maps to reach one in the middle of a sequence; for this reason the lesser used regional and non-series maps are stored horizontally. Vertical arrangement is used for the major national map series; although access and refiling is easier, the guards used to hold the maps in the cabinets are not wholly satisfactory and require maintenance.

In the case of shelved maps and explanations, these use a normal shelf-location mark system. This consists of a one- or two-letter physical location code, followed by a numerical sequence which achieves country arrangement. The location mark for flat maps has seven elements:

1. A prefix such as 'H' for horizontal plan presses, 'V' for vertical presses, and 'C' for vertical cupboard filing.
2. Thesaurus geographical code for the area covered by the whole series (rather than the individual map sheet).
3. The series code.
4. The issue (normally the sheet number).
5. The date of the map.
6. The variant indicator (a sequence number to distinguish between minor variations, particularly in the case of manuscript maps).
7. The copy (a letter code, from A onward, to distinguish identical maps).

This location mark serves a number of purposes:

1. All parts of the mark have meaning, other than being merely a filing location.
2. Each mark must be unique.
3. The mark can be treated in parts, so that only a few characters need be used at a time to find or file a map.
4. The system is infinitely expandable.
5. The system is as efficient as possible, in that another artificial location mark does not have to be used.

6. The accession number can be used as a check in map retrieval, as the number is always included in printed indexes and computer retrievals; this gives an independent check.

7. The collection is most frequently consulted geographically, and the location mark reflects this.

An accession stamp can be designed to incorporate all elements of the location mark, with the addition of:

1. Country or organization name.
2. The acquisition number, from the acquisition catalog.
3. The date the accession stamp was applied.

The design is shown in figure 2.

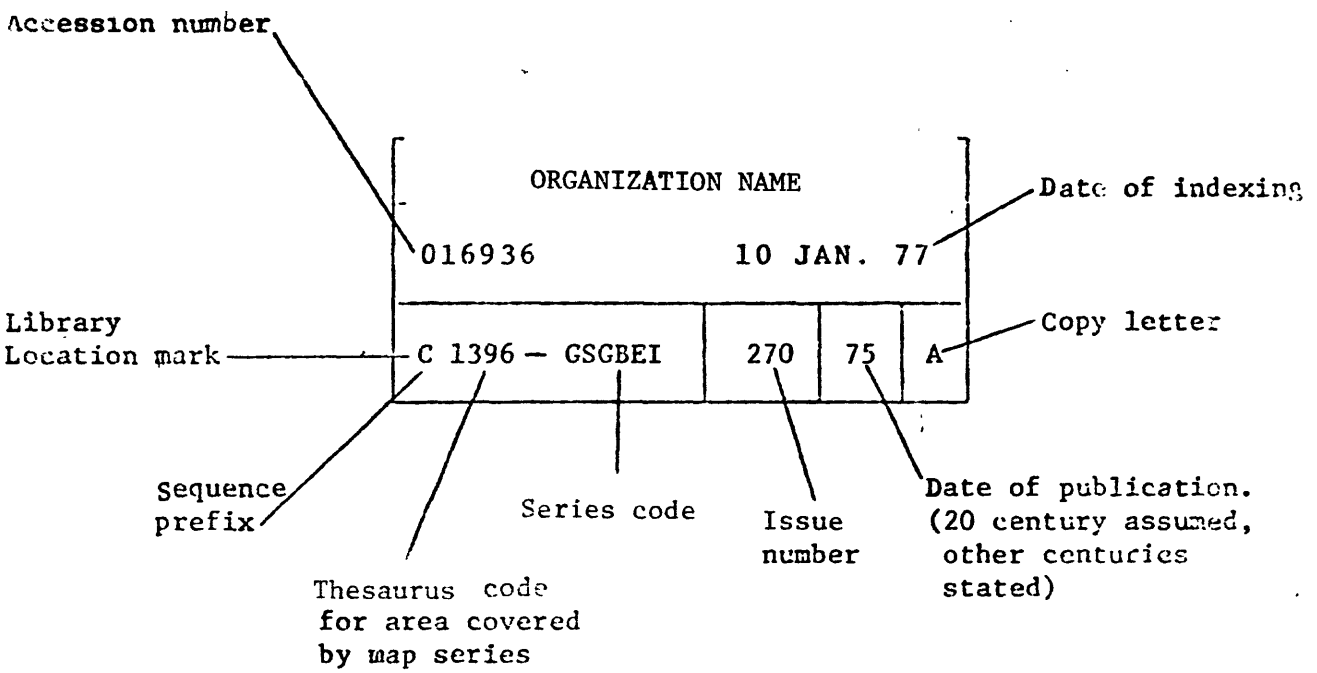


Figure 2. Map accession stamp. (from: Lea, 1978).

Geophysical data

The storage, retrieval, and analysis of geophysical data is perhaps the largest single area of data handling within the oil and gas agencies of the CCOP countries. Most geophysical data processing is related to seismic data, and is almost always done either by the contractor or in-house by the agencies, utilizing software packages purchased or leased from the major geophysical companies. As a result of this procedure, the greatest problem faced in the storage of geophysical data is in fact a problem in map storage and archiving. There is also the additional problem of tape storage of seismic data. Because the major oil and gas agencies require the contractor to maintain all geophysical raw data, the agencies face a large storage problem when seismic data are turned over to them for handling.

Well-log data represent the second large volume of geophysical data that is available to the oil and gas agencies and produces almost identical problems to that of the seismic data, i.e., submittal in paper format and a large number of digital tapes containing basic data. The problem associated with tape storage of well log data is not nearly as severe as that for seismic data, simply because there are fewer digital logs. There is, however, a growing tendency within both the major companies and the CCOP oil and gas agencies to digitize a larger number of logs.

Because the majority of all geophysical data collected that relate to oil and gas activities of the CCOP countries are normally processed

by either private contractors or in-house computer centers by means of commercial data packages, this report does not deal with these activities. There is, however, a need to discuss national collection and storage procedures with respect to magnetic tapes of geophysical data.

National collection and storage procedures for geophysical data.-- At present most CCOP countries require, or would like to require, that contractors provide magnetic tapes of all seismic data collected within the nation's jurisdiction. Although the requirements are all-inclusive, they rarely specify the following:

a) Precisely when data are to be transmitted to the oil and gas agency.

b) The physical description of computer tapes that are provided with the basic data.

c) Standards for data format for geophysical data provided.

The lack of specific standards related to the areas listed above has resulted in numerous problems, the end result of which is that adherence to the requirement to provide basic geophysical data is incomplete at best. Some of the more significant problems are:

1. Virtually no nation has an immediate need to acquire all the historic data related to seismic surveys. Therefore, there is not a concentrated effort to acquire the data and as a result data organization is spotty.

2. Virtually no nation is in a position to receive the thousands, in some cases hundreds of thousands, of magnetic tapes of geophysical data.

3. The lack of clear-cut standards for even the size of magnetic tapes creates a serious storage problem.
4. The lack of data formats for the submitted data means that most of the information would need to be converted to a standard format before it could be used. This represents a major task both in terms of computer time and personnel.
5. The widespread dispersion of seismic data outside the CCOP countries, both regionally and by company, makes the maintenance of an index or archive almost impossible.

Given the desire of all nations to acquire and archive magnetic tapes of their data and the present problems associated with meeting this objective, there is a clear need within the CCOP countries to initiate the following actions:

1. To effectively store, retrieve, and utilize geophysical data, each country should establish, either nationally or by adopting an international standard, a procedure for the submittal of magnetic tapes that includes:
   a) standardized label of tape characteristics;
   b) standard size of reel and method of sealing;
   c) grouping of data by survey, area, and scale at the time of submittal.
2. If detailed standards on a national or international basis are not feasible or not available within a reasonable time period, then each nation should develop an internal standard, and upon receipt,

all tapes that do not conform to the standard should be duplicated in-house to meet standards.

3. For the physical storage and retrieval of magnetic tapes it is recommended that all standard size reels be color-coded, normally by multi-colored sealing strips where the color designates:
   a) Type of data
   b) Area covered
   c) Geophysical company
   d) Year of data acquisition.
4. All geophysical data should be stored together in a common facility which provides the required physical environment, security, and access to tapes for utilization.

These recommendations represent the minimum standards that would be acceptable for the submittal, storage, and retrieval of magnetic tapes of geophysical data.

Anticipated programs in computer processing of geophysical data.-- As the need for expanded analyses of data related to exploration, reserve estimation, basin analysis, and regional correlations becomes apparent, and the applications are recognized, there will be a major effort within the oil and gas agencies to better utilize their geophysical data. Indeed, there is at present a growing interest in the following areas that will mandate an expanded data processing activity with respect to geophysics:

1. Reservoir engineering studies
2. Seismic reprocessing
3. Modelling
4. Velocity analyzers.
5. Depth conversions.
6. Density analysis.
7. Graphics.
8. Resistivity profiles.

These needs and associated areas of activity are rapidly expanding and require an expanded effort in at least two major areas: geophysical data files, and in-house mini-micro processing. Both these subjects are covered in following chapters of this report. In general, however, it is anticipated that the initial development of geophysical data files will normally proceed by the development of individual special-purpose files that will be used in a limited number of applications. Because of this fact, considerable attention must be given to the use of mini and microprocessers which would, at present, seem to offer the greatest potential for cheap, efficient, and rapid processing and handling of geophysical data files.

The very nature of the development, handling, and processing of individual geophysical data files mandates that there be some overall data management to insure that the activities are coordinated. Specifically, there is a need to set minimum standards for data content and definition to insure that at some later date the various files can be integrated into

a comprehensive well data base or geophysical data base. With respect to these considerations, three major areas need to be monitored:

1. The basic input to geophysical data files will be digital data, much of which will be produced by hand digitizing. Therefore, it is necessary to insure that the same digitizing standards are employed to insure data compatibility.
2. Careful attention should be paid to insuring that digital data are compatible from file to file with respect to intervals and specific contacts, units, or zones.
3. All digitized geophysical data should carry specific identifiers with respect to company, time, method, etc., to insure that data to be compared are compatible.

Careful attention to detail and monitoring of activities will produce a series of files which can later be merged into a geophysical data base. Failure to provide the proper administration will lead to costly redevelopment of the data and sizeable delays in development of application.

Active, inactive, and dormant data storage

During the visit of the CCOP consultants to the oil and gas agencies, it was observed that an undetermined but sizeable amount of data is maintained in the files that is either duplicates or is not used at present. Removal of these data from the library would reduce both the volume of the library and the necessity to maintain a record of the data.

Duplicate data are best represented by the daily, weekly, and monthly progress reports that are superseded either by annual reports or completion

reports which are a compendium of the daily, weekly, and monthly reports. To alleviate this problem it is suggested that preliminary reports be maintained in a separate file, and, on receipt of annual or completion reports, that the preliminary reports be placed in storage or destroyed.

Data that are presently not used, i.e., very old, or on areas or subjects that are no longer under study should be removed from the library and placed in suitable storage. In addition, data presently used for study but which are of little value for subsequent studies, or for which summaries are available, should also be placed in storage.

It is appropriate to mention that three levels of data are normally designated:

a) Active--data that are of present and ongoing use, or have a recognized use in the future, should be maintained in the master library;

b) Inactive--data that have been superseded, are of no forseeable use in analyses or studies or for which other data sources are available (such as summaries). Such data are stored external to the master library but in an area and state such that they are readily retrieved if needed;

c) Dormant--data of only historical value, that are not required for any future studies, or are totally superseded. Such data are normally boxed, indexed, and sent to a permanent storage area and are normally retrievable only with sufficient lead time.

Development and implementation of a three-stage physical storage plan will substantially reduce the space requirements of the present and future library and will result in a much more efficient and useful library facility.

Data control

The present system of data control within the CCOP countries is inadequate to:

1. Insure the security of data.
2. Insure the proper filing of data.
3. Provide accountability for specific data items.
4. Accomodate an expanded study, analysis, and data base development program.

The major problems with the present system, recording the data user and the data borrowed on individual cards, is that the system is not used consistently and no one single individual serves to monitor data use and distribution.

It is recommended that the present Ad Hoc system become mandatory and that some one individual be placed in charge of monitoring the use and distribution of the library materials. The ideal situation would be that one of the staff to the Data Manager be assigned this task.

Microfilming

Microfilming is an efficient way to handle the preservation and duplication of archival materials for the following reasons:

1. Amount of physical storage is reduced.
2. Information is readily available in one spot.

3. Material is easily reproduced.
4. Method is exceedingly efficient for storing and retrieving map information.
5. Reduces wear on original material.
6. Acts as a backup library to insure against loss through fire, etc., of original documents.
7. Allows cheap and easy dissemination of data to regional offices.
8. Stable and easy to store, deteriorating less quickly than paper.
9. Microfilm is cheap to mail.
10. Color can be reproduced cheaply, as positives.
11. COM (computer output on microfilm) can be cheaper than a line printer, especially if several copies are required.
12. Storage costs are minimal.

A few disadvantages are encountered in that (Lea, 1978):

1. A microfilm reader is required.
2. There are many 'standards' and sizes: 16 mm and 35 mm roll microfilm; microfiche in 3" x 5", 5" x 8", but most commonly 4" x 6" (104 x 148.75 mm).
3. Some users do not like the medium.
4. Some data and papers on microforms are poorly edited.
5. Browsing is difficult or impossible.
6. Archive must be in order before microfilming, as an unorganized microfilm file is unusable.

It is recommended that provisions be made in the CCOP countries to buy microfilm equipment and proceed in duplicating their archival data, or that they contact microfilm contractors to provide the service, allowing for future updates to the file.

Personnel

The acquisition, referencing, keywording, storage, and retrieval procedures in archiving materials requires a Data Management staff. The importance of data availability in an organization of these types spans all levels of activity. Data are needed for all operations (exploration, production, and regulatory) that need to be coordinated at the department level. Top administration also requires the submittal of reports data status justifying a position in line with other department heads.

The staff under the Data Management specialist should include a senior information specialist, preferably a librarian, two technical personnel, ideally a geologist and a geophysicist or a petroleum engineer, and three to five clerks and authorities, depending on the activity level with respect to data in the archive. Obviously this number will vary depending on the size of the installation; however, a minimum skill mix that includes the above areas of expertise should be maintained.

In most of the installations visited, junior geologists were put in charge of data activities in addition to their other duties. Geologists basically do not have the background to deal with the problems of physically storing and retrieving data, indexing, classification, etc.

Information specialists and librarians, however, have no geologic expertise, therefore lacking professional judgement in the actual indexing classification, and keywording. Therefore, a mix of information specialists to outline general procedure, organize data flow patterns and handle the physical storage problems is necessary with a complement of professional/technical people to provide the geologic background necessary to deal with the specific types of incoming data.

Computer data archival information systems

Once the archival procedures recommended are implemented: physical storage is arranged, indexes are complete with standard reference and keyword formats and the flow of incoming documents from acquisition procedures to storage is standardized, the conversion of the manual files to computer files is relatively easy. The majority of large oil companies and many other organizations dealing with petroleum data have converted their bibliographic files to computerized methods for the following reasons:

1. Organizations cannot acquire and manually process the majority of literature pertinent to their interests.
2. Traditional library methods are inadequate to cope with the detailed information requirements of users and potential users.
3. The retrieval system, the card catalog, is difficult and alien to many users.
4. Card catalogs become very large and inefficient to use.

Several existing systems successfully deal with bibliographic data. The American Geological Institute (AGI) publishes GEOREF which deals with

referenced keyword formats. Geosystem's database GEOARCHIVE uses a keyword/annotated bibliography format. Petroleum Abstracts publishes abstracts of all published exploration and production information in the United States. An overview is provided of each in Appendix 2 describing their indexing and classification procedures, record formats for references keywords and data, their computer facilities and published products.

A computerized system for bibliographic data provides the following advantages:

1. The search for pertinent information sources uses keywords which are fast and comprehensive.
2. The hierarchial structure of the classification allows for generic searches.
3. The ability of the computer to autopost the larger (broader) divisions of the classification of a reference is extremely useful and time-saving.
4. The capabilities of cross-referencing are extensive and easy.
5. Search parameters of two or more criteria can be accomplished with one step.
6. Master listings of accessions can be produced easily.

The computer hardware and software required to support a machine-processable bibliographic data system is dependent on the required applications. Normally, however, the bibliographic data base can be run on most existing systems with simple applications software. If no machines are accessible, bibliographic systems can be most easily run on minicom-

puters with simple software designed to manipulate datafiles.

For more detailed discussion on the computer applications of bibliographic data regarding international standards for machine-readable formats, the Reference Manual prepared by the UNISIST/ICSU-AB Working Group on Bibliographic Descriptions is included in Appendix 3. The purpose of the UNESCO working group has been to define, for scientific and technical literature commonly covered by secondary information services, a set of data elements which will constitute an adequate bibliographic citation. For each type of literature the minimum number of data items per record is identified with any supplementary elements that may be deemed necessary.

Elsewhere in this paper the computer hardware and software necessary to implement a bibliographic file are discussed.

Repository of samples

One of the major areas of data storage and retrieval that should be addressed in detail, within the CCOP countries, is the acquisition, storage, and retrieval of physical samples, i.e., drill core, chip samples, and analytical samples. The extent of this problem is actually difficult to ascertain in detail, a problem in itself, because of the present lack of acquisition logs, poor storage facilities, and no overall emphasis on the data. In some instances, however, the problem is simply inadequate space for storage, which itself poses difficulties.

The following general comments apply to virtually all the CCOP countries and represent problem areas which should be addressed. Although

the solutions will be unique to each country, there is a general approach that might resolve many of the problems which is discussed at the end of this section.

Core and chip sample acquisitions

In general, it is surprising how few physical samples are acquired by the oil and gas agencies of the CCOP countries. Although most countries have mandatory sampling requirements, there are very few concerted efforts to acquire these samples. It is believed that the majority of samples still remain with the drilling contractors; however, very few agencies know how much core or how many chip samples are held, nor do most have any knowledge of where such samples are stored. These factors pose a serious problem with respect to each nation's knowledge of its physical samples.

Given the above conditions, it would seem advisable that each country begin a program for the acquisition of core and chip samples and that this program proceed as rapidly as the samples can be handled.

Storage facilities

The very nature of core and chip samples dictates that they be physically archived separately from other types of data. This fact, however, does not negate the need for the development and maintenance of an acquisition log, similar to that used for text information, and an indexing system to catagorize the type of sample and other identification.

Physical storage facilities for core, chip, and analytical samples presents several problems, among the most significant of which can be mentioned:

a) Normally, the need for a special housing for the samples.

b) The need for staff to maintain and work with the preparation, retrieval, and utilization of the samples.

c) The need for large expansion potential which normally results in large front-end expenditure.

d) Physical handling and archiving are difficult.

Given all of these problems, however, it is still essential that physical samples be preserved and physically archived.

Analytical samples

Unlike their "big brothers," core and chip samples, most samples taken for laboratory analysis require considerably less space but do require unique storage accomodations. Additionally, most analytical samples are derived from chip or core samples and as a result are rarely included in normal acquisition logs and lack cross-referencing to data files on well information. This is a particularly acute problem when files of analytical data and samples are created, as they are rarely directly correlated with the well files on geology, geophysics, etc.

Analytical samples pose a peculiar problem in that because they are analyzed they are normally given privileged storage space. Indeed, in some organizations, samples occupy rooms while professionals are forced to share offices and find alternate work areas. Attention should therefore be paid to moving analytical samples back to the storage areas as soon as work is completed and they are no longer needed for analytical purposes.

Existing sample storage facilities

Because of the unique nature of core, chip, and analytical samples, their physical archiving and handling is a separate study and not specifically a part of the present study. It is, however, a major problem which can best be addressed by having the individual country representatives visit the physical storage facilities of the Norwegian Petroleum Directorate, Stavanger, Norway, or the Alberta Core Storage Facility in Calgary, Alberta, Canada. Specifically, the Calgary repository is one of the world's largest and most efficient; it should be visited prior to the development of any sample-storage facility so that planning officials may gain the required insight into both the physical plant requirements and the procedures for sample storage.

Potential uses for sample storage

As stated earlier, the acquisition and storage of physical samples have not been given a high priority in the CCOP countries. Although there are many reasons for this fact, perhaps the most important is that the value of such samples is not truly recognized. It should therefore be stressed that the development of a physical sample repository is of great value in modern exploration and exploitation technology which now employs physical and chemical properties of rocks for analyses utilizing new concepts of geology and petrophysics. Today, geologists and engineers can learn as much or more using samples from unsuccessful holes as samples from successful ones. Modern exploration is directed toward the search for stratigraphically trapped hydrocarbons. These accumulations

are already becoming harder to find in the offshore areas of most CCOP countries, and successful exploration requires rock cores and cuttings to determine the lateral and vertical distribution of porous reservoirs, impermeable seals, and traps. Obviously, fossils found in cores and chips are invaluable for correlation of subsurface rocks and in the predicting of reservoir rocks. Perhaps more important in the future will be the value of cores and chips to provide critical information for secondary recovery processes.

The present and potential value of core and chip samples is enormous and a concerted effort should be made to acquire and maintain this valuable information source.

COMPUTER APPLICATIONS RELATED TO PETROLEUM DATA HANDLING

Analysis of computer-based systems and programs in the earth sciences

Dr. Stein Bie, of the Norwegian Computer Center, recently completed a review of computer-based systems and programs in the earth sciences as a part of the present IUGS/CCOP study. The report details that the earth sciences are in an early stage of development of computer-based systems. Nearly all systems are first or second generation, many not yet in routine production.

Geophysics forms the major exception, with highly developed and stable systems in extensive use, and with a well-informed and numerically minded user community. Standard software packages, often commercial, are in use with both government and private industry. Major activities are confined to private industry, with less evidence of active government research participation for systems development.

Outside geophysics, there is no distinct difference in level of attainment between government and industry, with government actively involved in systems research and development. Development is frequently initiated and maintained by a few devoted individuals, but there are some examples of firm organizational commitment to computerized information systems.

Input now creates a major bottleneck in many organizations. Data capture from field records and archival material remains problematic, particularly for alphanumeric data sets. Input efforts are frequently underestimated and sometimes allocated to staff with incomplete understanding of original data quality and context. Examples of large-scale data capture being successfully accomplished are found with commercial oil well records and government minerals files. Record costs of $10 (U.S. dollars) or more are frequently quoted. Also, in cartography digitizing is a major problem. Automated digitizing of earth science manuscript maps has been largely unsuccessful; hopes are pinned on recent developments. Lack of large cartographic data files also prevents development of efficient cartographic systems. Data input seems to be an important field for active research and development.

For data storage and retrieval, simple sequential or index-sequential file systems have achieved most success. Earth scientists frequently have insufficient computing experience to operate large data base management systems. Supporting computer centers sometimes lack interest in applying the potentials of large systems to geological problems. There are, however, successes with system 2000 ADABASE, TOTAL, STAIRS and IMS in selected organizations with high computing ability. Beginners are well advised to start with simple systems (standard file routines, GRASP, GIPSY).

Many different processing programs are in use and it is difficult to generalize about them. Geological users strongly wish to have inter active systems replacing batch oriented processing, and a willingness to bear the higher costs. Many find use of the computer as a preprocessing tool important, easing the geological interpretation of data rather than automatically generating conclusions.

Although graphical display is currently poorly developed, some fine analytical work is done in environmental geology, geochemistry, sedimentary petrology, and regional planning using raster (cell)-based cartography. Colors seem important for user communication. Computer-aided cartography has yet to make a major impact in the earth sciences, apart from in contouring. Grid methods are here near-universal, with experimental work with regionalized geostatistics. A few commercial packages dominate the digital terrain model field.

Relating to organizational structures we note mixed management support for computer systems for geology, which also reflects mixed feelings among their geologic staff. Long-term funding seems essential for useful developments, especially as data capture can be slow. Stop-go policies have widely interfered with systems development.

Traditions with working environments differ significantly between, for example, U.S.A. and western Europe. Small and crowded rooms for both equipment and scientists were common, and support staff (for example, data entry and digitizer operators) give simplistic and repetitive tasks which would enfringe on labor agreements in some other countries. We noted high turnover rates among personnel. Carefully designed entry systems and good job

organization in some institutions in the U.S.A. and Canada were often associated with successful systems.

Geologically, the new techniques have yet to make a fundamental impact, but younger geoscientists are clearly more quantitatively inclined than their older colleagues. Multivariate data analysis seems useful for such subjects as geochemistry. Remote sensing has yet to show consistency in production environments. Educational aspects are important to future progress and to the system user; friendliness is a valuable attribute of a system. Training tools (for example, prospector) offer some promise.

We expect the next decade to bring major changes to data handling in the geosciences, with computer-aided processing playing an increasingly important role. Most constructive developments so far have centered on creating archival files, simple processing, and preparation for manual interpretation. Data-about-data systems are particularly successful and should be more widely encouraged.

This analysis of international activities provides an overview of problems and activities that are in large part similar, if not identical, to those within the CCOP member countries as evidenced in the following discussions.

Oil and gas data files

Within all the oil and gas agencies visited by the consultants during the information collection phase of the program, there was both a clear need and desire to develop both manual and computer-processable data files. Many data files have already been developed for use in specific programs and projects. Although the present emphasis is on the creation of specific data files, there is an intermediate- to long-term

need to integrate the existing or planned data files into a data base (a comprehensive file or set of files, normally in a machine processable format, for use by several users). However, to accomplish the present intermediate- and long-range goals of data base development, several key factors must be considered in terms of the design, construction, updating, and uses of the data base as its constituent files. The purpose of this section is to review the more critical aspects of these areas, and to discuss these specific types of oil and gas data bases. The three major data base activities common to the majority of the CCOP countries are the formation of a well file, an oil and gas data file, and a basin file. When use together in a data base system, these three files can be used to answer the majority of questions addressed by the exploration and production departments of the oil and gas agencies.

It should be emphasized that throughout the following discussion reference is made to the construction and development of computer based files applicable to the development of manual files both because of increasing the integrity and usefulness of the manual file but also because experience has shown that with increased application and data volumes the majority of manual files will be converted to machine processable files. It is therefore imperative that they be originally designed and constructed with the same guidelines as machine processable files to expedite their later conversion.

DATA FILE CONSTRUCTION

Data file structure

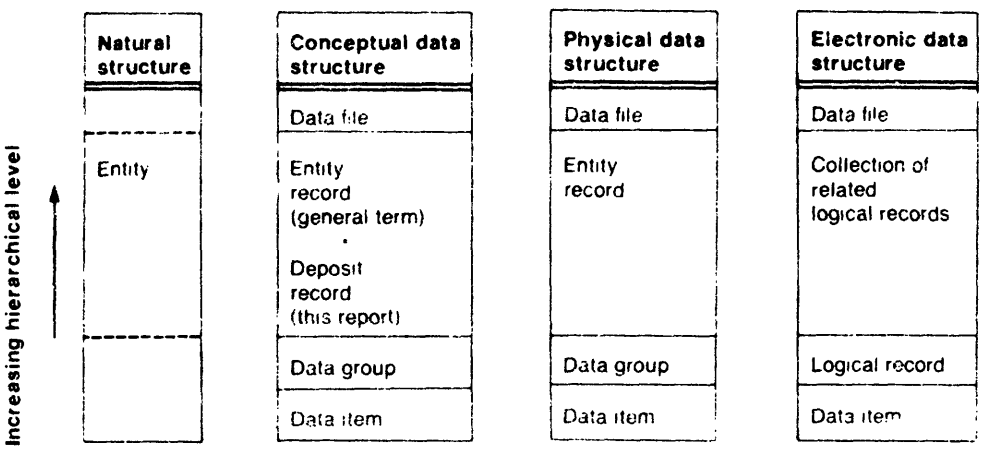
Critical to the development of any data file or data base system is the definition of the file structure.

The interrelationship or organization of individual items of data in a file define what is termed the data structure. In order for file-builders to capture, store and communicate the intended meaning of their data it is essential that the structure of the data be analyzed and defined. However, there are several levels that require definition (Table 1). First, file-builders should acknowledge existence of the *natural structure* of the entity being described, which is real but unknowable. The ways in which a scientist then logically arranges or "structures" data about natural phenomena reflect his or her current perception of them and form the basis for the *conceptual structure*.

A third level for definition is introduced when one considers the limited number of ways in which data can be recorded and stored. Each recording and storage medium (e.g. data forms, diagrams) constrains in some way the physical structuring of the data, which may not correspond exactly to the conceptual structure of the object being studied, and still less to the natural structure. This limitation is inherent in all data storage devices, from the simplest field notebook to the most complex electronic equipment. Thus we must distinguish conceptual structures from *physical* and, at a fourth level, *electronic structures*. In most cases, the structures at each level are similar, but failure to appreciate and recognize some real differences can lead to confusion.

Except where stated otherwise, the recommendations in this report are confined to *conceptual data structures*. We have considered only how the data must be logically associated and "linked" in order to preserve a given meaning.

Data structures may be portrayed or "mapped" in terms of one or more models, the most common being the hierarchical, network and relational models (Bie *et al*., 1977). The Working Committee has employed the familiar hierarchical (inverted tree) model throughout, but recognizes that in certain circumstances others may be superior in view of file objectives and/or available data-base management systems. We have not pursued this important aspect of data management.



Schematic relationship between natural, conceptual, physical and electronic data structures. This report focuses on conceptual data structures. (After Longe and others, 1978).

File definition

Too often, in the majority of organizations, the initial definitions of a data file, in terms of its content and applications is left to a single individual or a small group of people with a common problem or philosophy. This situation almost invariably leads to the development of a data file which has limited applicability and supports only a very small user community. Unfortunately, the opposite is also true and that is that a large group defines the file content and application with the result that the file is too complex to be effectively constructed and will rarely be able to meet the diverse users needs.

To avoid the problems described above the following procedure is recommended for defining the content and scope of a data file.

1. A users' committee should be defined, which includes a data base specialist, several of the larger potential users and several data specialists who are either responsible for the development or acquisition of the basic data.
2. The users' committee should address in detail the following three factors with respect to the entire agency:
   (a) How many people will use the data file.
   (b) How often will the data file be used.
   (c) Specific purposes of the data file.
3. Given the information from the questions in No. 2, the users' committee should develop a check list of data items required to meet the intended uses.

Upon completion of the above three steps the next element in the data file development is the format definition.

Format definition

Central to the development of any data file is the definition of the format to be used in data collection. Although simple in concept, one only needs list the data required. The actual development of the format is considerably more difficult if it is to be done correctly. The following are critical considerations:

(1) There is the basic need to insure that all the relevant data items, these that will be used singly or together, are included in the format.

(2) Normally only disaggregated data, usually referred to as the basic data element in its simplest form, should be stored in the file. It must always be remembered that basic data can always be aggregated; however, aggregated data cannot be reduced to basic data.

(3) A standardized set of terms and a corresponding thesaurus must be developed for each data field within the file.

(4) Standard units of measure must be utilized throughout the format so that data can be aggregated without the necessity of conversion of units.

(5) Every format must contain sufficient ancillary data, much of which will not be of direct use in the files application, to allow linkage with other files in the data base, the most

common links being by longitude-latitude, national grid, or map area.

(6) As no data file is static, the basic format must allow for the addition of more basic data than originally planned, and for the addition of other data items.

Once a preliminary data file format has been developed, a form should be sent to a group of users, or circulated through the user community, who are asked to fill in the form with available data. During this exercise, careful records should be kept of time requirements, problems in data acquisition, and other problems in completion of the format. Following such an evaluation, the format should be revised to eliminate problem areas and to make it more efficient with respect to data acquisition.

Data acquisition

Data acquisitions are normally the most expensive, time consuming, and personnel intensive activity in the development and application of a data file on a data base. At the same time, it is an area where perhaps the least effort is expended to make the job efficient and comprehensive. For data acquisition activities within the CCOP countries, the following problems are critical.

First is the problem of the sequence of data acquisition with respect to the basic data. There are three fundamental types of data: PAST, PRESENT, and FUTURE, which must be accomodated in data acquisition. Although past data are obviously the bulk of most archives, they should be treated last in any data acquisition program. Initial effort should

always be placed on the efficient capture of future data. The emphasis on future data insures that all of the most recent data and that to be acquired, which normally has the highest information value, will be available in the data file. Once the procedures have been developed for the acquisition of present and future data, then and only then can attention be placed on recovering the past data.

Although the above is a simple concept, it is too often overlooked in many agencies where only the supposedly overwhelming problem of handling past data is recognized.

Second is the problem of who collects the basic data for input into the data file. In most agencies it is assumed that this task can be handled by clerical personnel but experience has shown that this is not workable. Although the data acquisition task is long and tedious, it must in large part be done by professional personnel. Even those parts done by the clerical staff must be done under the close supervision of a professional and all data acquisitions must be checked by a professional.

The need for professional data acquisition can be substantiated by the facts that:

1. Most technical data require some subjective evaluation as to its merits before it is entered into a data file.
2. Professional data acquisition insures the technical integrity of the file and reduces the time required for cross-checking and verification.

3. Only technically trained people recognize the need for additional data and where such data may be acquired.

The level of professional expertise need not be overly high for data acquisition activities but must be sufficient to insure data integrity within the file and be capable of data file updating.

Data file updating

There are two major philosophies with respect to updating data files.

1. Updating can and should be done by the users of the data base.
2. Updating can and should only be done by a special staff charged with this responsibility.

The procedure selected, however, is totally dependent on the type of users and applications of the data file; indeed, in some international oil and gas agencies, both systems are utilized.

The procedure of user updating is most often employed when the data file is small, has only limited applications, and the user community is composed only of highly skilled technical personnel. The user update system is particularly effective in an environment where data are often updated, but at irregular intervals, and results based on new data are needed quickly.

The system where a specific group is charged with updating is normally employed in conjunction with large data files that have a large number of applications and users. Normally the user community is professional in nature but from diverse backgrounds and the input data needs additional review. The group-updating procedure is most effective where many entries

in a large number of files are regularly updated. The system is also employed where there is a geographically dispersed reporting community.

As stated previously each procedure has its benefits depending on application and uses, and an agency must decide which system it will employ very early in data file creation. It must, however, be cautioned that if one adopts the user-update procedure, there is no actual accountability for file and data credibility. It is this single fact that has dissuaded most companies from adopting the system. It is required that the update procedure be decided initially because it will in large part dictate the data base management system and will have a major impact on whether updating needs to be done in a batch or interactive mode.

SPECIFIC DATA FILES

Although a large number of data files can and will be developed for use within the oil and gas agencies of the CCOP countries, perhaps 2 files, well data file, and the oil and gas pool file, are a common requirement within all petroleum-producing countries. In the following sections a generalized outline of the content and sequential development of such files is given as a potential model for the development of such files, with appropriate modifications for the CCOP countries.

WELL DATA FILE

Well data represents perhaps the greatest single volume of information available in all the oil and gas agencies within the CCOP countries. In addition, it is also the most used information and therefore has a very high priority for being placed in a machine-processable data base.

It is recommended that a well data file be used as the pilot program for data file creation in most of the CCOP countries, both because of its extreme utility and the fact that it can be developed in a modular fashion. The modular development allows for the rapid development and application of the data file for specific uses and also provides for a wide variety of applications as additional data are required.

Sequential development program

Each well record must contain a minimum of heading information which serves to locate and uniquely identify the well. The amount and type of information will depend on the use of the data but at a minimum should include:

(a) Geographic coordinates (longitude and latitude or national grid).

(b) Operator name, well number, contract number.

(c) Spud and completion dates.

(d) Depth data.

(e) Projected geologic formation or formations.

Given the above information unique to each well, then the sequential development of a well file could proceed as follows:

Step I. To build a data file, utilizing well data, for the computation of porosity and permeability, the data base would have a matrix for construction and data capture as follows:

		Laterlog Deep		Gamma Ray				
DH#	Interval	Max	Min	Max	Min	GR	RW	tbulk....
	$x - x_1$							
	$x_1 - x_2$							
	$x_2 - x_3$							
	$x_n - x_{n+1}$							

Step II. Utilizing the matrix above, all that is required to expand the file, assuming constant well intervals, is simply add columns for the added data and the expanded version becomes:

DH#	Interval	(Present Data Items)	(Added Data Items) Lithology	Paleontology	Age
	$x - x_1$				
	$x_1 - x_2$				
	$x_2 - x_3$				
	$x_n - x_{n+1}$				

Step III. If for data processing reasons it is considered advisable to not carry all of the data in one file, the data could very easily be broken into 2 or more files. The primary consideration, however, is to maintain the unique descriptors in both files. This will be particularly true within PETRONAS with respect to production and reserve data. In the case of the well data file there would be two files:

File I
Well log File Production

DH#	Interval	t bulk	Matrix
	$x_1 - x_2$	"	"
	$x_2 - x_3$	"	"
	$x_3 - x_4$	"	"
	$x_n - x_{n+1}$	"	"

File II
Well log File (Porosity-Permeability)

DDH#	Interval	Lithology	Age
	$x_1 - x_2$	"	"
	$x_2 - x_3$	"	"
	$x_3 - x_4$	"	"
	$x_n - x_{n+1}$	"	"

The eventual expansion of data base activities to accomplish a wide variety of analyses will obviously require the addition of a large number of variables to the file. This expansion, however, will result in a more useful data file which will have a wide range of applications.

Petroleum Information has developed an excellent and widely-used well file record format (see Appendix 4).

Applications of well data file

Obviously a complete well data file would contain a greater variety and number of entries described in the proceeding sections, specifically with respect to data relating to:

(a) Tops and bottoms of formations.

(b) Initial potential and production tests.

(c) Core data.

(d) Drillstem and wireline test data.

(e) Production data.

(f) Analytical data.

Given the above data, the normal applications of such a file would include the following:

(a) Structure and show maps.

(b) Producing and non-producing show maps.

(c) Initial potential maps.

(d) Penetration maps.

(e) Well data listings.

(f) Audit reports.

(g) Production decline curves.

Once a well data file has been created and is operational, or in some instances while it is being created, there is normally a need to expand data file activities to begin development of an oil and gas pool file.

OIL AND GAS POOL FILE

With the development of mature producing fields, the transition from exploration to production, and an expanding role in reserve and resource estimation, many of the CCOP countries are finding that the data contained in the well data file is not adequate to support their activities. There is a need therefore to begin the development of an oil and gas pool file which will provide the basic data required to support such analyses. The same procedures should be used in defining the data file and undertaking its sequential development as have been described before.

Sequential development program

The oil and gas pool data file is potentially a very large and complex file which covers a wide spectrum of activities, all, however, related to a specific oil and gas pool. To begin the development of such a file, it is necessary to once again define those attributes that constitute the heading information for each record for an oil and gas pool. Such information would include:

Identification and location	Ownership
Discovery date	Type of field (oil and gas condensation)
Geologic age of producing formation	
Geologic basin	Discovery well identification

Step I. The primary data requirements of an oil and gas pool file are concerned primarily with discovery and development data including the following:

- Information source document
- Producing formation name
- Field discovery method
- Deepest formation penetrated
- Trap type (specific)
- Trap type (specific)
- Present status (abandoned, producing, enhanced recovery, etc.)
- Deepest well depth

Step II. Having acquired the discovery and development data the next step is to acquire the basic engineering reserves data which include:

- Status and types of wells
- Proved acreage
- Spacing (acre/well)
- Producing Interval
  - Average thickness
  - Depth to top
  - Depth range
- Bulk volume
- Pressure decline
- Gas/oil ratio
- Reservoir lithology
- Primary drive type
- Porosity
- Permeability
- Formation volume factor
- Recovery factor
- Average oil and water saturation
- Temperature
- Shut in bottom-hole pressure

Step III. Following the acquisition of the engineering and reservoir data acquisition, which is of critical importance in monitoring the pool development, there is a need to acquire production, reserve and recovery data as follows:

- Annual production
  - Oil
  - Natural gas
  - Condensate
- Cumulate production
  - Oil
  - Natural gas
  - Condensate

Recoverable hydrocarbon

Primary

Secondary recovery

Step IV. The final step in the sequential acquisition and construction of the oil and gas pool file is the acquisition of analytical data including the following:

Crude oil analyses

API gravity

Viscosity

Sulfur

Crude oil analyses

(fractions)

Water analyses

Natural gas analyses

Having completed the development and construction of a oil and gas pool data file there are a wide range of potential applications for the data. A good example of a pool file record format has been created by the Petroleum Data System (PDS) (see Appendix 4).

Applications of the oil and gas pool file

There are many uses for the oil and gas pool file; however, perhaps the most important is that for each nation it serves as the permanent archive of its oil and gas endowment; a factor that is often unfortunately overlooked in considering the development of such a file. In addition, however, there are the following applications:

1. Scientific research.
2. Evaluation of reserves.
3. Resource distribution studies.
4. Analysis of quality of oil and gas.
5. Development of national policy with respect to:

   exploration

   production

   secondary recovery projects

6. Resource assessments

7. Production decline analyses

All of these are areas where there is either already a need or will be a need in the near future.

ANCILLARY FILES

There is at present, and will continue to be in the future, a broad spectrum of data file development for individual projects and for special purposes. Some of the more obvious being specialized geological (paleontology, stratigraphy), geophysical (seismic, gravity, magnetics), and geochemical (brine analyses, hydrocarbon analyses). Regardless of the content of the data file being created, it is recommended that the basic concepts discussed in this section be applied to all data bases.

DATA BASE CONSTRUCTION

Data processing environment

Present capabilities

All the organizations in Southeast Asia responsible for the petroleum data collection have either in-house or in their geographical vicinity large computers of the type IBM 370/145, or UNIVAC 1100, or smaller minicomputers like PDP 70. These computers are currently used mostly for business management (financial planning and analysis or production monitoring) and to a lesser degree to applications in petroleum exploration or to the bibliographic control of existing petroleum data.

Therefore, in general, it can be stated that computer hardware is available to support the majority of processing needs within the CCOP member countries. More critical to the problem, however, is the availability of computer software, particularly Data Base Management Systems (DBMS) and Data Management Systems (DMS).

A DBMS, on the other hand, is a software system intended to manage and maintain data in a nonredundant structure for the purpose of being processed by multiple applications. A DBMS organizes data elements in some predefined structure, and retains relationships between different data elements within the data base.

A DMS can perhaps best be defined as a software system intended primarily to permit access to, and retrieval from, already existing files, usually for a single application. Although a DMS may provide the capability to minimize data redundancy and centralize the storage of data, the principal intent of the system is to perform such functions as information retrieval, report generation, and inquiry for a single application.

Most of the existing installations are supported by either a DBMS or DMS system which can run concurrent in both mode or on-line and which are either machine dependent like IMS (IBM system 360, 370, 303X), DMS-1100 (Univac 1100 series) or a system like Total which is running on most major minicomputers, medium-and large-scale computers.

The effort involved in installing a minicomputer DBMS can be as large as for a full-blown DBMS on a giant mainframe; the degree of preparation is not necessarily proportionate to the size of the mainframe. The extent of implementation of application programs may or may not be smaller, but the planning efforts are much the same.

FUTURE NEEDS

The field of both present and anticipated needs for data processing are expanding rapidly within the petroleum agencies of the CCOP countries and can only increase as demands for data analysis increase. The major areas of anticipated increase are discussed in the following sections.

Hardware

The rapid evolution of the minicomputer industry (Digital Corp., Hewlett Packard, Nova etc.) and the introduction of small computers by the big computer firms, such as IBM's system 38 (512k bytes of main storage, 193-5 megabytes of auxiliary storage, a 650-line-per-minute printer, seven display stations, a remote printer and all necessary system software can be purchased for less than $140,000 (U.S.) offers the necessary hardware to implement all three phases described in the previous section without having to use a large mainframe like IBM 370/175 or UNIVAC 1100. If, however, these machines are available and are not reserved for other applications all three phases could be implemented on them. It should be pointed out there seems to be a trend toward the use of smaller computers for interactive graphical type work involved in parts of the applications of phase III.

Software requirements

Each of the individual phases of the sequential development program requires specialized software to process the data and produce the reports and analyses required. In many instances the software programs will actually be written at the installation to do a specific task (utility programs). Alternatively, programs will be developed which allow the user to utilize portions of existing software programs extant on available machines. In both cases the software should be written in compatible or single programming languages and be well documented.

With an increase in data processing activities the normal computer center will begin to rely less on utility programs, although they will always be of value for specific applications, and more on commercially available data base management systems (DBMS) as well as graphical subroutine packages.

It is important to emphasize that the acquisition of computer software is a complex and time consuming task if the software acquired is to be compatible with any anticipated integrated system. Very large sums of money can be expended on software packages which will become obsolete or inadequate with the expansion of data processing activities. Therefore in the evaluation and acquisition of all software packages the following general guidelines should be considered:

1. Applicability to present and anticipated program needs
2. Adequacy of documentation and seller support for package
3. Machine and peripheral dependencies which limit use of package
5. Ease in modification and linkage of software package with other software
6. User friendliness and technical support requirements.

Software activities are perhaps the most volatile aspect of computer processing with an enormous number of packages available for almost every application. It is therefore critical that the exact software specifications be developed for each application and that all acquisitions made support not only the user but the longer term need of the individual computer centers.

Data base management software

Data Base Management Systems (DBMS) have been available for more than a decade, yet have had a profound effect on the market only in the last 3-4 years. Of particular interest to the CCOP countries is the fact that the most recent trends have been in the application of the DBMS technology and applications to minicomputers and even microcomputers.

Many systems have started out as DMS and through time and expanded capabilities have become excellent DBMSs and well as DMSs. It should be emphasized that many of the initial applications for data files could be, and most probably will be in most installations, handled by application programs. Ultimately, however, almost all installations will require a true DBMS in order to reduce redundancy in data files and permit greater efficiency in the storage and utilization of information.

This sequential development within the oil and gas agencies is also reflected in the development trends of DBMS systems toward total systems. In particular, this trend is characterized by a modular set of programs that is combined to handle not only the users' data base management requirements, but also to supply the associated inquiry/response, data retrieval, accounting and billing, report writing, and other functions in a single integrated system. Originally, interfaces were built to independently supplied application programs; however, it soon became clear that it was more beneficial to develop a series of related programs and market the resulting "total system" to the end users.

There is a constant changing, compacting, subsetting, and modifying activity within the DBMS industry. The introduction of new and more powerful hardware systems and new DBMS technologies, such as relational and distributed data base concepts, have necessitated a reevaluation and improvement of packages.

It is important to keep in mind that the DBMS systems that are presently being marketed are actually packages, and although this may be an approach that is just right for some users, it may be excessive for others. It is important to realize that once an agency has committed itself to a DBMS

environment, it becomes progressively more difficult to change systems as the implementation and application become basic to the agency's operation. The DBMS field, however, is rapidly changing to accommodate an equally rapid changing environment in data processing within the geological sciences and the oil and gas activity, specifically.

The general conclusion from the overall analysis is that the field of computer applications is changing rapidly and that organizations are best prepared to cope with the growth if they have a capacity to respond to these diverse changes. This fact is further demonstrated within the oil and gas agencies of the CCOP whose role has changed rapidly in the last 5 years. Therefore, because a DBMS allows for maximum efficiency and supports multiple applications, considerable effort should be directed toward the selection of a DBMS or a DMS that can be expanded. However, the acquisition of a DBMS is a major decision and should be carefully planned, and available DBMS or DMS should be evaluated carefully.

Data Base Management System selection

Perhaps the single most important decision, with respect to computer software, is the selection of a DBMS. This problem is particularly critical in the CCOP countries, as they are either now in the process, or will shortly find it necessary to consider, the acquisition of a DBMS to handle their computing need. Given this need, the consultants would suggest that each country utilize a standardized procedure, peculiar to each country's needs, for evaluating DBMSs. The following procedure is modified from that used by the U.S. Geological Survey in evaluating DBMS procurements. The system utilizes

a series of critical factors which are given weights depending on their potential importance to anticipated applications. The numerical weights can be modified to suit the specific needs of each country.

Evaluation scheme for Data Base Management Systems

DBMS Characteristics	Weights
1. Hardware independence	
A separate device media control language exists	[2]
The placement of data is completely automatic, or	[2]
A "place near" type of command exists	[4]
Interface of DMS with operating system	[2]
2. Language facilities	
Application programs in COBOL, FORTRAN, assembler, ALGOL, PL/I: all five	[4]
four	[3]
three	[2]
*An interactive enquiry language exists (IEL)	[3]
A data management language exists (DL)	[2]
Reportwriters in both IEL and DL	[2]
IEL and Dl are "the same language"	[1]
User extensions to IEL	[2]
User functions in IEL and DL	[2]
*Terminal networks language or equivalent	[2]
Data dictionary and data directory	[2]
3. Data independence and system/subsystem considerations	
System description is separate from subsystem descriptions	[2]
Security locks at system and subsystem level	[2]
Validation rules in system	[2]
Location modes: standard (set-subset), direct, calculated (random)	[2]
ordered (next, prior, owner)	[2]
User-defined functions in subsystem, e.g., scramblin	[2]
Data manipulation language interface for macro READ, WRITE, CALL	[3]
Add or delete a domain - must be transparent to application programs not using domain	[2]
*System must not store blanks, zeros, or pointers if domain absent	[2]
4. Other utilities	
Data base recovery: back-up tapes	[2]
mistake in program: rollback	[2]
__ partly lost; reconstruction	[2]

	Security: lockout from certain operations	[1]
	terminal type	[2]
*	user's password for access to "his" data	[2]
	Structure simulation	[2]
	Monitoring routines	[1]

5. Usage and users

	Datamation Dec. 77 users opinions: placed first	[5]
	second	[3]
	third	[1]
	Opinions of local users	[3]
	General impression when using terminal	[4]
	Ease of diagnostic messages	[1]
	Ease of recovery procedures	[1]

6. Cost

	Hardware cost p.a. lowest	[4]
	second lowest [3], etc.	
	Software cost p.a. lowest	[4]
	Cost of educational support/documentation	[2]
	Cost of technical/specialized support	[2]

7. Other considerations

	Multi or single thread: only one copy of DMS in memory	[2]
	Only missing parts of subsystem added to transaction file	[1]
	Overheads on DB size due to pointers, tables, indices: <10%	[2]
	<50%	[1]
	What percent of firm's turnover is in S.A.: highest	[3]
	second highest	[2]
	third highest	[1]
*	DBMS must handle networks, i.e., many-many relationships	[3]
	Re-entrancy (more than one set of complete registers)	[2]

Certain of the evaluation criteria will be mandatory, i.e., must be present before the system can be considered, depending on the specific needs of the user and the installation. As an example, the * in the above format would identify mandatory aspects of a DBMS that was specifically to be used for interactive data processing.

In order to effectively evaluate a DBMS, using the proposed evaluation scheme, the minimum information concerning the DBMS, which should be provided by the vendor, would include the following sections:

System summary

This section should provide a general description of system requirements and capabilities. The information should be provided at a level of detail such that the evaluator can very quickly determine whether a given system satisfies the minimum requirements.

Current applications.--A list of general applications for which the system has proven useful should be given. The list need not be exhaustive, or imply that the system is limited to the particular applications cited.

Hardware/software requirements.--The Hardware/Software Requirements section provides a list of the computers on which the system has been implemented, the operating systems required, minimum main storage necessary, and auxiliary storage requirements. Any special hardware or software requirements, such as teleprocessing support, should also be indicated.

Capabilities.--Topics discussed in this section should be descriptive entries and provide the reader with a general idea of system strengths.

Mode of operation.--The system's operating environment is indicated: remote terminal, batch, remote batch, or time-sharing, and general system class and operations supported should also be indicated.

Data files.--Information should be given on the file structures supported by the system. The information provided would depend upon the class of system being described. For self-contained and host language data management systems, the information indicates the type of file structured during the creation. For

retrieval and report formatting systems, the type of file structure acceptable to the system should be given.

System output.--Descriptions should be given of the types of output provided by the system:

- User or system formatted reports. Simple reports requiring few computational steps, or complex reports with numerous computational steps to include sums, tallies, and averages.
- Selected subsets of master files. Subfiles selected from master files based upon user-defined logical selection criteria.
- Transaction journaling. Records kept of dates added to, changed, or deleted from the master file.

User interface.--This section should include a discussion of the manner in which system functions are invoked by the user. Indicated should be the general steps required of a user to perform the following:

- File creation and restructuring.
- File maintenance.
- Data retrieval.
- Report formulation.

This section should also discuss how a user communicates with the system, whether through punched cards, pre-printed control forms, or on-line interactive remote terminals.

System characteristics.--This section would provide a more detailed description of the system's operations than presented in the System Summary section.

File structure.--This section should provide an explanation of the physical and logical file structures supported by the system. The type of information

presented would depend on the class of system being described. For self-contained and host language data management systems, a description of the physical and logical files created by the system for storing the data and data indexes should be presented. For retrieval and report formatting systems, an explanation of the acceptable physical and logical file structures should be provided. The information is an expansion of the material contained in the Data Files section under System Capabilities.

File creation.--A description should be given of the steps a user must follow to create a file:

- Prepare the file definition.
- Prepare the input
- Generate the file

The manner in which the file is created should be discussed, as well as methods of file restructuring, and the user-environment (remote terminal, batch, remote-batch, time-sharing) supported during the file creation process.

The File Creation section will be present only for self-contained and host language data management system descriptions. Retrieval and report formatting systems process files created by other systems or programs, and do not support a file creation capability.

File maintenance

This section would describe the system functions available to the user to add, change, or delete data in the file and the manner (on-line or batch) in which these updates are performed.

Retrieval and output

The methods available to the user to retrieve data from the file and format reports should be given. Described in general terms are:

- The query language.
- The query formulation method (batch or interactive).
- The types of simple and compound logical selection criteria provided.
- The types of output supported.
- The report formulation method.
- Other system-unique features.

This section should provide the reader with a general idea of a system's ability to respond to his information and reporting needs.

External programming interfaces.--Many systems provide exit points where the user, to improve flexibility, can enter his own routines to perform processing not inherently supported by the system. The purpose of this section should be to provide the user with a general idea of the types of user-exits provided by the system.

Users of host language data management systems have all the capabilities of the host language at their disposal to perform processing not supported by the system, therefore this section would not be presented for host language data management systems.

Applications

For minor applications, programs should be developed according to the specific needs of the individual organization. For the major petroleum oriented applications a collection of computer programs should be assembled by purchasing or leasing some of the available packages. The technical programs available in such packages cover fields like: the calculation of subsurface safety valve sizing, core data processing, optimum casing design, calculation of reservoir and aquifer volumes by material balance, fluid analysis by correlation technique and simulation technique, multi-purpose flash,

recombination and plant recovery, flow string gradients in gas wells, grid-type reservoir analysis and simulated performance, general reserve estimating and appraising and tabulating, quantitative interpretation of electric logs, flow string gradients in oil wells, pressure analyses for reservoir definition.

Production and reserve information management and evaluation, pumping unit and rod string design, oil-gas and water PVT data, risk analysis for drilling prospects, stratified waterflood element performance, theoretical recovery analysis and productivity, decline and volume of gas in place.

Batch vs. interactive computing environment

Most of the modern systems can operate concurrent in batch or in interactive mode, and this is a necessary requirement for the activities described as phase II and phase III. The use of interactive timesharing to either process data directly or to submit a job as a batch session gives flexibility and will very soon make the use of punched cards and card readers superfluous.

Personnel

The need for personnel to run a computer center are a function of the type of hardware (mini machine/big machine) and the amount and complexity of the software which should be maintained and developed.

There is a need for manpower to support the following automatic processing functions:

ADP Management

ADP Technical support

Systems Analysis Programming

Computer Operations

Computer Aides and Technicians

Key-Punch Operators

In addition to these people who work closely in connection with the computer, there is a need for manpower to register and manage the incoming petroleum data.

Computer resource administration

The CCOP member countries are presently entering a period of growth both with respect to computer acquisition and with respect to computer applications to support a wide range of users, many of whom have specific computing requirements that are both hardware- and software-dependent. As a result, it is absolutely essential that all computer activities adequately reflect the diversity of needs within each country and provide not only for immediate computer support, but also anticipate and accommodate future computer requirements. There is serious doubt that the present system of a single management level committee, found in most organizations, is adequate to meet the above stated needs. A committee composed of only management level presents the following problems:

a) The user needs are not adequately reflected because of the composition of the committee.

b) Management should deal primarily with policy and funding problems and not with individual technical problems.

c) Systems needs and developments are generally foreseen first by the user who has the responsibility for a specific task.

d) Technical aspects of the hardware and software are usually more familiar to the user than to management.

Experience has shown in the majority of private and public organizations that the most efficient means of managing computer development and resources is to establish the following procedure.

First, designate an executive level committee which is responsible for establishing interdepartmental policy with respect to the computer resources, and evaluates and approves systems expansion or software acquisition and oversees computer applications.

Second, the establishment of a users committee, composed of representative users from each of the operating departments, which has the responsibility for:

a) Liason between departmental users with respect to computer hardware and software needs.

b) Providing recommendations to the executive committee with respect to hardware and software acquisitions, computer resource utilization, and problems related to present computing operations.

c) Prepares a quarterly, semi-annual or yearly report, whichever is deemed necessary, with specific recommendations for systems development of expansion to meet specific user needs.

d) Serves as a task force to the Executive Committee for analyses or specific studies required to support Executive Committee decisions.

Third, as deemed necessary and when the scope of the study is beyond the capability of the expertise of the user committee, the Executive Committee should establish specific task forces of interdepartmental specialists to

evaluate major hardware or software acquisitions on the impact of major programs on the existing system.

The primary benefits of the proposed system of an Executive Committee, a user committee ans task forces are:

a) Frees Management from dealing with problems other than policy, planning, and budget.

b) Provides user inputs which anticipate needs rather than having the Executive Committee in a "react mode" when the need suddenly appears.

c) Insures that all user needs are considered in the acquisition of hardware and software.

d) Provides the Executive Committee with an established accountable group to provide required inputs.

e) Insures communication on an interdepartmental level and between the Executive Committee and user level.

It should be stressed that representation from the computer center is essential to all of the proposed committees and task forces. It is also essential that the proposed system be initiated as soon as possible so that all inputs are considered during the initial phases of hardware and software acquisition. It is a long-established and sometimes painful fact that decisions with respect to hardware and software can only be influenced prior to acquisition. From then on you must make do with the system, as changes are too expensive.

Sequential development program

In order to reach the objectives CCOP member countries have been entrusted to achieve, in the regulation and/or operations of petroleum exploration, development, and production, it is necessary to utilize

the complete spectrum of data provided by contractors or national companies. In order to utilize the data effectively, it must be received in a logical form, the flow of data through the organization must be regulated, and the aggregation or use of the data should be facilitated by specialists in petroleum information and automatic data processing.

The development of the capacity to store, retrieve, and analyze petroleum data can only be accomplished by a sequential development program which provides for the basic information being made available for each phase of the program. The developmental sequence begins with the physical acquisition and archiving of the data, proceeds through data base, hardware and software development, and ends with the development of a truly integrated petroleum data system (see figure 3).

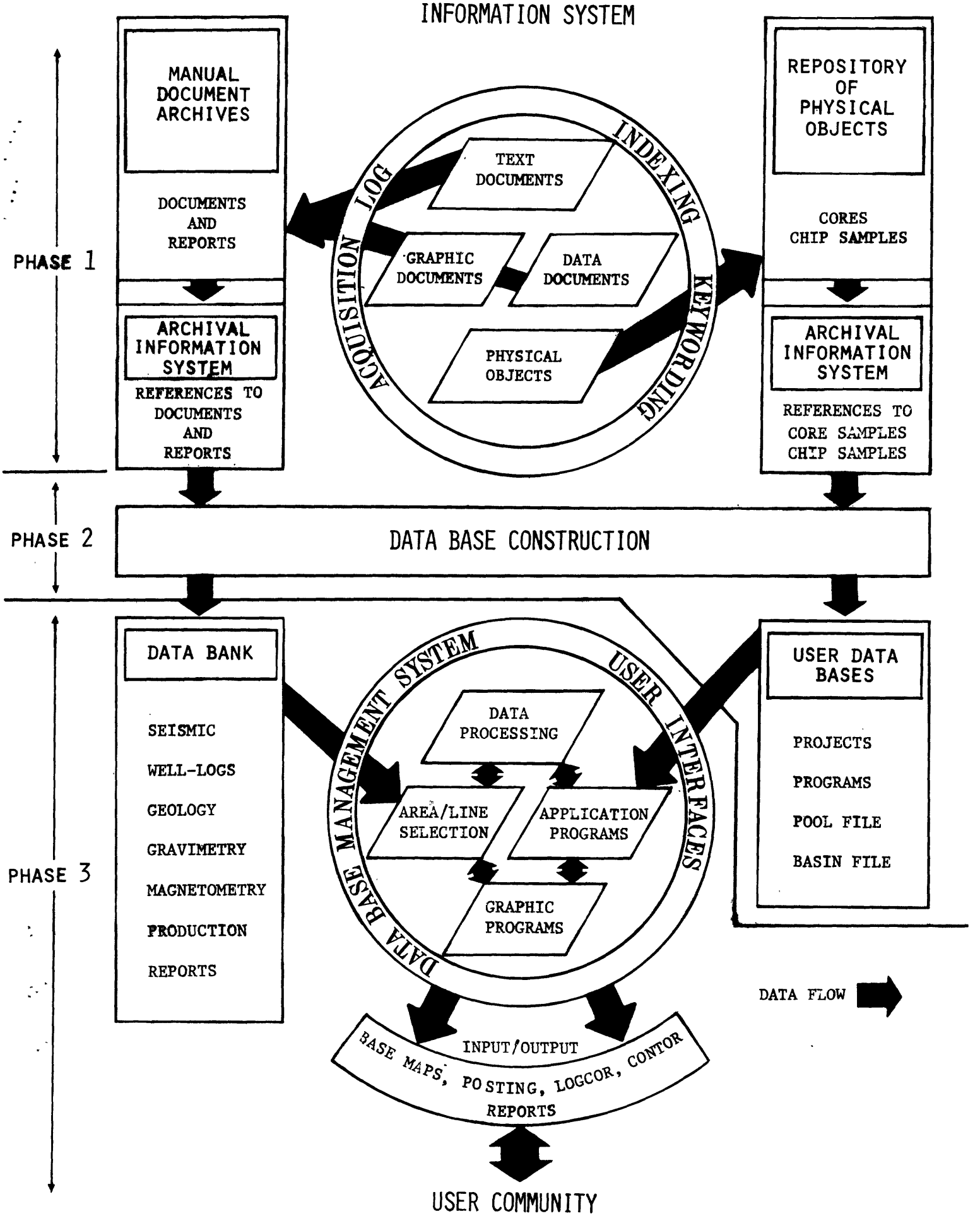
Each CCOP country is, of course, at a slightly different level of development within the sequence, and therefore has differing needs with respect to consultants, hardware, software, training, organization, and data. In order to accommodate these diverse needs, a broad range of activities should be undertaken, at the CCOP, national, and organizational level, the most significant of which are discussed in the following sections.

Program development

The elements of a program to resolve the Petroleum Data Storage and Retrieval problem for the CCOP countries are as follows:

1. Establish standing working group on Petroleum Data.
2. Surveys workshops/regional seminars.

Figure 3. PETROLEUM DATA STORAGE AND INFORMATION SYSTEM



3. Petroleum data literature.

4. Software development/distribution

5. Institutional development

6. Consultation

7. Software and hardware specification

WORKING GROUP ON PETROLEUM DATA

It is recalled that the Committee, at its 13th session, had endorsed the proposal of the Seminar on Data Collection, Storage and Retrieval, held in Bandung, Indonesia, in April 1976, that a Standing Working Group of Experts be organized to undertake, upon request of the member countries, the following phase of work:

1. Assist countries in assessing the existing status of their data collection, storage and retrieval activities, and in formulating their long-range national objectives and requirements in petroleum exploration and development data, including governmental data management and expanded uses of the data in future programs;
2. Develop uniform formats and terminology as guidelines for the governments' collection of exploration and production data and geological samples to ensure that complete data are reliably acquired;
3. Conduct training and pilot studies in computer applications to specify exploration and production problems;
4. Advise and assist the countries in feasibility studies, systems design, and implementation of the required systems which would

constitute their national petroleum data centers and sample repositories.

It was considered during that session that three or four international experts having extensive practical experience should be first selected and appointed as core members of the Standing Working Group to cover a range of specialized fields, including down-hole data systems (i.e. well data systems) geophysical data systems, reservoir and production/ data systems, and sample repositories. Because of the confidential nature of some of the national petroleum data acquired, it was felt that the core members of the Group should preferably be obtained from governmental agencies and academic institutions.

Surveys

A study mission should be undertaken for selected technical staff from the CCOP countries pursuing work on petroleum data collection, storage and retrieval, to visit governmental agencies and petroleum companies that have systems ranging from efficiently operating manual to sophisticated computer processing. They would themselves see how other people have solved problems similar to their own.

Workshops/regional seminars

Workshops or regional seminars of about one week duration should be arranged at which specific problems could be discussed and solutions proposed.

Petroleum data literature

Another important element of the program should be the distribution of literature on petroleum data storage and retrieval for the CCOP countries.

Software development/distribution

The software needs of the CCOP countries should either be accommodated by the distribution of available software packages or through development contracts benefiting one or more of the countries. A substantial reduction in development costs can be expected if several of the countries pool their efforts.

Institutional development

Contact between the petroleum organization in the CCOP countries and similar organizations in Europe or North America should be developed on a long-term basis. The European or North American organizations should provide opportunities for the staff of the CCOP petroleum organizations to come and learn about their special capabilities, and to develop the capacity of the CCOP countries to conduct the same type of work. Such organizational contact should also include consultation on such matters as general program direction for the petroleum data activities, e.g., building facilities and hardware procurement.

Consultation

The presence of a major data acquisition, storage, retrieval, and applications problem within the CCOP countries, especially those within the Asian Commission of Petroleum Exporters (ASCOPE) has been recognized for several years. Because of this recognized need, the current program was undertaken to specifically define many of the problems and to make appropriate recommendations for their resolution. However, the recognition of a problem and recommending a solution is rarely adequate to insure a satisfactory resolution. This has been and will continue to be

true unless the CCOP itself, or in conjunction with other groups within the CCOP community and the international community (such as COGEODATA), makes adequate provisions to provide high-level consultation, on a continuing basis to the interested oil and gas agencies. The need for continuity and expertise with respect to consultation cannot be stressed too strongly--it is absolutely critical to the success of the program!

Given the need for consultation assistance, in virtually all the CCOP countries, it is suggested that this need would be most effectively provided, given the requirements above, by the following consultation services.

Permanent full-time information specialists

The level of activity and scope of data management problems within the CCOP countries could best be met by the appointment of a permanent full-time staff information specialist. In general, the individual should have a background in the archiving of petroleum data and experience in the development of oil and gas data bases. Ideally, such an individual should also have a broad general knowledge in data processing. However, because of the tremendous range of hardware and software available, it is not feasible to assume that the individual could provide more than general information. Such an individual should be hired for a minimum of 1 year and preferably 2, and then the position reevaluated after the 2-year period.

It should be emphasised that this individual will be completely occupied with simple program oversight and consultation activities because of the magnitude of the task and should not be expected to actually work on the implementation of specific programs with the oil and gas agencies.

There is a need to secure the services of at least 3 additional consultants, probably for approximately 8-10 person months, to assist in the actual program implementation and training phases within individual oil and gas agencies. The recommended areas of expertise for these individuals are:

Physical data archiving.--An expert in the area of indexing, archiving, referencing, keywording, and archival information systems. This would include text, graphic and physical sample archiving. This individual should preferably be from industry or a major geological survey.

Data base construction.--An expert in the development and definition of oil- and gas-related data bases, who should have broad experience in file definition, data formats, data input procedures and equipment, data file structures, and data base management systems. Experience with the construction of data bases and work with large integrated systems is essential.

Hardware and software.--An expert in the definition of hardware and software specifications to meet multiple user needs is required. Emphasis should be placed on expertise in mini and microprocessors and peripheral equipment. Experience in systems design, contract writing, and bench-marking of systems is required. Preferably, this expert should come from a research-oriented environment where knowledge of hardware and software development is required.

The following tabulation shows the present areas of need for expert consultation within the CCOP countries visited and the CCOP office itself.

Software and hardware specifications

An important task is the procurement of software and hardware. Basic

training in how to write specifications for computer software and hardware contracts should be given. Owing to the tremendous development in computer science, it is recommended that, if possible, the latest hardware and software products available be used.

The area of consultation is one that must be addressed quickly and effectively and the above recommendations are regarded as minimal if the major tasks and problems areas are to be addressed.

CONCLUSIONS

The present study has shown that the CCOP countries can be divided into three major groups: those having a small amount of data and data management problems which can be addressed manually, those that have modest amounts of data which are expanding rapidly and require a combination of manual and machine procedures, and finally, those that have very large amounts of data which are expanding rapidly and whose data handling problems would be best addressed by machine processing. In all the countries there are data-handling problems and many countries are on the verge of major decisions and actions with respect to data storage, retrieval analysis; others are moving less rapidly, but are rapidly approaching the time when major decisions and actions are required.

Fortunately, the needs and approaches with respect to the storage, retrieval, and analysis are similar within oil and gas agencies worldwide and variations occur primarily in the areas of responsibility. As a result,

the activities of European and North American organizations are relevant and applicable to the problems within the oil and gas agencies of the CCOP countries. As a result, the experience of the COGEODATA consultants could be adapted for the individual agencies and appropriate recommendations made within the following major areas:

Physical archiving

The physical control and handling of petroleum data represents the single greatest problem in the majority of oil and gas agencies. To resolve this problem there is a need to consider the following activities:

(a) Develop and maintain an acquisition and catalogue system for data control.

(b) Develop and implement a data classification scheme which can be utilized by both the exploration, development, and production departments.

(c) Develop a keyword and thesaurus program, which might include an annotated bibliography, for retrieving data.

Geophysical data

The largest volume of data within all of the oil and gas agencies, with respect to a single data group, is geophysical data, and it is the sheer volume of data which poses the major problems. In particular, the following problems are common to most oil and gas agencies:

(a) Need to develop standards of format, size and type, to be followed by industry, for magnetic tapes.

(b) Physical storage presents a major problem because of the shear number of tapes to be stored.

(c) Standardized procedures should be adapted for duplicating and dissemination of archival geophysical data.

(d) Geophysical data files, developed for specific purposes and operated on main frame, mini and microcomputers, should have a coordinated development to insure compatibility.

Data processing

Data processing is a rapidly expanding activity within the majority of oil and gas agencies and its development poses numerous problems among which the most significant are:

1. Definition and selection of an appropriate Data Base Management System (DBMS).
2. Lack of coordination with respect to main frame, mini or micro computing activities and the resultant piecemeal systems development.
3. Dominance of batch computing in an environment which would be more efficiently supported by time-sharing.
4. Develop and implement a micro-filming program for development of a micro-film library.
5. Develop a data control and distribution procedure to monitor data.
6. Appoint a high-level data administrator, with sufficient staff, to oversee the data management activities of the organization.

Data files

Data file development is at present one of the major considerations of the majority of the oil and gas agencies. The development of such files is totally dependent on the availability of a good physical archive, but there is also a need to address the following areas:

1. Need to develop a clear statement with respect to (a) how many users are there for the file, (b) how often will the file be addressed, and (c) for what purpose will the file be used.
2. Comprehensive data formats and input procedures need to be developed for each data file to insure that separate and distinct files are compatable.
3. Need to develop a program of sequential development of data files to insure continued development, updating, and application.
4. Appointment of a data-base administrator, at a high level organizationally, to oversee and coordinate the data file and computer support development.
5. Lack of skilled computer personnel, working in coordination with geologists and geophysists, to develop overall programs and systems.

ADP Administration

The present distribution of computer resources, the development of computer files and applications, and the acquisition procedures for hardware and software are all major areas effected by ADP administration; and all are major problem areas in most organizations. The major problems with the present procedures are that:

1. The users needs are not adequately reflected because of the composition of the administrative committees.
2. Systems needs for upgrading, or additional application packages, are not forseen by present administration and action is often taken after the fact.

3. Present committees are normally not familiar with hardware and software developments and trends and have inadequate procedures for advice.

4. Liason between the user and the computer centers is normally poor, with no clear channels for access.

The vast majority of the above problems have come about primarily through the Ad Hoc development of individual aspects of data handling, storage, retrieval, and application programs. There are numerous reasons why development has proceeded to produce the present problems, but perhaps the most significant have been the lack of understanding of the sequential development of data management and application within an organization, and the lack of a clearly defined and responsible information and data base coordination. A clear definition of the sequential development of data administration and application needs, from physical archiving, to data files, to DBM systems to a final integrated system, must be made a primary objective of the organization and given both the budget and personnel to insure its successful completion.

The impact of the recommendations upon the activities of the oil and gas agencies will in large part be dependent on the internal circumstances of the individual countries and agencies. In particular it is hoped that the recommendation will effectively encourage top management in the oil and gas agencies to place more emphasis on data storage, retrieval and applications. At present the majority of programs suffer most because of the lack of a clear mandate for action and there seems to be a general lack of top management awareness of the required infrastructure to insure that petroleum

data are archived, retrieved and used in a efficient way.

There is also a clear need to make available to the individual countries and oil and gas agencies the services of consultants who have experience in the areas of archiving, data files and hardware and software systems. A common problem within all the countries is that there simply is not an adequate number of personnel who are trained in the above areas of activity. Without the services of experts in these fields to provide training and to actively work at the program level, it is doubtful if any overall program on the storage, retrieval, and application of oil and gas data can be effectively implemented and developed.

It should be stressed that there are very few short cuts, either by hardware or software, to the development of adequate storage, retrieval, and application programs. As a result, there must be a sequential development of the capability desired that begins with physical archiving and only through time and development will truly integrated multi-purpose systems be developed.

REFERENCES

Lea, G., 1978, GeoArchive: Geosystems indexing policy: Proc. Geoscience Information Society, v. 8, p. 43-56.

Lea, G., and others, 1978, Computerized indexing of the Institute of Geological Sciences (UK) Geological Map Collection: Special Libraries Association, Geography and Map Division, Bull. no. 112, p. 27-46.

Longe, R. V., and others, 1978, Computer-based files on mineral deposits: Guidelines and recommended standards for data content: Geol. Survey of Canada Paper 78-26, Energy, Mines, and Resources, p. 7.

APPENDIX 1. Data collection format.

EVALUATION OF NATIONAL NEEDS (CCOP COUNTRIES)

for

PETROLEUM DATA STORAGE AND RETRIEVAL

I. NATIONAL REGULATIONS CONCERNING PETROLEUM DATA

A. CCOP or Other International Recommendations

B. Norwegian Recommendations

C. National Regulations (Petroleum Act. etc.)

D. Present Method of Acquiring Data

1. Personal basis

2. Legal basis

3. Cooperative (Joint Working Arrangement)

4. Need to know (special requests)

E. Responsible Agency

1. Geology

2. Exploration

3. Production

4. Leasing

II. NATIONAL COLLECTION PROCEDURES

A. Data Types

1. Exploration

a. well logs

i. how acquired

ii. in what form is data transferred

iii. frequency of acquisitions

iv. data volume (no. of logs) logs

v. release procedures

time requirements

to whom

b. Geologic information

i. how acquired

ii. what form

iii. timing of acquisitions

iv. data volume

v. relaese procedures

time requirements

to whom

II. NATIONAL COLLECTION PROCEDURES (con't)

A. Data Types (con't)

1. Exploration (con't)

c. Gravity - Magnetic data

i. how acquired

ii. what form

iii. timing of acquisitions

iv. data volume

v. release procedures

time requirements

to whom

d. Maps

i. how acquired

ii. what form

iii. timing of acquisitions

iv. data volume

v. release procedures

time requirements

to whom

II. NATIONAL COLLECTION PROCEDURES (con't)

A. Data Types (con't)

2. Production data

a. Well data

i. how acquired

ii. what form

iii. timing of acquisitions

iv. data volume

v. release procedures

time requirements

to whom

b. Production data

i. how acquired

ii. what form

iii. timing of acquisitions

iv. data volume

v. release procedures

time requirements

to whom

II. NATIONAL COLLECTION PROCEDURES (con't)

A. Data Types

3. Documents and Reports

i. how acquired

ii. what form

iii. timing of acquisitions

iv. data volume

v. release procedures

time requirements

to whom

4. Physical Data

i. drill cores

a. how many, etc.

b. what form stored

c. how controlled

ii. rock chips

a. how many, etc.

b. what form stored

c. how controlled

II. NATIONAL COLLECTION PROCEDURES (con't)

A. Data Types

5. Maps (General)

i. how acquired

ii. what form

iii. timing of acquisitions

iv. data volume

v. release procedures

time requirements

to whom

6. Analytical Data

i. who performs analyses

ii. does it come back in a standard form

iii. data volume

iv. release procedures

to whom

II. NATIONAL COLLECTION PROCEDURES (con't)

A. Data Types

7. Tract and Leasing area Data

i. how acquired

ii. what form

iii. timing of acquisitions

iv. data volume

v. release procedures

8. Inventory Data (Compiled to date)

What have they inventoried to date

II. NATIONAL COLLECTION PROCEDURES (con't)

B. National Handling and Storage of Data

1. Data Centers

a. central (Location, contact)

b. Local (Locations, contacts)

2. Acquisition Procedures

a. Acquisition Logs

b. Indexing

c. Keywords

3. Physical Archiving

a. cross referencing

b. card/computer files

c. duplication

d. microfilming

4. Distribution procedures and control

a. to whom

b. how

c. security

II. NATIONAL COLLECTION PROCEDURES (con't)

C. Data Retrieval

1. Retrieval practices

a. retrieval questions

b. retrieval uses

c. retrieval volume

2. Adequacy of System

a. card files

i. problem areas

ii. Present/Future

b. Computer files

i. Problem areas

ii. Present/Future

II. NATIONAL COLLECTION PROCEDURES (con't)

D. System Configuration

1. Manual

2. Machine

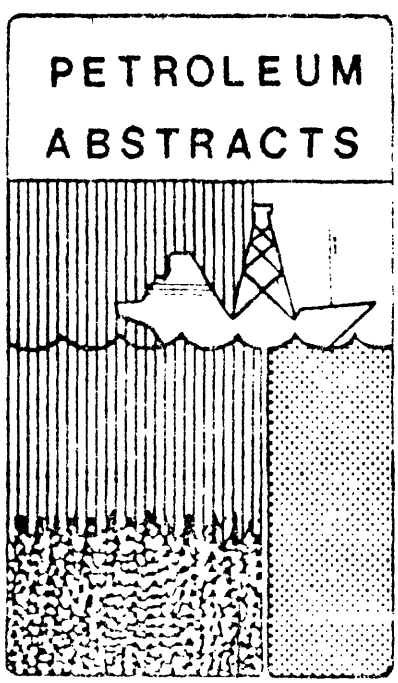
PETROLEUM ABSTRACTS INFORMATION SYSTEM

by

Roy W. Graves (Exploration Editor, Information Services Division, The University of Tulsa)

and

John A. Bailey (Director, Information Services Division, The University of Tulsa)



(Presented at the Geoscience Information Society Symposium on Geoscience Information, Denver, Colorado, November 8, 1976)

PETROLEUM ABSTRACTS INFORMATION SYSTEM

PETROLEUM ABSTRACTS INFORMATION SYSTEM

Now in its sixteenth year, The University of Tulsa's Petroleum Abstracts Information System for petroleum exploration, development, and production has increased its information retrieval capability. Presently in use for in-house information retrieval is the recently developed Petroleum Abstracts Search System (PASS). Through an arrangement with System Development Corporation, the Petroleum Abstracts information base now can be accessed internationally through the SDC ORBIT III search system. The Petroleum Abstracts Information System is based on the weekly abstract bulletin Petroleum Abstracts, which covers a selected range of worldwide scientific and technical serial literature. Printed bi-monthly and annual cumulative Alphabetic Subject Indexes are distributed to subscribers to the services. Dual Dictionary Coordinate Indexes have been changed from printed to microfilm format and are issued every six months. Back issues of Petroleum Abstracts also are available on microfilm. Master Record Tapes, for computer retrieval of information derived from articles used in preparing Petroleum Abstracts, are issued every four months. The Exploration and Production Thesaurus is being revised and expanded in its forthcoming Fifth Edition. A Geographic Thesaurus of area terms used in indexing in the System will be updated in a Third Edition. The Petroleum Abstracts Information System can be expanded into other segments of energy development.

INTRODUCTION

The Petroleum Abstracts Information System, initiated in January, 1961, is operated by the Information Services Division of The University of Tulsa and is funded primarily by the Petroleum Industry through subscriptions to the services. Presently, 40 major subscribers (petroleum companies and petroleum service companies) and 137 minor subscribers (government agencies, institutions, universities) support the work of the Division. Approximately 700 serial publications provide the base from which this information system operates. Articles from journals, state and national periodicals, published symposia, patent disclosures, etc., are selected for inclusion in the System on the basis of pertinence to the oil and gas exploration, production, and development activities of the Petroleum Industry.

Selections of articles for inclusion in Petroleum Abstracts and indexing of information contained in those articles is done by experienced scientists and engineers. Most of the work is performed within the Division. Some, however, particularly for many articles in languages other than English, is performed on a contract basis.

SYSTEM COMPONENTS

The Petroleum Abstracts Information System has two basic parts: (1) Petroleum Abstracts, a weekly current awareness bulletin; and (2) Information Re-

trieval materials and services that include printed indexes and magnetic tape stored information files. Complete activities of the Information Services Division are concerned with the daily production and maintenance of the System.

Petroleum Abstracts

Each page-plate for the weekly bulletin is prepared "in-house" for direct offset reproduction by a contract printer who also produced the covers and mails designated numbers of final copies of Petroleum Abstracts to Subscribers, in this country and abroad. Page format for the bulletin has been changed from its original four abstracts per page to the present column format (Figure 1). Abstracts average about 150 words and are controlled for readability and for presentation of maximum information. Back issues of Petroleum Abstracts bulletins now are available on microfilm.

Abstracts appear in the bulletin divided into the major categories of information provided by the Service:

GEOLOGY
GEOCHEMISTRY
GEOPHYSICS
DRILLING
WELL LOGGING
WELL COMPLETION & SERVICING
PRODUCTION OF OIL AND GAS
RESERVOIR ENGINEERING & RECOVERY METHODS
PIPELINING, SHIPPING & STORAGE
ECOLOGY & POLLUTION
ALTERNATE FUELS & ENERGY SOURCES
SUPPLEMENTAL TECHNOLOGY

Petroleum Abstracts bulletins contain 200 to 300 abstracts each week. Through mid-year 1976, more than 200,000 abstracts have been published.

Information Retrieval

Information contained in the articles for which abstracts are published in Petroleum Abstracts is indexed manually from the Exploration and Production (E & P Thesaurus, the Geographic Thesaurus, and from the list of Supplementary Descriptors. This process produces from 10 to more than 100 descriptors for each article, depending on the amount of information contained therein. The manual indexing furnishes the basic input for production of all the information retrieval materials and services. A computer program provides autoposting of descriptors from the hierarchies of the E & P Thesaurus. Thus, only the most specific term for any concept is posted manually. All broader terms are added automatically to the indexing.

Exploration and Production Thesaurus

The Exploration and Production (E & P) Thesaurus was prepared as a cooperative effort between the Information Services Division and the major Subscribers.

FORAMINIFERA 218,400
RECENT LITERATURE ON THE FORAMINIFERA-- R. Todd; J. FORAMINIFERAL RES. v. 6, No. 1, pp 78-85, Jan. 1976

This bibiography is the latest in a series by the same author. Some annotations are given for the articles which are recent publications concerning foraminifera. (90 refs.)

GLAUCONITE 218,401
FURTHER INFORMATION RELATED TO THE ORIGIN OF GLAUCONITE-- B. Velde and G. S. Odin (Paris Univ); CLAYS CLAY MINERALS v. 23, No. 5, pp 376-381, Nov. 1975

Glauconite-smectite and illite-smectite interlayered minerals are compared by various means in an attempt to establish the mineralogical relations between the 2 groups. Experiments at 2 Kb pressure and 200° to 350°C are reported as well as microprobe scans of pelletal glauconites. This new information is used along with published chemical data in order to establish the following: (1) Illite and glauconite mixed layered phases appear to be crystallographically similar. Both series show the same relations between potassium (mica) content and the amount of smectite layers apparent in the interlayered structure. (2) Illite and glauconite mica or mica-like phases can be separated on the basis of Fe and K contents. (3) Probable phase relations of the 2 mixed layered mineral series indicate that, when the starting materials contain mixed layered mica-smectites, increasing temperature produces an iron-rich mica in the case of glauconite and an aluminous mica in the case of illite. The mixed layered phases present at intermediate temperatures are not the same for illites and glauconites. (26 refs.)

GREAT BASIN 218,402
STRATIGRAPHY OF THE ORDOVICIAN ELY SPRINGS DOLOMITE IN THE SOUTHEASTERN GREAT BASIN, UTAH AND NEVADA-- T. L. Chamberlin; Illinois Univ., Urbana-Champaign, Ph. D. Thesis, 209 pp, 1975; Abstr. No. 76-6717, DISS. ABSTR. INT., SECT. B v. 36, No. 9, p 4347-B, March 1976

The Ely Springs Dolomite of S. and E. Nevada and SW. Utah includes 13 informally defined members. These members are recognized on the basis of their chert content, color, detrital constituents, presence of algal balls, bedding properties, crystallinity, and weathering character. The formation is composed of 10 lithotopes. Depositional environments inferred from these lithotopes range from those of low to intermediate energy levels at depths of about 100 ft, as represented by the bioclastic dolomite, to shallow, low-energy environments represented by dolomicrite and shallow, high energy environments represented by lithoclastic dolomite and arenaceous dolomite. Offshore shoals are represented by oolitic dolomite and algal ball dolorudite. The Ely Springs Dolomite of the study area is almost entirely of Late Ordovician age. (Longer abstract available) (Abstract only- original article not available from T.U.)

GREENLAND 218,403
UPPER JURASSIC COAL-BEARING SHORELINE DEPOSITS, HOCHSTETTER FORLAND, EAST GREENLAND-- L. B. Clemmensen and F. Surlyk; SEDIMENT. GEOL. v. 15, No. 3, pp 193-211, Apr

Upper Jurassic coal-bear
at several localities on Hochs
Greenland. The sandstones h
sedimentary facies, each faci
assemblage of sedimentary st
and, occasionally by the cont
The interpretations of the est
high subtidal oyster banks ov
lagoonal and coastal swamp d
facies occur in a vertical sequence where 2 slightly different facies associations could be discerned. It is suggested that both facies associations have been deposited in a barrier-lagoon coastal area characterized by minor shoreline oscillations. The paleogeographic setting of the investigated sequence in the fault-controlled basins along the E. Greenland continental margin is discussed. (27 refs.)

HYDRODYNAMICS (GEOLOGY) 218,404
COMPARSION OF THE HYDRODYNAMICS OF STEEP AND SHALLOW BEACHES-- D. A. Huntley and A. J. Bowen (Dalhousie Univ); NEARSHORE SEDIMENT DYNAMICS AND SEDIMENTATION [Book: ISB 0 471 33946 6] John Wiley & Sons, New York; pp 69-109, 1975

This study describes times series for the 2 horizontal components of water velocity, measured at different distances from the shoreline on the 2 beaches, and discusses the probability distributions of the velocities, the mean current patterns close to the shore, and the frequency dependence of the wave energy. The hydrodynamics of the steep and shallow beaches differ widely. In particular, periodic longshore variations of the nearshore velocity field were observed on the steep beach, but not on the shallow beach. On the steep beach, edge waves with a period twice that of the incident waves and with a longshore wavelength of 32 m were observed and it is suggested that swash interaction in the narrow surf zone was responsible for generating these waves. The mean flow field on other occasions also revealed the existence of nearshore circulation cells on the steep beach. (58 refs.)

ILLINOIS 218,405
MICROFACIES AND GEOCHEMISTRY OF THE BRERETON LIMESTONE (MIDDLE PENNSYLVANIAN) OF SOUTHWESTERN ILLINOIS-- M. R. Khawlie; Illinois Univ., Urbana-Champaign, Ph. D. Thesis, 110 pp, 1975; Abstr. No. 76-6819, DISS. ABSTR. INT., SECT. B v. 36, No. 9, p 4351-B, March 1976

The Brereton Limestone in SW. Illinois is a transgressive carbonate unit over a delta system. It represents marine deposition in 3 interdeltaic troughs, and over an open shelf. The environment of deposition, entirely under relatively low energy conditions, consists of a general infratidal slope extending from a prodelta edge to a shelf and showing topographic irregularities such as depressions, corresponding to protected areas, and elevations represented by organic mounds and banks, and bioclastic bars. Detailed petrographic analysis reveals 13 distinct microfacies divided in 3 series, characterized by the following benthonic associations: phylloid algae-bryozoans, crinoids-brachiopods-pelecypods, and fusulinids-arenaceous forminifers. The Brereton Limestone is a variety of the bank model of deposition typical of the Pennsylvanian of the Mid-Continent. (Longer abstract available) (Abstract only- original article not available from T.U.)

INDONESIA 218,406
SUBDUCTION IN THE INDONESIAN REGION-- W. Hamilton (US Geological Survey); PROC. SOUTH EAST ASIA PETROL. EXPLOR. SOC. v. 2, pp 37-40, Oct. 1975

The Indonesian region has developed as the result of the Cretaceous and Cenozoic convergence of 3 great lithosphere plate systems. Plates from the Indian Ocean region have been moving northward, and from the Pacific region

Plate boundaries have
subduction zones, spreading
have broken through, evolved
scores of millions of years,
subject to much internal
een huge plates which have
fashion. No boundaries
tion: all have changed
migrated relative to one

Figure 1.

Example of page format from Petroleum Abstracts

The presently available Fifth Edition is the product of extensive revision and updating. A typical page from the E & P Thesaurus is shown in Figure 2.

Geographic Thesaurus

Terms (descriptors) included in the Geographic Thesaurus are limited to sedimentary basins, geographic features, and selected geographic areas. In addition to the sedimentary basins, troughs, and embayments, this Thesaurus lists named areas (e.g. BIG BEND AREA) as well as named geographic features such as mountains and ranges, deserts, rivers, beaches, canyons, valleys, lakes, hills, national parks, deltas, islands, divisions of states (e.g., WEST TEXAS), oceans, seas, bays, gulfs, continents, countries, states, coasts, straits, ridges, lagoons, plains, peninsulas, submarine fans, and other comparable entries. Names of formations, groups, and series are omitted, as are oil fields, counties, and named geologic structures such as anticlines and faults. The geographic descriptors listed are those assigned by the indexers; ultimate authority for location is the original article from which the term was derived. A revised and expanded Third Edition of the Geographic Thesaurus will be available early in 1977. The Geographic Thesaurus is patterned after the E & P Thesaurus. Figure 3 illustrates type of entries.

Supplementary Descriptors

The addition to the descriptors contained in the E & P Thesaurus and the Geographic Thesaurus, some specific terms such as chemicals, company names, geographic and geologic named features (excluded from the Geographic Thesaurus), and E & P Thesaurus-type descriptors (seldom used terms - added as needed) are contained in a list of Supplementary Descriptors. As with all descriptors in the System, these are used for both indexing and retrieval. An example from the list is shown in Figure 4.

Key Word Out of Context Descriptor List

The Key Word Out of Context (KWOC) Descriptor List is an aid in expediting searching and indexing. It is a list of descriptors from the E & P Thesaurus and from the seldom used term list (of the Supplementary Descriptors List) organized in KWOC format so that descriptors related to a particular subject (or concept) are listed together. As an example, all of the descriptors in the system (excluding those in the list of Company names) that contain the word EXPLORATION appear in one place. Terms from the seldom used list are indicated by an asterisk. Some descriptors contain words in parentheses. In the KWOC listings these parentheses are not shown in the alphabetical listing column. Abbreviated words in a descriptor are listed in the alphabetical listing column in their full spelling. Connecting words such as AND, IN, OF are eliminated. A sample from a KWOC Descriptor List is shown in Figure 5.

Alphabetic Subject Index

The Alphabetic Subject Index (ASI) is a manual search index designed for rapid location of major articles and patents on a given subject, for review of

E & P THESAURUS

AADOC SPECIFICATION
** *ADDED JANUARY 1965.*
BT (76---) SPECIFICATION
BT SPECIFICATION

ABANDONMENT
UF ABANDONMENT PLUGGING
WTH WELL PLUGGING
UF WELL ABANDONMENT
SA DEPLETED RESERVOIR
SA DRY HOLE
SA LAND RECLAMATION
SA MARGINAL WELL
SA RESERVE ESTIMATE
SA SALVAGE VALUE
SA SALVAGING
SA WATERED OUT
SA WELL KILLING

ABANDONMENT PLUGGING
USE ABANDONMENT
PLS WELL PLUGGING

ABC TRANSACTION
BT LAND AND LEASING
ECONOMIC FACTOR
SA ACQUISITION
SA ACREAGE
SA CAPITAL ASSET
SA CONTRACT
SA INVESTMENT
SA LEASE
SA LEGAL CONSIDERATION
SA OWNERSHIP
SA PROPERTY (REAL)

ABIOGENESIS
** *PERTAINS TO NONBIOLOGIC ORIGIN OF PETROLEUM, ORGANIC COMPOUNDS, OR LIFE.*
ADDED APRIL 1966.
USED (65) INORGANIC PLUS OIL AND GAS ORIGIN.
BT (67---) ORIGIN
BT ORIGIN
SA OIL AND GAS ORIGIN

ABNORMAL PRESSURE RESERV
* *ABNORMAL PRESSURE RESERVOIR*
USE OVERPRESSURED RESERVOIR

ABOVEGROUND STOR FACILITY
* *ABOVEGROUND STORAGE FACILITY*
** *ADDED JANUARY 1967.*
USED (65-66) STORAGE FACILITY(IES) PLUS SURFACE.
UF STORAGE ABOVEGROUND
BT STORAGE FACILITY
SA SPHERICAL TANK
SA STORAGE PIT
SA SURFACE
SA UNDERGROUND STOR FACILITY

ABOVEWATER STOR FACILITY
* *ABOVEWATER STORAGE FACILITY*
** *ADDED JANUARY 1976.*
USED (65-75) STORAGE FACILITY(IES).
UF STORAGE ABOVEWATER
BT OFFSHORE STORAGE
OFFSHORE STRUCTURE
SA OFFSHORE TERMINAL
SA STORAGE FACILITY
SA UNDERWATER STOR FACILITY

ABRASION
USE WEAR

ABRASION (GEOLOGY)
UF GEOLOGIC ABRASION
BT EROSION (GEOLOGY)
SA FRAGMENTATION (GEOLOGY)
SA SUBMARINE EROSION
SA WEAR

ABRASIVE
** *ADDED FEBRUARY 1965.*
SA ABRASIVE JET
SA EROSION
SA FRICTION
SA SURFACE PREPARATION
SA WEAR RESISTANCE

ABRASIVE JET
UF ABRASIVE JET PERFORATING
WTH JET PERFORATING
UF SAND JET
BT JET NOZZLE
NOZZLE
SA ABRASIVE
SA HYDRAULIC PERFORATING
SA JET DRILLING
SA JET PERFORATING
SA SANDBLASTING
SA SHOT PEENING

ABRASIVE JET DRILLING
USE JET DRILLING

ABRASIVE JET PERFORATING
** *USED (65-66) ABRASIVE JET PLUS PERFORATING.*
USE ABRASIVE JET
PLS JET PERFORATING

ABSOLUTE AGE
USE RADIOACTIVE AGE DETERMINAT

ABSOLUTE GEOCHRONOLOGY
USE RADIOACTIVE AGE DETERMINAT

ABSOLUTE OIL RECOVERY
USE OIL RECOVERY

ABSOLUTE OPEN FLOW TEST
USE OPEN FLOW TEST

ABSOLUTE PERMEABILITY
USE PERMEABILITY (ROCK)

ABSOLUTE POROSITY
USE POROSITY (ROCK)

ABSOLUTE RECOVERY
USE OIL RECOVERY

ABSORBENT
NT ABSORPTION OIL
BT SORBENT
SA ABSORPTION
SA ABSORPTION PROCESS
SA GAS ABSORPTION
SA NATURAL GASOLINE PLANT
SA REGENERATION

ABSORBER
** *NT (76---) STRIPPER*
UF ABSORBER SYSTEM

ABSORBER SYSTEM
USE ABSORBER

ABSORPTION
** *PHENOMENON, NOT PROCESS.*
NT (76---) GAS ABSORPTION
NT (67---) IMBIBITION
NT (76---) WAVE ABSORPTION
NT GAS ABSORPTION
NT IMBIBITION
NT WAVE ABSORPTION
BT SORPTION
SA ABSORBENT
SA ABSORBER
SA ABSORPTION PROCESS
SA ABSORPTION SPECTROSCOPY
SA ADSORPTION

ABSORPTION COLUMN
USE ABSORBER

ABSORPTION GASOLINE
USE NATURAL GASOLINE

ABSORPTION OIL
BT ABSORBENT
SORBENT
SA ABSORPTION PROCESS

ABSORPTION PLANT
** *USED (65-66) GASOLINE PLANT(S)*
USE NATURAL GASOLINE PLANT

ABSORPTION PROCESS
** *NT (68-75) GAMMA RAY ABSORPTION*
NT (68-75) INFRARED ABSORPTION
NT LEAN OIL ABSORPTION
BT SORPTION PROCESS
PHYSICAL SEPARATION
SA ABSORBENT
SA ABSORBER
SA ABSORPTION
SA ABSORPTION OIL
SA GAS ABSORPTION

ABSORPTION SPECTROSCOPY
NT ATOMIC ABSORPTION SPECTROS
NT INFRARED SPECTROSCOPY
NT ULTRAVIOLET SPECTROSCOPY
BT SPECTRAL ANALYSIS
ANALYTICAL METHOD
TESTING
SA ABSORPTION
SA EMISSION SPECTROSCOPY
SA INFRARED ABSORPTION
SA WAVE ABSORPTION

ABSTRACT
UF SUMMARY
SA INFORMATION RETRIEVAL SYST

ABUNDANCE
** *ADDED JANUARY 1965.*
SA AVAILABILITY
SA DISTRIBUTION
SA SHORTAGE
SA SURPLUS

ABYSSAL DEPOSIT

ABYSSAL DEPOSIT (Cont'd)
UF DEEP SEA DEPOSIT
BT MARINE DEPOSIT
DEPOSIT (GEOLOGY)
SA SEDIMENT (GEOLOGY)
SA SEDIMENTARY ROCK

ABYSSAL ENVIRONMENT
** *FOR LAKES, INDEX LAKE PLUS DEEP WATER.*
(70-75) INDEX ALSO AS DEPOSITIONAL ENVIRONMENT, IF APPLICABLE.
BT (65-66) DEPOSITIONAL ENVIRONMENT(S)
BT (67-75) ENVIRONMENT
BT MARINE ENVIRONMENT
DEPOSITIONAL ENVIRONMENT
ENVIRONMENT
SA APHOTIC ZONE
SA BATHYAL ENVIRONMENT
SA COMPENSATION DEPTH
SA DEEP SEA
SA DEEP WATER
SA NERITIC ENVIRONMENT
SA QUIET WATER ENVIRONMENT
SA SHALLOW WATER ENVIRONMENT

ABYSSAL HILL
** *ADDED SEPTEMBER 1970.*
USED (65-70) SUBMARINE TOPOGRAPHY.
BT (76---) SUBMARINE TOPOGRAPHY
BT SUBMARINE TOPOGRAPHY
UNDERWATER TOPOGRAPHY
TOPOGRAPHY
SA ABYSSAL PLAIN
SA SEAMOUNT

ABYSSAL PLAIN
** *BT (65-66) SUBMARINE TOPOGRAPHY*
BT (67-75) PLAIN
BT SUBMARINE TOPOGRAPHY
UNDERWATER TOPOGRAPHY
TOPOGRAPHY
SA ABYSSAL HILL
SA OCEAN BASIN
SA PLAIN

ABYSSAL SAMPLE
USE ABYSSAL DEPOSIT

ACADEMIC
** *ADDED MARCH 1967.*
USED (65-66) TRAINING PROGRAM(S).
NT (76---) EDUCATION
UF UNIVERSITY
NT EDUCATION
SA THESIS

ACADIAN OROGENY
** *BT (65-66) OROGENY*
BT OROGENIC PERIOD
OROGENY
TECTONICS
SA ANTLER OROGENY

ACCELERATING AGENT
** *USED (65-66) CATALYST(S) OR CEMENT ACCELERATOR(S).*
USE CATALYST

ACCELERATION
** *BT (65-66) VELOCITY*
SA ACCELERATOR

Figure 2.

Page from the 5th Edition of the Exploration and Production (E & P) Thesaurus.

FEZ AREA
  BT MOROCCO
     AFRICA

FEZZAN
  BT LIBYA
     AFRICA

FIJI
  ST FIJI ISLANDS
     OCEANIA

FIJI ISLANDS
  ** EAST OF NEW HEBRIDES
  NT FIJI
  NT VITI LEVU ISLAND
  BT OCEANIA
  SA SOUTH FIJI BASIN

FIJI PLATEAU
  ** EAST OF CORAL SEA BASIN
  BT PACIFIC OCEAN
     SEAS AND OCEANS

FILCHNER ICE SHELF
  ST ANTARCTICA

FILLMORE QUADRANGLE
  BT CALIFORNIA
     UNITED STATES
     NORTH AMERICA

FINDLAY ARCH
  ** VALID DESCRIPTOR PRIOR TO
     JANUARY 1973
  USE FINDLAY ARCH AREA

FINDLAY ARCH AREA
  UF FINDLAY ARCH
  BT OHIO
     UNITED STATES
     NORTH AMERICA

FINISTERE AREA
  BT FRANCE
     EUROPE

FINLAND
  NT LAKE OULUJARVI
  BT EUROPE
  SA BALTIC REGION
  SA BALTIC SHIELD
  SA FENNOSCANDIAN SHIELD

FINLAY MT
  BT TEXAS
     UNITED STATES
     NORTH AMERICA

FIORDLAND
  BT NEW ZEALAND
     OCEANIA

FIRE ISLAND
  ** SOUTH OF LONG ISLAND
  BT NEW YORK
     UNITED STATES
     NORTH AMERICA
  SA ATLANTIC OCEAN

FISH CREEK RANGE
  BT IDAHO
     UNITED STATES
     NORTH AMERICA

FISH SPRINGS RANGE
  BT UTAH
     UNITED STATES
     NORTH AMERICA

FITZROY BASIN
  BT WALES
     UNITED KINGDOM
     EUROPE

FIVE ISLANDS ALIGNMENT
  BT LOUISIANA
     UNITED STATES
     NORTH AMERICA

FLACK LAKE AREA
  BT ONTARIO
     CANADA
     NORTH AMERICA

FLAMENGO EMBAYMENT
  BT BRAZIL
     SOUTH AMERICA

FLAMING GORGE AREA
  ** INDEX STATE NAME AS APPLIC.
  BT UNITED STATES
     NORTH AMERICA
  SA COLORADO
  SA UTAH
  SA WYOMING

FLAMING GORGE RESERVOIR
  BT UTAH
     UNITED STATES
     NORTH AMERICA

FLANDERS AREA
  BT FRANCE
     EUROPE

FLANDERS BASIN
  BT BELGIUM
     EUROPE

FLAT POINT AREA
  BT NEW ZEALAND
     OCEANIA

FLAT RIVER AREA
  ** INDEX PROVINCE NAME AS APPLIC.
  BT CANADA
     NORTH AMERICA
  SA NORTHWEST TERRITORIES
  SA YUKON

FLAT TOPS AREA
  BT COLORADO
     UNITED STATES
     NORTH AMERICA

FLATHEAD CROWSNEST PASS AR
  * FLATHEAD CROWSNEST PASS AREA
  ** INDEX STATE AND/OR PROVINCE
     NAME AS APPLICABLE
  BT NORTH AMERICA
  SA BRITISH COLUMBIA
  SA MONTANA

FLATHEAD LAKE
  BT MONTANA
     UNITED STATES
     NORTH AMERICA

FLATHEAD MAP AREA
  ** INDEX PROVINCE NAME AS APPLIC.
  BT CANADA
     NORTH AMERICA
  SA ALBERTA
  SA BRITISH COLUMBIA

FLATHEAD VALLEY
  BT ATLANTIC OCEAN
     SEAS AND OCEANS

FLEMISH CAP BANK
  ** VALID DESCRIPTOR PRIOR TO
     JANUARY 1973
  USE FLEMISH CAP AREA

FLINDERS RANGES
  BT SOUTH AUSTRALIA
     AUSTRALIA
     OCEANIA
  SA ARROWIE BASIN

FLINT HILL QUADRANGLE
  BT SOUTH DAKOTA
     UNITED STATES
     NORTH AMERICA

FLORIDA
  UF FLORIDA PENINSULA
  UF FLORIDA PANHANDLE
  WITH PANHANDLE AREA
  UF FLORIDA SHELF
  WITH ATLANTIC OCEAN
  NT ALLIGATOR HARBOR AREA
  NT APALACHEE BAY
  NT APALACHICOLA BAY
  NT APALACHICOLA DELTA
  NT BELLE GLADE AREA
  NT BIG GRASS ISLAND
  NT BISCAYNE BAY
  NT BONE VALLEY AREA
  NT BUTTONWOOD SOUND
  NT CALOOSAHATCHEE RIVER AREA
  NT CHARLOTTE HARBOR
  NT CHOCTAWHATCHEE BAY
  NT COUPON BIGHT
  NT DRY TORTUGAS
  NT EVERGLADES AREA
  NT FLORIDA KEYS
  NT FORT MEADE QUADRANGLE
  NT GULLIVAN BAY
  NT HILLSBORO INLET
  NT OCALA UPLIFT
  NT PENINSULAR ARCH
  NT PENSACOLA BAY
  NT PINE ISLAND
  NT SARASOTA AREA
  NT SOUTH FLORIDA EMBAYMENT
  NT SOUTH LAKE WORTH INLET
  NT SPANISH HARBOR
  NT ST ANDREW BAY
  NT ST JOSEPH BAY
  NT SUWANNEE RIVER DELTA
  NT TAMPA BAY
  NT TEN THOUSAND ISLANDS AREA
  NT WHITEWATER BAY
  BT UNITED STATES
     NORTH AMERICA
  SA GADSDEN AREA
  SA GULF BASIN
  SA GULF COAST
  SA MIAMI TERRACE
  SA MUD LAKE
  SA OKEFENOKEE EMBAYMENT
  SA PANHANDLE AREA
  SA PERDIDO BAY
  SA POURTALES TERRACE
  SA SOUTHEASTERN US
  SA ST VINCENT ISLAND
  SA SUWANNEE RIVER BASIN

BAY
EXICO GULF
ATLANTIC OCEAN
SEAS AND OCEANS
UTTONWOOD SOUND
LORIDA KEYS

COAST
SE GULF COAST; FLORIDA;
MEXICO GULF; ATLANTIC COAST;
ATLANTIC OCEAN. VALID

Figure 3.

Sample page from the 2nd Edition of the Geographic Thesaurus.

CANSO STRAIT
CANTABRIA DOME
CANTAURE FM
CANTON GAS FIELD
CANTON TROUGH
CANTUA CREEK OIL FIELD
CANTUA OIL FIELD
CANTWELL FM
CANYON CREEK FM
CANYON FM
CANYON SPRING FM
CAP AL AIGLE FM
CAP AUX MEULES FM
CAP BLANC
CAP BRETON AREA
CAP DES ROSIERS FM
CAP ENRAGE FM
CAP LOPEZ FM
CAP MARTIN FM
CAPARD FM
CAPE ARAGO
CAPE BASIN
CAPE BIOT FM
CAPE BOJADOR
CAPE CAMPBELL SYNCLINE
CAPE CANAVERAL AREA
CAPE COVE FM
CAPE DISCOVERY FM
CAPE FLATTERY
CAPE FOLD BELT
CAPE GEORGE AREA
CAPE GR
CAPE HENLOPEN
CAPE HENRY AREA
CAPE INSULATION LTD
CAPE LIMESTONE
CAPE LOOKOUT
CAPE MENDOCINO
CAPE PERCE ANTICLINE
CAPE PROVINCE
CAPE RISE
CAPE RODNEY FM
CAPE SAN MARTIN QUADRANGLE
CAPE SCHUCHERT FM
CAPE STORM FAULT
CAPE STORM FM
CAPE SUBMARINE CANYON
CAPE VERDE PLATEAU
CAPE VOGEL GR
CAPE YORK PENINSULA
CAPEL CURIG FM
CAPETI ANTICLINE
CAPITOLA PARK OIL FIELD
CAPPANANA BEDS
CAPRICORN REEF COMPLEX
CAPRDATE
CAPROATE, DODECYLAMMONIUM=
CAPROLACTAM
USE HEXAHYDRO=2H=AZEPIN=2=ONE
CAPRYLATE
CAPTAINS FLAT FM
CARABA FM
CARADOCIAN SERIES
CARANDA OIL FIELD
CARAPACHA FM
CARATAS FM
CARBAMATE, DIMETHYLDITHIO=
CARBAZIC ACID
CARBLA OOLITE
CARBOLI AREA
CARBON SUBOXIDE
CARBONATE DIAGENESIS
CARBONE LORRAINE SA
CARBONERA FM
CARBONISATION CHARBONS ACT
CARBORUNDUM CO
CARBOXYLIC ACID, AMINO=
CARBOXYLIC ACID, HYDROXY=
CARBOXYLIC ACID, NITRO=
CARBOXYNAPHTHALENE, DIHYDR
* CARBOXYNAPHTHALENE, DIHYDROXY=
CARDIFF SHALE
CARDINAL CHEMICAL INC
CARDINAL PETROLEUM CO
CARENTON BASIN
CAREY DOLOMITE
CAREY MACHINE & SUPPLY CO
CARGO MUCHACHO MT
CARIACO GULF
CARIAQUITO FM
CARIBBEAN OROGENY
CARIBOO GR
CARIBOO MT
CARLIN CANYON FM
CARLSBAD SOUTH GAS FIELD
CARLSBERG RIDGE
CARMEL BAY
CARMEL SUBMARINE CANYON
CARMEN FM
CARMET CO
CARMILA BEDS
CARNEDD IAGO FM
CARNEGIE INST WASHINGTON
CARNEGIE RIDGE
CARNIAN SERIES
CAROLINE RIDGE
CARONI PLAIN
CARONI SYNCLINE
CAROTENOID
CARPA OIL FIELD
CARPINTERIA OIL FIELD
CARRETO FM
CARRIACOU FM
CARRIACOU ISLAND
CARRIER CORP
CARRIGEEN FM
CARRIGHILL FM
CARTER CAVES SANDSTONE
CARTER (J C) CO
CARTERVILLE FM
CARTY SANDSTONE
CARUPANO AREA
CARUPANO FM
CARUPANO SEA VALLEY
CARVAJAL FM
CARVER & CO (ENG) LTD
CARWELL CREEK BEDS
CARWOOLA BEDS
CASA BLANCA OIL FIELD
CASA DIABLO GEOTHERMAL FLD
CASA GRANDE FM
CASABE OIL FIELD
CASAL DA BOMBARDA ANTICLN
CASAL DO AMARO SYNCLINE
CASAPALCA FM
CASCADE PACIFIC RIM CO INC
CASEIN
CASEY (S F) CO
CASHEW KABUSHIKI KAISHA
CASPER MT
CASSELLA FARBWERKE MAIN AG
CASSINASCO FM
CASTELLANIA FM
CASTILLETES FM
CASTLE CRAGS FM
CASTLE HARBOR
CASTLE HILL OUTLIER
CASTLE MUIR FM
CASTLE REEF DOLOMITE
CASTLE RIVER ANTICLINE
CASTLEGATE SANDSTONE
CASTLEMAINIAN SERIES
CASTLEPOINT FM
CASUPE FM
CAT ISLAND
CATA SEP INC
CATAL TEPE SEQUENCE
CATALANA GAS & ELECTRIC SA
CATALINA ISLAND
CATALONIA BASIN
CATALONIDE MT
CATAMARAN FAULT
CATANZARO AREA
CATATUMBO FM
CATERPILLAR TRACTOR CO
CATHEDRAL CLIFFS FM
CATHEDRAL CRAGS ANTICLINE
CATHODE RAY TUBE
CATLINS GR
CATOCHE FM
CATOCHE TONGUE
CATRELEO GRANITE
CAUBERRY BASIN
CAUCASUS MT AREA
CAUB FM
CAUBEY DAM QUADRANGLE
CAUSTIC WATERFLOODING
CAUX AREA
CAVALIERI (R C) DITTA
CAVE MT ANTICLINE
CAVE SANDSTONE
CAY SAL BANK
CAYMAN ISLANDS
CAYO CHICO DE MOA
CAYO COCO FM
CAZAUX OIL FIELD
CEAG DOMINIT AG
CEARA ABYSSAL PLAIN
CEARA BASIN
CELADA FM
CELANESE CORP
CELEBES
CELENDIN FM
CELL (STRUCTURAL)
CELMAC PLASCLIP LTD
CEMENT MARKETING CO LTD
CEMENT OIL FIELD
CENE FM
CENSURE GR
CENT PHILIPPINE RSN FAULT
CENTENNIAL RIDGE FAULT
CENTERFIELD FM
CENTINELA FM
CENTRAHOMA OIL FIELD
CENTRAL BASIN AREA
CENTRAL GEOPHYSICS LTD
CENTRAL GRABEN
CENTRAL MISSISSIPPI UPLIFT
CENTRAL PACIFIC BASIN
CENTRAL RANGE ANTICLINE
CENTRAL SICILY BASIN
CENTRAL SOMERSET BASIN
CENTRAL SUMATRA BASIN
CENTRALIA OIL FIELD
CENTRE GEOL MARINE CAEN
CENTRE NATL EXPLOIT OCEANS
CENTRE RECH ETUD OCEANOGR
CENTRE RECH MEC HYDRO FROT
* CENTRE STEPHANOIS DE
RECHERCHES MECANIQUES
HYDRODYNAMIQUE & FROTTEMENT
CENTRE RECH SEDIMENTOL MAR
CENTRO SPERI METALL SPA
CEPHALONIA ISLAND
CEPHALOPOD SHALES
CEREAL
CEREBRO DYNAMICS INC
CERITHIUM LIMESTONE
CERIUM BORIDE
CERMAT
CERRO ALTO LIMESTONE
CERRO BLANCO FM
CERRO BORORO
CERRO BORORO FM
CERRO BREAS FM
CERRO CARNERERO FM
CERRO CARRIZALITO GR
CERRO COLORADO GR
CERRO DRAGON OIL FIELD
CERRO FM
CERRO FORTIN FM
CERRO GORDO CO, IOWA
CERRO JHU SANDSTONE
CERRO LUPIN FM
CERRO MORADO FM
CERRO PENA NEVADA
CERRO POZO SERNA
CERRO ROSILLO FM
CERROS AZULES FM
CERVANTES FM
CERVAROLA GR
CESCO SA
CESIUM CARBONATE
CESSOLE FM
CETYL PYRIDINIUM BROMIDE
CETYL PYRIDINIUM CHLORIDE
CEUTA GAS FIELD
CEVENNES BASIN
CEVENNES FAULT
CEZE BASIN
CHACAHOULA SALT E
CHACAY GR
CHACO
CHACO BENIANA BASIN
CHACO GR
CHADRON ARCH
CHAGOS FRACTURE ZONE
CHAGOS LACCADIVE RIDGE
CHAGRES SANDSTONE
CHAIDAM BASIN
CHAIN BIT
CHAIN RIDGE
CHALCANA FM
CHALCOCITE
CHALOON HERRING ANTICLINE
CHALEUR TROUGH
CHALK FM
CHALKY ISLAND FM
TEAU
ICS
IELD
ONE
SERV LTD
AULT

Figure 4.

Typical listings contained in the List of Supplemental Descriptors.

```
EVENT                  *SCHOONER EVENT
EVENT                   SEISMIC EVENT
EVENT                  *SHOAL EVENT
EVENT                   STEEP DIP EVENT
EVENT                  *STERLING EVENT
EVERDINGEN              HURST VAN EVERDINGEN EQUAT
EVOLUTION               CONTINENTAL EVOLUTION
EVOLUTION               EVOLUTION
EVOLUTION               EVOLUTION (ORGANIC)
EVOLUTION               EVOLUTION THEORY
EXAMINATION             EXAMINATION
EXAMPLE                 EXAMPLE
EXCAVATING              EXCAVATING
EXCAVATION              PIT (EXCAVATION)
EXCAVATION              SHAFT (EXCAVATION)
EXCHANGE                FOREIGN EXCHANGE
EXCHANGE                ION EXCHANGE
EXCHANGE                ION EXCHANGE RESIN
EXCHANGER               HEAT EXCHANGER
EXHAUST                 EXHAUST GAS
EXINE                   EXINE
EXPANDED                EXPANDED PERLITE
EXPANDER                EXPANDER
EXPANDING               EXPANDING CEMENT
EXPANSIBLE              EXPANSIBLE
EXPANSION               EXPANSION
EXPANSION               EXPANSION JOINT
EXPANSION               EXPANSION RATE
EXPANSION               POWER SERIES EXPANSION
EXPANSION               THERMAL EXPANSION
EXPEDITING              EXPEDITING
EXPENDABLE              EXPENDABLE
EXPENDABLE              EXPENDABLE PERFORATOR
EXPERIMENT              EXPERIMENT
EXPERIMENT              STRUCTURAL EXPERIMENT
EXPERIMENTAL            EXPERIMENTAL DATA
EXPLODER                GAS EXPLODER
EXPLODER                WIRE EXPLODER
EXPLORATION             AEROMAGNETIC EXPLORATION
EXPLORATION             DIRECT CURRENT EXPLORATION
EXPLORATION             ELECTRICAL EXPLORATION
EXPLORATION             ELECTRICAL EXPLORATION EQ
EXPLORATION             ELECTROMAGNETIC EXPLORATN
EXPLORATION             ELECTROMAGNETIC EXPLR EQ
EXPLORATION             EXPLORATION
EXPLORATION             EXPLORATION COST
EXPLORATION             EXPLORATION EVALUATION MAP
EXPLORATION             EXPLORATION RESEARCH
EXPLORATION             GEOBOTANICAL EXPLORATION
EXPLORATION             GEOCHEMICAL EXPLORATION
EXPLORATION             GEOLOGIC EXPLORATION
EXPLORATION             GEOPHYSICAL EXPLORATION
EXPLORATION             GEOTHERMAL EXPL EQUIPMENT
```

Figure 5.

Sample from the Key Word Out of Context (KWOC) Descriptor List.

current technology, and for browsing. This Index brings together, under a single subject heading, titles of articles and patents whose abstracts have appeared in the weekly bulletin, Petroleum Abstracts. The ASI is photocomposed from processing tapes and is printed and distributed bi-monthly, with the first issue being a hard-bound, 12 months' cumulative index. Three appendices contain bibliographic information (arranged numerically by abstract number), an alphabetic listing of authors, and a patent index (arranged sequentially by patent or application number, under each individual country).

Basically, the Alphabetic Subject Index is a listing of the titles of documents (both articles and patents) under two to six pertinent descriptors. One of these considered as being most descriptive of the document involved (or the major geographic location of the report), is designated as the Primary Descriptor. Additional cross-reference listings under Secondary Descriptors aid in retrieving desired information.

The format for Primary and Secondary Descriptor listings differs. In addition to the title and abstract number, a list of selected descriptors is printed under the Primary entry, following the title. This list of descriptors shows the subject matter of the document and serves as a miniature abstract. Asterisks indicate secondary descriptors, which appear elsewhere in the Index as cross-referenced listings. Remaining descriptors in the list do not appear individually, but are cited for information only. Typical entries in the Alphabetic Subject Index are shown in Figure 6.

Dual Dictionary Coordinate Index

The original concept for the Dual Dictionary (DD) Coordinate Index was the issuance each year of two printed copies at 4-month intervals, cumulative at 8 and 12 months. Presently, the Dual Dictionary is distributed on 16-mm. microfilm in July and December, the year-end issue being cumulative for the year. The Index also is available on microfiche, at the Subscriber's choice.

Two copies of the DD constitute the Dual Dictionary concept. Each copy contains an alphabetical listing of all descriptors used in indexing the information contained in the articles for which abstracts are published in Petroleum Abstracts. The abstract numbers are arranged by terminal digit in order to facilitate coordination. Each abstract number is listed under every descriptor that was assigned by the indexer or that was generated from the E & P Thesaurus hierarchies by computer processing. With the present microfilm or microfiche format, work paper copies of the pertinent DD page entries may be made with a reader-printer, to facilitate coordination. A sample page from a printed copy of the DD is shown in Figure 7.

Master Record Tapes

When complex, deep, and long time span searches are needed, computer searching becomes feasible and economic. For this purpose, computer search tapes, called Master Record Tapes, are issued every four months. These tapes are organized sequentially by abstract number and contain all descriptors assigned or generated (by autoposting from E & P Thesaurus hierarchies) for each article concerned.

ALPHABETIC SUBJECT INDEX

SAFETY VALVE
MEANS FOR PREVENTING DAMAGE TO JACKETED FLEXIBLE PUMPING STRAND 220,799
*CABLE *PRESSURE SURGE
*SHEATHING *WELL PUMPING
.ACTIVATION .CORROSION INHIBITOR
.EXTERNAL COATING .OIL PRODUCING
.PROTECTION
PIPELINE SURGE RELIEVER WITH SANITARY BARRIER 219,569
*PIPELINE *PIPELINE PRESSURE
*PRESSURE SURGE *PROTECTION
.DENSITY .INERT
.LIQUID .MEMBRANE
.PRESSURIZED TANK
PRESSURE ACTUATED SAFETY VALVE 220,198
*ACTIVATION *PRESSURE CONTROL
*PRESSURE SURGE *WELL FLOW CONTROL
.PRODUCING .REVERSING MECHANISM
.SAFETY EQUIPMENT .SUBSURFACE
.WELL COMPLETION
MOUNTING**RETRACTABLE LANDING SHOULDER FOR DOWNHOLE DEVICES* 219,180

SAIPAN ISLAND
MARIANA ISLANDS**LARGER FORAMINIFERA FROM THE ISLANDS OF SAIPAN AND GUAM, MICRONESIA* 219,640

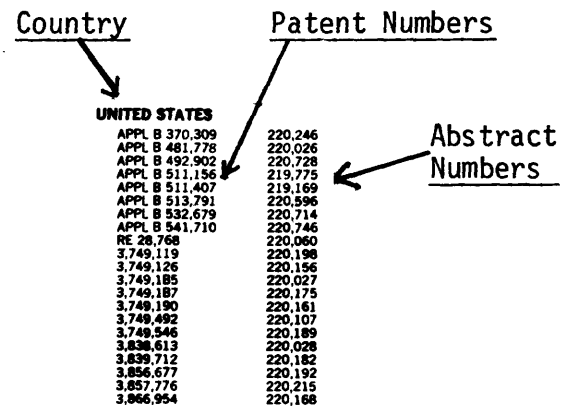
SAKHALIN ISLAND
JAPAN SEA**RESULTS OF GRAVIMETRIC INVESTIGATIONS IN THE SOUTH PART OF THE WEST SAKHALIN SHELF* 220,365

SALT CAVERN
EXPERIENCES GAINED IN THE CREATION AND OPERATION OF CAVERNS IN SALT DOMES WITH A LARGE CONTENT OF IMPURITIES 219,570
*CRUDE OIL STORAGE *SALT DOME
*UNDERGROUND STOR FACILITY .CAVITY
.ELUTION .GERMANY
.IMPURITY .ROCK MECHANICS
IN SITU INVESTIGATIONS OF FRACTURING IN SALT CAVITIES FOR DETERMINING STRESS COMPONENTS 219,571
*FRACTURING *ROCK FAILURE
*SALT DOME *UNDERGROUND STOR FACILITY
.FIELD TESTING .FRACTURING PRESSURE
.IN SITU .ROCK STRESS
.STRESS ANALYSIS
UNDERGROUND STORAGE OF LIQUID AND GASEOUS HYDROCARBONS WITH SPECIAL CONSIDERATION TO PUBLIC SAFETY, REGIONAL PLANNING AND ENVIRONMENT 219,572
*CRUDE OIL STORAGE *GAS STORAGE
*GERMANY *UNDERGROUND STOR FACILITY
.ENVIRON IMPACT STATEMENT .PLANNING
.REGULATION .SAFETY
.SUBSIDENCE
UNDERGROUND STOR FACILITY**ORIGINAL OBSERVATIONS ON THE MECHANICAL BEHAVIOR OF LEACHED CAVITIES IN THE EARTH AND NEW PROCEDURE FOR REHEATING FUEL STORAGE CAVERNS* 219,573

Typical AUTHOR INDEX Entries

TAKAYANAGI, Y 219,661
TALENT, J A 220,098
TAM, W A 220,159
TAM, W A 220,647
TAMAR-AGHA, M Y 220,520
TAMURA, M 221,135
TAN, B K 220,548
TANAKA, K 220,866
TANCHOCO, J M A 221,102
TANER, M T 219,482
TANGEN, H D 220,854
TANGUY, D R 221,185
TANIYAMA, M 221,079
TANIYAMA, M 221,101
TANJI, K K 220,441
TANKIN, R S 220,247
TANOV, E I 221,236
TAPPAN, H 220,061
TAPSCOTT, C 220,321
TARAKAD, R R 220,203
TARANGO, G O 220,109
TARMAN, P B 220,487
TARMAN, P B 220,490
TARRANT, D J 220,765
TARUNINA, O L 220,711
TATE, J F 220,442
TATE, J F 220,601
TATE, J F 220,602
TATE, J F 220,603
TATE, J F 220,809
TAUSCH, G H 220,198
TAVENER-SMITH, R 220,683
TAYLOR, J C 220,679
TAYLOR, J H 220,370
TAYLOR, J M JR 221,104
TAYLOR, K 220,070

Typical PATENT INDEX Entries



Bibliographic Information Listings

Abstract No.	Bibliographic Data
220,197	*OFFSHORE MIDEAST: OIL AND POLITICS MIX IN THE RICH GULF STATES* OFFSHORE SERV V 9, NO 4, PP 24-26, APRIL 1976 *(OFFSHORE PRODUCING)*
220,198	*PRESSURE ACTUATED SAFETY VALVE* U S 3,749,119, C 7/31/73, F 11/19/71; CAMCO INC *(SAFETY VALVE)*
220,199	*LAND SUBSIDENCE AS A RESULT OF NATURAL GAS EXTRACTION IN THE PROVINCE OF GRONINGEN* SPE OF AIME & ROYAL INST ENG DIV UNDERWATER TECHNOL EUROPE SPRING MTG PREPRINT NO SPE-5751, 20 PP, 1976 *(SUBSIDENCE)*
220,200	*PROBLEMS ASSOCIATED WITH THE OPERATION OF OFFSHORE SEA WATER INJECTION SYSTEMS* SPE OF AIME & ROYAL INST ENG DIV UNDERWATER TECHNOL EUROPE SPRING MTG PREPRINT NO SPE-5770, 10 PP, 1976 *(WATER INJECTION)*
220,201	*CAPILLARY PRESSURE CURVES AND STRUCTURAL CHARACTERISTICS OF PORES IN ROCKS* NEFTEPROMYSLOVOE DELO NO 7, PP 4-6, 1975 (IN RUSSIAN) *(CAPILLARY PRESSURE)*

Figure 6.

Typical entries from the Alphabetic Subject Index (ASI).

ABSORPTION OIL	.	.	.	.	.117,424	.	.	.	.	.
ABSORPTION PROCESS	.115,150	.109,701	.110,372	.	.108,464	.106,535	.107,966	.107,487	.107,318	.115,579
(50)	.116,020	.110,341	.110,912	.	.112,514	.108,575	.109,386	.110,907	.110,428	.
	.120,960	.111,101	.112,892	.	.116,904	.111,285	.111,966	.112,647	.112,858	.
	.121,240	.116,431	.113,932	.	.117,424	.113,945	.114,596	.115,887	.117,418	.
	.	.117,431	.118,792	.	.119,724	.116,295	.118,306	.117,427	.	.
	.	.120,031	.	.	.	.117,995	.119,266	.118,797	.	.
	.	.120,311	.	.	.	.121,745	.120,266	.119,267	.	.
	.	.	.	.	.	.	.120,466	.	.	.
	.	.	.	.	.	.	.120,966	.	.	.
	.	.	.	.	.	.	.121,236	.	.	.
ABSORPTION SPECTROSCOPY	.110,240	.106,451	.110,912	.109,043	.111,864	.111,285	.106,456	.113,157	.106,348	.107,199
(69)	.112,300	.107,631	.111,102	.110,733	.117,234	.114,505	.110,516	.113,807	.106,438	.108,109
	.115,150	.107,881	.113,222	.113,483	.120,964	.117,565	.113,806	.114,487	.106,458	.113,139
	.116,400	.109,041	.114,492	.114,813	.	.117,975	.114,596	.115,767	.107,318	.
	.120,310	.109,701	.117,282	.115,573	.	.117,995	.116,826	.115,887	.108,708	.
	.	.110,241	.120,562	.119,703	.	.118,695	.120,146	.119,857	.110,228	.
	.	.111,101	.120,572	.119,843	.	.118,905	.120,156	.120,887	.110,428	.
	.	.115,571	.	.	.	.121,975	.	.	.112,608	.
	.	.116,101	.	.	.	.	.	.	.118,608	.
	.	.116,821	.	.	.	.	.	.	.	.
	.	.119,181	.	.	.	.	.	.	.	.
	.	.119,861	.	.	.	.	.	.	.	.
	.	.121,221	.	.	.	.	.	.	.	.
ABSTRACT	.	.	.	.	.	.	.	.107,877	.	.120,559
ABU DHABI	.111,690	.112,521	.118,312	.118,373	.108,664	.117,775	.106,656	.110,817	.116,228	.108,479
(14)	.	.	.	.	.118,794	.	.117,926	.	.	.
	.	.	.	.	.	.	.118,236	.	.	.
	.	.	.	.	.	.	.118,316	.	.	.
ABUNDANCE	.107,590	.111,061	.106,422	.109,223	.106,644	.107,605	.106,706	.107,127	.107,608	.106,919
(76)	.109,550	.112,711	.106,882	.109,473	.107,114	.108,115	.109,216	.107,567	.107,878	.107,569
	.114,030	.113,771	.106,892	.111,843	.107,124	.113,175	.113,166	.109,467	.109,538	.107,859
	.114,050	.115,551	.107,852	.114,073	.107,874	.114,785	.113,736	.109,537	.111,788	.111,839
	.118,650	.119,561	.108,052	.114,803	.108,084	.116,375	.114,036	.110,507	.114,468	.114,029
	.121,930	.121,951	.109,512	.115,983	.114,784	.118,665	.119,636	.114,457	.115,838	.114,069
	.	.	.114,052	.118,663	.115,554	.	.120,846	.120,807	.118,158	.
	.	.	.114,982	.119,613	.121,294	.	.121,946	.	.119,848	.
	.	.	.115,552	.	.	.	.	.	.121,088	.
	.	.	.115,812	.	.	.	.	.	.	.
	.	.	.119,852	.	.	.	.	.	.	.
	.	.	.120,102	.	.	.	.	.	.	.
ABYSSAL DEPOSIT	.111,840	.117,771	.	.	.117,064	.	.120,396	.	.121,098	.
ABYSSAL ENVIRONMENT	.119,870	.	.	.	.117,064	.	.119,626	.	.111,788	.
(5)	.	.	.	.	.	.	.120,396	.	.	.
ABYSSAL PLAIN	.107,160	.111,121	.109,562	.109,513	.110,484	.108,505	.107,156	.106,467	.111,118	.114,799
(34)	.108,460	.115,911	.119,862	.119,823	.110,524	.117,305	.108,716	.117,597	.118,148	.116,759
	.111,120	.117,331	.121,142	.120,803	.	.120,085	.113,486	.	.121,098	.117,339
	.116,130	.117,771	.	.	.	.	.120,396	.	.	.
	.117,350	.119,581	.	.	.	.	.	.	.	.
	.118,450	.	.	.	.	.	.	.	.	.
ACACUS SANDSTONE	.	.	.	.	.	.	.116,786	.	.	.116,769
ACADEMIC	.113,510	.110,601	.115,042	.	.	.	.113,696	.	.	.
ACADIAN OROGENY	.	.108,121	.111,842	.	.108,954	.108,985	.	.	.	.106,389
(7)	.	.	.	.	.108,964	.	.	.	.	.
	.	.	.	.	.109,014	.	.	.	.	.
ACCELERATION	.106,470	.108,251	.115,802	.112,873	.114,264	.121,995	.107,316	.107,317	.107,218	.110,829
(22)	.	.110,821	.118,532	.116,103	.117,324	.	.115,966	.	.118,988	.113,399
	.	.	.	.121,523	.120,504	.	.121,376	.	.	.115,799
	.	.	.	.	.	.	.	.	.	.116,149
ACCELERATOR	.	.	.	.	.	.	.111,256	.	.112,038	.113,379
(4)	.	.	.	.	.	.	.	.	.	.113,529
ACCELEROMETER	.	.110,821	.107,882	.114,103	.	.	.115,116	.110,827	.107,218	.115,899
(16)	.	.113,831	.110,252	.	.	.	.121,376	.	.118,698	.117,319
	.	.114,701	.114,082	.	.	.	.	.	.	.
	.	.117,321	.115,802	.	.	.	.	.	.	.
ACCIDENT	.108,040	.107,791	.107,772	.107,773	.107,024	.109,685	.111,996	.112,607	.108,788	.107,039
(53)	.108,940	.108,041	.108,032	.109,453	.111,644	.111,205	.112,196	.	.113,428	.107,359
	.112,180	.108,771	.108,302	.111,313	.113,424	.111,995	.114,016	.	.114,138	.109,929
	.112,880	.108,941	.109,202	.116,923	.114,114	.112,035	.115,796	.	.114,288	.112,299
	.115,060	.112,881	.111,652	.117,743	.115,294	.115,375	.115,976	.	.	.113,389
									.	.
									.	.
									.	.
									.	.
									.	.
ACCIDENT GAS FIELD									.	.

Figure 7.

Example of format of the Dual Dictionary (DD) Coordinate Index.

The tape can be searched sequentially with available computer programs. It is issued in several formats to match the requirements of the Subscriber's specific computer. Some search systems are available on local or national/international retrieval systems (to be described in a following section).

Card Files

At the outset of operation, the information retrieval aspect of the Petroleum Abstracts Information System was based on an abstract card file. Abstracts were printed on card stock for this purpose and contained Classification numbers. In addition to the classification file, cards were prepared for author files and for patent files. The classification card file no longer is active but the other two are current. At present, specially prepared abstract cards are used for this purpose. An accession number card file is maintained for quick access to abstracts.

Classification Retrieval System - During its first four years of operation, the Petroleum Abstracts Information System utilized an extensive classification coding system for information retrieval. Under that system, each abstract was assigned a series of code numbers based on 1200 classifications of information pertaining to petroleum exploration and production technology. From two to as many as seven such classification numbers were assigned to and printed on each abstract entry in the Petroleum Abstracts bulletin. At that time, the printing format was four abstracts per page and each page also was printed on card stock and the cards filed by classification number and by author name. An example of the Subject Classification System and an abstract card are shown in Figure 8.

Author File - For purposes of retrieving information based on author names and for checking against previously published articles or abstracts, a card file of authors is maintained. Abstract cards are used for this purpose.

Accession Number File - Since January, 1965 (beginning with abstract number 50,000) an abstract card accession number file has been maintained. This file provides quick access to any numbered abstract and facilitates easy reproduction of abstracts when needed.

Patent File - A patent file (of abstract cards) is maintained for retrieval purposes and for checking for related patents. The file is separated by country and contains both patent number and priority date listings.

Related Patent Index

An index of related patents is issued each six months and is cumulative from January 1, 1973. Prior to January 1, 1973, related patents were indicated by reissue of the original abstract card showing the related patent data. After January 1, 1973, no abstract cards have been distributed to Subscribers, as had been done as part of the services since 1961.

The Related Patent Index is a list of each related patent processed since January 1, 1973. The index is ordered by the primary patent abstract number

513.48 Other Minerals in Sedimentary Rocks
.49 Alternating Lithologies (includes more than one of the above rock types)

514 Stratigraphy and Historical Geology

.1 Principles of Stratigraphy
.2 Stratigraphy of Specific Areas (subdivide by country or state)
.21 Europe (excluding U. S. S. R.)
.22 Asia (including U. S. S. R. and Russian Arctic)
.23 South America and Caribbean
.24 North and Central America
.26 Australasia and Antarctica
.27 Africa
.28 Pacific Island Arc
.29 Oceans and Seas (international waters)
.3 Type Wells and Sections (arranged alphabetically by stratigraphic unit)

Fr.
155.3, 115, 184.2, 506.142, 513.25, 514.21, 701 4-11893

THE UNDERGROUND STORAGE OF GAS - M. Perraud; 2ND U.N. DEVEL. PETR. RESOURCES, ASIA & FAR EAST SYMP. (Tehran, Iran, 9/1-15/62) PROC. v.2, pp 66-73, 1963 (Recd. Dec. 1964)

The realization and utilization of underground storage at Lussagnet provided an underground storage in the vicinity of the Lacq gas plant with an adequate reserve capacity. Underground storage had the advantage of greater reliability: a serious stoppage at the plant or field could result in a complete, if temporary, operational shutdown, whereas underground storage at a distance from Lacq would not run this risk. This Lussagnet structure is made up of a rather large anticline. The reservoir is a sandy horizon, ending in a relatively shallow depth and of good tightness due to a thick layer of impermeable marls. These characteristics seemed to meet with the requirements. Conceived and realized by a team of company engineers including specialists in geology, drilling, machinery and gas transport, this storage proved most useful in the exploitation of the Lacq deposits because of the following: (1) By its easy and secure functioning, and also by its great working flexibility, allowing a conveniently rapid change of flow; and (2) by guaranteeing supplies in any event, so as to play the part of regulator between the transport networks and the refining plant.

.47 Africa
.48 Pacific Island Arc
.5 Studies of Oil and Gas Fields and/or Areas, Proven or Potential, by Structural Environment
.51
.511

Figure 8.

Illustrations of typical entries in the Subject Classification System and an abstract card showing use of the System.

to which the patent is related and contains, as well, the related patent abstract number with its country of issue and patent number.

An abstract card with related patent information and a sample page from the Related Patent Index are shown in Figure 9.

Computer Hardware and Processing

The computer presently in use by the Information Services Division is a Xerox Sigma 6, which is housed at the University's Computer Center. All computer programs for processing and handling in the System are written in Fortran IV with a number of important assembly language subroutines. Thirty-plus programs are needed for all computer processing in the System.

PETROLEUM ABSTRACTS SEARCH SYSTEM

The Petroleum Abstracts Search System (PASS) is a coordinated set of computer routines that provides the user with a comprehensive literature search capability. Operating on-line from a remote terminal, a searcher can structure a search, review the results, and restructure as necessary to obtain whatever amount of generality or specificity is desired. Functions are available to allow display of results on the terminal and to print the final search results on the Computer Center line printer.

The search program is supported by two major information bases: (1) an inverted search file of descriptors that lists all abstract numbers to which each descriptor has been assigned; and (2) the item files containing titles, bibliographic citations, and author names. Physical files in each class are stored on separate disc-packs for literature and for patents. These files are updated monthly.

PASS makes use of a Boolean search technique, based on logical combinations of logical operators. These operators are AND, OR, and NOT which may be combined with descriptors in three types of associations:

AND - associates multiple descriptors, all of which must be present to satisfy search requirements.
OR - associates alternate descriptors, any one of which is acceptable.
NOT - indicates descriptors that eliminate the article (abstract number) from consideration.
* - logical AND for descriptor groups.
\+ - logical OR for descriptor groups.
\- - logical NOT for descriptor groups.

In tabular form, the above translates to:

Function	Singly or Within a Group	Between Groups
Intersection	AND	*
Union	OR	+
Negative	NOT	-

PATENT ABSTR #	RELATED PATENT ABSTR #	CITATION
"	216,001	GR BRIT 1,421,014
183,611	199,837	CAN 960,207
183,619	201,265	CAN 960,456
183,665	199,813	CAN 958,326
183,806	187,831	FR 2,174,223
183,807	192,597	GR BRIT 1,359,719
183,861	201,236	AUSTRAL 456,800
"	208,284	GER 2,051,829
184,008	202,824	BELG 779,957
184,033	189,124	U S 3,799,258
184,072	202,874	CAN 962,292
184,293	1	
184,295	1	
"	2	U.S. 3,944,003, c. 3/16/76, f. 4/24/72 (18 claims)
184,319	1	Gr. Brit. 1,419,280, c. 12/31/75, f. 3/29/73, pr. U.S. 4/24/72
184,323	1	Gr. Brit. 1,419,279, c. 12/31/75, f. 3/29/73, pr. U.S. 4/24/72
"	2	
184,332	1	Can. 967,942, c. 5/20/75, f. 9/26/74, pr. U.S. 4/24/72 (4 claims)
184,334	2	Can. 967,941, c. 5/20/75, f. 3/27/73, pr. U.S. 4/24/72 (11 claims)
"	2	PERCUSSION DRILL
184,344	1	BORE HOLE AIR HAMMER -- S. Afr. 73/0,719, c. 9/12/73, f. 1/31/73
184,345	1	(pr. U.S. 4/24/72, Appl. 246,837); A.R. Curington, asr.; (Baker Oil Tools
"	1	Inc); Abstr., PATENTJOERNAAL (S. AFR.) v. 6, No. 10, p 87, Oct. 1973
184,346	2	In a percussion drilling apparatus, the equipment consists of: (1) a
184,349	1	housing structure connectable to a drill string; (2) an anvil in the lower por-
"	1	tion of the housing structure and operatively connectable to a drill bit;
"	1	(3) a hammer piston reciprocable in the housing structure for intermittently
"	1	impacting against the anvil, the piston having an upper passage; (4) inlet
"	1	means for directing a fluid medium under pressure into the passage;
"	2	(5) first means for directing the fluid medium from the passage into the hous-
"	2	ing structure above the piston upon upward movement of the piston in the
"	2	housing structure for driving the hammer piston downward toward the mandrel;
"	2	(6) second meane for directing the fluid medium from passage into the
"	2	housing structure below the piston upon downward movement of the piston in
"	2	the housing structure for elevating the piston in the housing structure; and
"	2	(7) means for alternately exhausting the fluid medium from the housing struc-
"	2	ture above and below the piston. (22 claims) (Abstract only - original patent
"	2	not available from T. U.)
"	2	
"	2	
"	2	
"	2	
184,351	2	
184,353	1	
"	202,980	GR BRIT 1,389,614
184,366	212,195	CAN 973,431
184,407	187,840	FR 2,176,950
184,435	192,475	BELG 747,833
184,446	192,567	GR BRIT 1,355,460
"	219,002	GER 2,221,121
184,552	199,908	U S 3,848,898
"	204,165	GR BRIT 1,391,717
"	215,925	CAN 978,223
184,566	208,243	CAN 968,785
"	214,458	AUSTRAL 467,016
"	214,551	GR BRIT 1,418,984
184,567	208,220	CAN 967,941
"	208,221	CAN 967,942
"	214,555	GR BRIT 1,419,279
"	214,556	GR BRIT 1,419,280
"	219,066	U S 3,944,003
184,568	198,265	GR BRIT 1,376,094
"	199,906	U S 3,848,683
"	210,942	BELG 795,205
"	215,909	CAN 977,330
184,581	191,581	GER 2,316,059
"	209,839	CAN 970,411
"	210,945	BELG 797,580
184,587	194,628	FR 2,19
"	217,004	CAN 982
184,619	192,608	GR BRIT
"	204,195	U S 3,8
"	215,905	CAN 977
184,622	198,343	U S 3,8
"	202,938	GR BRIT
184,625	195,857	CAN 953
184,630	205,639	BELG 79
"	212,314	U S 3,9

PATENT ABSTR #	RELATED PATENT ABSTR #	CITATION
184,631	205,638	BELG 795,309
184,635	191,609	GR BRIT 1,350,274
"	199,782	AUSTRAL 456,210
184,636	199,864	GR BRIT 1,382,505
184,792	202,974	GR BRIT 1,388,713
"	204,125	CAN 963,886
184,795	191,655	U S 3,815,540
184,800	208,320	GR BRIT 1,401,558
"	212,214	CAN 974,450
"	212,337	U S 3,906,820
184,813	191,662	U S 3,818,922
		,316,060
		,870,351
		797,579
		77,005
		IT 1,398,959
		194,877
		60,580
		IT 1,415,435
		,880,584
		,888,626
		,888,627
		34,039
		70,578
		IT 1,440,243
		,837,401
		IT 1,382,119
		7,874
		,8,724
		886,981
		T 1,371,315
		8,573
		81,705
		1,479
		T 1,404,207
		T 1,372,903
		2,608
		855,803
		94,971
		T 1,396,496
		1,045
		91,134
		T 1,418,050
		84,989
		9,861
		906,224
		0,016
		U S 3,891,454
"	219,035	U S 3,937,282
185,049	194,646	GER 2,342,726
"	214,513	GR BRIT 1,414,721
185,060	219,912	CAN 986,849
185,061	214,609	U S 3,914,949
185,092	189,113	NETH APPL 7,309,807
"	194,625	FR 2,193,175
"	198,290	GR BRIT 1,378,999
"	218,966	CAN 985,129
185,095	208,361	U S 3,885,432
185,098	209,811	AUSTRAL 462,867
185,121	198,219	CAN 956,810
"	209,809	AUSTRAL 462,803
185,126	198,272	GR BRIT 1,376,838
185,136	219,938	GR BRIT 1,425,365
185,422	194,576	BELG 761,150
185,438	202,892	CAN 962,849
185,452	192,629	GR BRIT 1,364,574
"	202,901	CAN 963,179
"	212,258	GER 2,245,965
185,453	192,628	GR BRIT 1,364,573
"	199,803	CAN 958,127
185,454	192,630	GR BRIT 1,364,575
"	199,804	CAN 958,128
		GR BRIT 1,429,349
		GER 2,029,039
		U S 3,818,991
		AUSTRAL 454,484
		GR BRIT 1,411,406
		BELG 782,222
		GR BRIT 1,390,193
		U S 3,903,701
		GR BRIT 1,430,084
		GER 2,305,917

Figure 9.

Sample page from a Related Patent Index and an example of previously designated related patents on an abstract card.

A PASS search structure can be as simple as a search on one descriptor, or as complex as is required. The number of descriptors that can be combined in one group is limited by the disc file space available. A maximum of 9 groups can be used in a given search.

Figure 10 illustrates a literature search for articles, in languages other than Russian, concerned with computer processing of paleontologic and stratigraphic data. The search strategy for this question is (COMPUTER or COMPUTER PROGRAMING) and (PALEONTOLOGY or STRATIGRAPHY and GEOLOGIC DATA PROCESSING not RUSSIAN).

ORBIT III SEARCH SYSTEM

Through an arrangement with System Development Corporation (SDC) the Orbit III Search System adds a new facet to the Petroleum Abstracts Information System. The information base of the Petroleum Abstracts System (literature and patents) now can be accessed through SDC's Search Service Orbit III Search System (file TULSA).

The Orbit III Search System is an extensive and easily used information retrieval program that has been in operation daily since 1970. The program allows the searcher to specify his information needs by a logical combination of descriptors and of substantive keywords from the titles. Searches also can be made on specified author names. An interactive system, ORBIT III provides capability for progressively refining the statement of a search request to quickly and easily identify the item of primary interest. The TULSA file is updated quarterly.

Search results can be printed on the user's terminal or they can be directed to a high speed, off-line printer. Off-line reports are delivered by airmail from System Development Corporation's offices in Santa Monica, California.

ORBIT III is accessed through a worldwide communications network (Tymshare) that provides local telephone access to minicomputers in major U. S. population centers as well as selected cities in Canada and Europe. The System also may be used directly through WATS lines or by direct distance dialing.

The Orbit III Search System provides access to many other information files, some selected examples of which are as follows:

American Petroleum Institute (APILIT/APIPAT)
American Chemical Society (CHEMCON)
American Geological Institute (GEOREF)
Smithsonian Scientific Information Exchange (SSIE)
National Technical Information Service (NTIS)

The cost of searching the Petroleum Abstracts information base is structured upon an hourly charge for use of the file, an hourly charge for the communications network (optional), and a charge per reference for off-line printing. The actual rates vary; SDC search service customers and Petroleum Abstracts Information System subscribers are given preferential rates. No minimum charges or startup fees are imposed. Specific rates may be obtained from System Development Corporation or from the Information Services Division at The University of Tulsa.

Figure 11 illustrates a literature search (for the time period 1975) for articles concerned with the use of computers in geology excluding paleontology.

```
!PASS.
P A S S   VERSION 6 - -

PLEASE ENTER YOUR OPERATOR ID:ROYG
ENTER FILE NAME::TULIT
OPENING FILE
COMMAND:RQ
ENTER FIRST DESCRIPTOR
: COMPUTER
SEARCHING
FND-     3264
ENTER OPER.+ DESCRIP.
:OR COMPUTER PROGRAMING
SEARCHING
FND=     3463     GRP=    5129    1
ENTER OPER.+ DESCRIP.
:*
ENTER FIRST DESCRIPTOR
: PALEONTOLOGY
SEARCHING
FND-     8172
ENTER OPER.+ DESCRIP.
:OR STRATIGRAPHY
SEARCHING
FND=    17650     GRP=   19054    2
ENTER OPER.+ DESCRIP.
:AND GEOLOGIC DATA PROCESSING
SEARCHING
FND=      537     GRP=     127    2
ENTER OPER.+ DESCRIP.
:NOT RUSSIAN
SEARCHING
FND=    10893     GRP=     126    2
ENTER OPER.+ DESCRIP.
:END
       94 DOCUMENTS FOUND
COMMAND:PT
ENTER NO. TO PRINT:3
ENTER MODE:2
  197740
APPLICATION OF SOME CORRELATION COEFFICIENT
  TECHNIQUES TO TIME-SERIES ANALYSIS
   J INT ASS MATH GEOL V 6, NO 4, PP 363-372, DEC 1974

  197650
THE STATISTICAL ZAP VERSUS THE SHOTGUN APPROACH
   J INT ASS MATH GEOL V 6, NO 4, PP 311-332, DEC 1974

  194279
A BIBLIOGRAPHY OF THE FAMILY FUSULINIDAE:  ADDENDUM 9
   J PALEONTOL V 48, NO 4, PP 833-839, JULY 1974
COMMAND:TM
END OF SESSION

!OFF
```

Figure 10.

Example of Computer terminal printout from a Petroleum Abstracts Search System (PASS) search.

```
SS 1 /C?
USER:
COMPUTER OR COMPUTER PROGRAMING

PROG:
SS 1 PSTG (6230)

SS 2 /C?
USER:
GEOLOGY AND NOT PALEONTOLOGY

PROG:
SS 2 PSTG (34430)

SS 3 /C?
USER:
1 AND 2 AND FROM 1975 THRU 1975

PROG:
SS 3 PSTG (71)

SS 4 /C?
USER:
"PRINT 3,AN,TI,AU,SO"

PROG:

AN  - 214838
TI  - CALIBRATING SIMULATION MODELS FOR STUDYING UNDERGROUND AQUIFERS
AU  - BARADAT Y; BLANC G
SO  - REV INST FRANC PETROL V 30, NO 2, PP 295-301, MARCH-APRIL 1975
      (IN FRENCH)

AN  - 214666
TI  - RELATIVE EFFECTIVENESS OF GEOLOGISTS AND COMPUTERS IN MAPPING
      POTENTIAL HYDROCARBON EXPLORATION TARGETS
AU  - DAHLBERG E C
SO  - J INT ASS MATH GEOL V 7, NOS 5-6, PP 373-394, DEC 1975

AN  - 214643
TI  - APPLICATION OF ERTS IMAGES AND IMAGE PROCESSING TO REGIONAL
      GEOLOGIC PROBLEMS AND GEOLOGIC MAPPING IN NORTHERN ARIZONA
AU  - ABRAMS M J; BILLINGSLEY F C; GEOTZ A F H; GILLESPIE A R; SQUIRES
      R L
SO  - JET PROPULSION LAB REP NO JPL-TR-32-1597 NASA-CR-143068, 203 PP,
      5/15/75; E75-10331

SS 4 /C?
USER:
```

Figure 11.

Illustration of an Orbit III search.

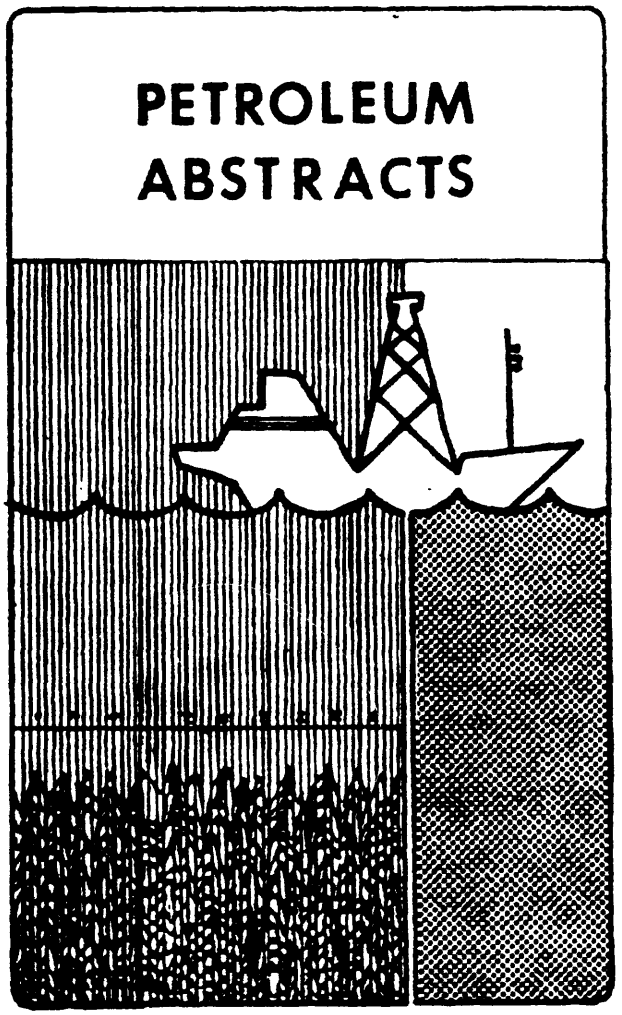
The search strategy for this operation is (COMPUTER or COMPUTER PROGRAMING) AND (GEOLOGY not PALEONTOLOGY) AND FOR 1975 THRU 1975.

SYSTEM EXPANSION CAPABILITIES

Because of the nature of the literature and patent base of the Petroleum Abstracts Information System, capability exists for rapid expansion into other mineral and/or energy fields. Proposals have been made over a period of the past few years to expand the services into specific areas of Economic Minerals and into limited areas of Nonconventional Energy Resources. The capabilities continue to exist even though the formal proposals met with negative results. Expert personnel and experience are available in these and other areas of interest.

Exploration and Production

THESAURUS



5th EDITION
JANUARY, 1976

THE UNIVERSITY OF TULSA
Information Services Division
1133 North Lewis Avenue
Tulsa, Oklahoma 74110

TABLE OF CONTENTS

E & P THESAURUS DESCRIPTION

INTRODUCTION

The Exploration and Production (E & P) Thesaurus covers the subject areas of geology; geochemistry; geophysics; drilling; well logging; well completion & servicing; production of oil & gas; reservoir engineering & recovery methods; pipelining, shipping & storage; ecology & pollution; alternate fuels & energy sources; and supplemental technology (automation, economics, corrosion, instrumentation, etc.). The first edition of the E & P Thesaurus (1965) was compiled in a format similar to that used by E.J.C. in its "Thesaurus of Engineering Terms." All subsequent editions of the Thesaurus, including this fifth edition, are similar in format to the first edition; however, the philosophy used in building hierarchies is different. In developing the hierarchical relationships of the first edition, discipline-oriented principles were used; whereas the later editions are based on concept-oriented (faceted) principles. A complete outline of the hierarchy, and an alphabetic index to the hierarchy are included at the end of the main Thesaurus.

DEFINITION

Thesaurus, by definition, is "a book containing a store of words, such as a dictionary or, especially, a book of classified synonyms and antonyms." The E & P Thesaurus, then, is a collection of words and phrases that are descriptive of the concepts and equipment pertaining to petroleum exploration, development and production. Further, it is a controlled vocabulary for these subjects, in which the various concepts have been linked by means of generic or hierarchical relationships. These relationships may be truly generic or may be associations by use, or even convenience. An important factor or aspect of this, or any similar Thesaurus, is its treatment of synonyms. All terms or words of like meaning have been directed to one term or word, for use as a descriptor for that particular meaning or concept. This selection has been either arbitrary or, preferably, dicated by popular usage. The purposes for which this type of Thesaurus has been designed do not require the use of antonyms.

MAIN BODY

The main body of the E & P Thesaurus consists of descriptors arranged in alphabetical order. Under each descriptor, one or more of the following entries may be found:

* - Entire spelling of Abbreviated Descriptor
** - Scope Note or Explanatory Note, including history of usage and previous relationships, where applicable.
USE - Use...(preferred synonym)
UF - Used For
NT - Narrower Term
BT - Broader Term
SA - See Also

The E & P Thesaurus preparation procedures allow a maximum of 26 characters (letters and/or spaces) for each descriptor. A few descriptors require more characters than this; hence, abbreviations are necessary. The single asterisk entry, designates the entire spelling o such descriptors.

ELECTROMAGNETIC EXPLR EQ
* ELECTROMAGNETIC EXPLORATION EQUIPMENT
MPR
* MAXIMUM PRODUCING RATE

"Scope Note" entries (double asterisk) are used to restrict the scope of a descriptor or define its meaning, to indicate previous (now invalid scope notes, to tell when the term was first available for indexing, tc show what terms were previously used to describe this concept, and tc indicate changes in hierarchical relationships. Numbers in parentheses (65-75) show applicable year ranges.

MEGAORGANISM
** FOR GENERAL DESIGNATION OF RECENT FORMS ONLY. SEE SPECIFIC TYPES.

MARGINAL BASIN
** INDICATES A MARINE DEPOSITIONAL BASIN ON THE CONTINENTAL MARGIN.

GEOPHYSICAL COST
** ADDED JANUARY 1968
USED (65-67) GEOPHYSICS PLUS COST.

GEOLOGIC MAP
** (65-75) USE FOR SURFACE GEOLOGIC MAPS ONLY.
NT (76---) PALEOGEOLOGIC MAP
BT (67---) MAP

The entry "USE" indicates the preferred term designated tc describe a single concept, when two or more synonyms exist.

DOWNHOLE PUMP
USE WELL PUMP

FLUIDITY
USE VISCOSITY

"Used For" (UF) indicates an unacceptable synonym, for which a given descriptor serves as a substitute.

WELL PUMP
UF DOWNHOLE PUMP

VISCOSITY
UF FLUIDITY

"Narrower Term" (NT) designates a term which is a more specific subdivision of the descriptor.

LIMESTONE
NT CHERTY LIMESTONE

LINER (WELL)
NT PERFORATED LINER

"Broader Term" (BT) designates one or more hierarchically related terms, of which the concept is a logical subdivision.

followed by (P), is assigned for searching. A complete list of such descriptors is shown in Figure 3.

HIERARCHY

A hierarchical listing of all acceptable descriptors, followed by an index to the hierarchy, will be found following the main body of the Thesaurus.

The hierarchy provides a compact listing of the descriptors in their structured form. Since the Thesaurus terms have been interrelated on the concept-oriented (faceted) principle, all descriptors are narrower

ALT FUELS + ENERGY SOURCES
DRILLING (WELL) (C)
ECOLOGY + POLLUTION
GEOCHEMISTRY (C)
GEOLOGY (C)
GEOPHYSICS (C)
PIPELINING, SHIP + STORAGE
PRODUCING OIL + GAS
RESERVOIR ENG + REC METHOD
SUPPLEMENTAL TECHNOLOGY
WELL COMPL SERV + WORKOVER
WELL LOGGING + SURVEYING

Figure 2. List of Category descriptors.

(P) ARGENTINA	(P) ITALY
(P) AUSTRALIA	(P) IRELAND
(P) BELGIUM	(P) JAPAN
(P) BOLIVIA	(P) MEXICO
(P) BRAZIL	(P) NETHERLANDS
(P) CANADA	(P) PORTUGAL
(P) COLOMBIA	(P) SOUTH AFRICA
(P) CUBA	(P) SWITZERLAND
(P) EAST GERMANY	(P) USA
(P) FRANCE	(P) USSR
(P) GERMANY	(P) VENEZUELA
(P) GREAT BRITAIN	(P) YUGOSLAVIA
(P) INDIA	

Figure 3. List of patent country descriptors.

terms of one of ten facet headings. These ten facets, which appear alphabetically, are as follows:

COMMON ATTRIBUTE	EARTH AND SPACE CONCEPTS
ECONOMIC FACTOR	EQUIPMENT
MATERIAL	OPERATING CONDITION
ORGANISM	PHENOMENON
PROCESS	PROPERTY

In the hierarchical listings, the words appearing in brackets are included to show the scope of the hierarchy, but do not appear in the main thesaurus body as usable descriptors. Words appearing in parentheses are usable descriptors but are not autoposted.

The Index to the Hierarchy provides a convenient means for locating any word in the Hierarchy. Since each column of the Hierarchy is numbered, the Index indicates the Hierarchy column in which the descriptor may be found.

MACHINE ALPHABETIZATION RULES

Knowledge of the thesaurus format is important to both the indexer and the searcher. The E & P Thesaurus is an alphabetic listing of single words and descriptive phrase terms that are known a descriptors. The alphabetic order of these descriptors does not follo the format of a conventional dictionary, wherein single, double, c compound words are treated alike, in strict alphabetical order. Rathe single-word and double-word descriptors appear before the plurals and before compound (joined) words; e.g., SLIP VELOCITY appear before SLIPS (PIPE); WAVE VELOCITY occurs before WAVEFORM

Letter abbreviations occur in regular alphabetic succession (e.g API CODE follows APHOTIC ZONE; BS&W follows BRYOZOA). O the other hand, it will be noted that descriptors containing numeral are entered in alphabetic sequence following the last normal entry o the word (e.g., CARBON 14 DATING occurs after CARBO NITROGEN RATIO, but precedes CARBONACEOUS DEPOSIT).

ABBREVIATION PROCEDURES

Descriptors, including spaces between words, are limited to a maximum length of 28 characters. For longer descriptors abbreviations are required. In addition, certain commonly occurrin words in proper names may be abbreviated.

(1) The following are typical abbreviations of proper names:

Mount	Mt
Saint	St
Company	Co
Limited	Ltd
Incorporated	Inc

(2) Publication names are abbreviated as shown in the annua Publications List for PETROLEUM ABSTRACTS.

(3) When abbreviations are used because of space limitation:

(a) The first word of a concept is not abbreviated, except in rare cases where such is common usage.

API STANDARD
NMR SPECTROSCOPY

(b) When necessary, individual letters (usually vowels) are deleted from individual words, as near the end of a concept as possible.

AIRBORNE GRAVITY EXPLORATN
* AIRBORNE GRAVITY EXPLORATION

(c) Spaces are not left between initials, and they are not punctuated.

API STANDARD

(4) Other abbreviations are selected from the following references:

(a) Abbreviation compilation used for PETROLEUM ABSTRACTS

(b) Suggestions to Authors, U.S. Geological Survey

(c) Webster's Third International Dictionary

REQUIREMENTS FOR NEW DESCRIPTORS

Rules for the selection of descriptors for inclusion in the Supplementary Descriptors list are as follows:

(1) When a concept cannot be found in the E & P Thesaurus, synonyms of this descriptor should be sought in the Thesaurus.

(2) The API Thesaurus is then checked to see if the descriptor, one similar to it, or a synonym exists. If so, consideration is given to

E & P THESAURUS

AAODC SPECIFICATION
** *ADDED JANUARY 1965.*
BT (76--) SPECIFICATION
BT SPECIFICATION

ABANDONMENT
UF ABANDONMENT PLUGGING
WTH WELL PLUGGING
UF WELL ABANDONMENT
SA DEPLETED RESERVOIR
SA DRY HOLE
SA LAND RECLAMATION
SA MARGINAL WELL
SA RESERVE ESTIMATE
SA SALVAGE VALUE
SA SALVAGING
SA WATERED OUT
SA WELL KILLING

ABANDONMENT PLUGGING
USE ABANDONMENT
PLS WELL PLUGGING

ABC TRANSACTION
BT LAND AND LEASING
ECONOMIC FACTOR
SA ACQUISITION
SA ACREAGE
SA CAPITAL ASSET
SA CONTRACT
SA INVESTMENT
SA LEASE
SA LEGAL CONSIDERATION
SA OWNERSHIP
SA PROPERTY (REAL)

ABIOGENESIS
** *PERTAINS TO NONBIOLOGIC ORIGIN OF PETROLEUM, ORGANIC COMPOUNDS, OR LIFE.*
ADDED APRIL 1966.
USED (65) INORGANIC PLUS OIL AND GAS ORIGIN.
BT (67--) ORIGIN
BT ORIGIN
SA OIL AND GAS ORIGIN

ABNORMAL PRESSURE RESERV
* *ABNORMAL PRESSURE RESERVOIR*
USE OVERPRESSURED RESERVOIR

ABOVEGROUND STOR FACILITY
* *ABOVEGROUND STORAGE FACILITY*
** *ADDED JANUARY 1967.*
USED (65-66) STORAGE FACILITY(IES) PLUS SURFACE.
UF STORAGE ABOVEGROUND
BT STORAGE FACILITY
SA SPHERICAL TANK
SA STORAGE PIT
SA SURFACE
SA UNDERGROUND STOR FACILITY

ABOVEWATER STOR FACILITY
* *ABOVEWATER STORAGE FACILITY*
** *ADDED JANUARY 1976.*
USED (65-75) STORAGE FACILITY(IES).
UF STORAGE ABOVEWATER
BT STORAGE FACILITY
SA OFFSHORE STORAGE
SA OFFSHORE TERMINAL
SA UNDERWATER STOR FACILITY

ABRASION
USE WEAR

ABRASION (GEOLOGY)
UF GEOLOGIC ABRASION
BT EROSION (GEOLOGY)
SA FRAGMENTATION (GEOLOGY)
SA SUBMARINE EROSION
SA WEAR

ABRASIVE
** *ADDED FEBRUARY 1965.*
SA ABRASIVE JET
SA EROSION
SA FRICTION
SA SURFACE PREPARATION
SA WEAR RESISTANCE

ABRASIVE JET
UF ABRASIVE JET PERFORATING
WTH JET PERFORATING
UF SAND JET
BT JET NOZZLE
NOZZLE
SA ABRASIVE
SA HYDRAULIC PERFORATING
SA JET DRILLING
SA JET PERFORATING
SA SANDBLASTING
SA SHOT PEENING

ABRASIVE JET DRILLING
USE JET DRILLING

ABRASIVE JET PERFORATING
** *USED (65-66) ABRASIVE JET PLUS PERFORATING.*
USE ABRASIVE JET
PLS JET PERFORATING

ABSOLUTE AGE
USE RADIOACTIVE AGE DETERMINAT

ABSOLUTE GEOCHRONOLOGY
USE RADIOACTIVE AGE DETERMINAT

ABSOLUTE OIL RECOVERY
USE OIL RECOVERY

ABSOLUTE OPEN FLOW TEST
USE OPEN FLOW TEST

ABSOLUTE PERMEABILITY
USE PERMEABILITY (ROCK)

ABSOLUTE POROSITY
USE POROSITY (ROCK)

ABSOLUTE RECOVERY
USE OIL RECOVERY

ABSORBENT
NT ABSORPTION OIL
BT SORBENT
SA ABSORPTION
SA ABSORPTION PROCESS
SA GAS ABSORPTION
SA NATURAL GASOLINE PLANT
SA REGENERATION

ABSORBER
** *NT (76--) STRIPPER*
UF ABSORBER SYSTEM
UF ABSORPTION COLUMN
UF LEASE ABSORPTION UNIT
NT STRIPPER
BT SEPARATION EQUIPMENT
SA ABSORPTION
SA ABSORPTION PROCESS
SA NATURAL GASOLINE PLANT
SA SHOCK ABSORBER

ABSORBER SYSTEM
USE ABSORBER

ABSORPTION
** *PHENOMENON, NOT PROCESS.*
NT (76--) GAS ABSORPTION
NT (67--) IMBIBITION
NT (76--) WAVE ABSORPTION
NT GAS ABSORPTION
NT IMBIBITION
NT WAVE ABSORPTION
BT SORPTION
SA ABSORBENT
SA ABSORBER
SA ABSORPTION PROCESS
SA ABSORPTION SPECTROSCOPY
SA ADSORPTION

ABSORPTION COLUMN
USE ABSORBER

ABSORPTION GASOLINE
USE NATURAL GASOLINE

ABSORPTION OIL
BT ABSORBENT
SORBENT
SA ABSORPTION PROCESS

ABSORPTION PLANT
** *USED (65-66) GASOLINE PLANT(S)*
USE NATURAL GASOLINE PLANT

ABSORPTION PROCESS
** *NT (68-75) GAMMA RAY ABSORPTION*
NT (68-75) INFRARED ABSORPTION
NT LEAN OIL ABSORPTION
BT SORPTION PROCESS
PHYSICAL SEPARATION
SA ABSORBENT
SA ABSORBER
SA ABSORPTION
SA ABSORPTION OIL
SA GAS ABSORPTION

ABSORPTION SPECTROSCOPY
NT ATOMIC ABSORPTION SPECTROS
NT INFRARED SPECTROSCOPY
NT ULTRAVIOLET SPECTROSCOPY
BT SPECTRAL ANALYSIS
ANALYTICAL METHOD
TESTING
SA ABSORPTION
SA EMISSION SPECTROSCOPY
SA INFRARED ABSORPTION
SA WAVE ABSORPTION

ABSTRACT
UF SUMMARY
SA INFORMATION RETRIEVAL SYST

ABUNDANCE
** *ADDED JANUARY 1965.*
NT (76--) SHORTAGE
NT (76--) SURPLUS
NT SHORTAGE
NT SURPLUS
SA AVAILABILITY
SA DISTRIBUTION
SA SUPPLY

ABYSSAL DEPOSIT
** *FOR LAKES, INDEX LAKE DEPOSIT PLUS DEEP WATER.*
65-66) INDEX ALSO AS
SEDIMENTARY ROCK(S).

ABYSSAL DEPOSIT (Cont'd)
SEDIMENT(S) (GEOLOGY) AS APPLICABLE.
BT (67-75) DEPOSIT (GEOLOGY)
UF ABYSSAL SAMPLE
UF DEEP SEA DEPOSIT
BT MARINE DEPOSIT
DEPOSIT (GEOLOGY)
SA SEDIMENT (GEOLOGY)
SA SEDIMENTARY ROCK

ABYSSAL ENVIRONMENT
** *FOR LAKES, INDEX LAKE PLUS DEEP WATER.*
(70-75) INDEX ALSO AS DEPOSITIONAL ENVIRONMENT, IF APPLICABLE.
BT (65-66) DEPOSITIONAL ENVIRONMENT(S)
BT (67-75) ENVIRONMENT
BT MARINE ENVIRONMENT
DEPOSITIONAL ENVIRONMENT
ENVIRONMENT
SA APHOTIC ZONE
SA BATHYAL ENVIRONMENT
SA COMPENSATION DEPTH
SA DEEP SEA
SA DEEP WATER
SA NERITIC ENVIRONMENT
SA QUIET WATER ENVIRONMENT
SA SHALLOW WATER ENVIRONMENT

ABYSSAL HILL
** *ADDED SEPTEMBER 1970*
USED (65-70) SUBMARINE TOPOGRAPHY.
BT (76--) SUBMARINE TOPOGRAPHY
BT SUBMARINE TOPOGRAPHY
UNDERWATER TOPOGRAPHY
TOPOGRAPHY
SA ABYSSAL PLAIN
SA SEAMOUNT

ABYSSAL PLAIN
** *BT (65-66) SUBMARINE TOPOGRAPHY*
BT (67-75) PLAIN
BT SUBMARINE TOPOGRAPHY
UNDERWATER TOPOGRAPHY
TOPOGRAPHY
SA ABYSSAL HILL
SA OCEAN BASIN
SA PLAIN

ABYSSAL SAMPLE
USE ABYSSAL DEPOSIT

ACADEMIC
** *ADDED MARCH 1967*
USED (65-66) TRAINING PROGRAM(S).
NT (76--) EDUCATION
UF UNIVERSITY
NT EDUCATION
SA THESIS

ACADIAN OROGENY
** *BT (65-66) OROGENY*
BT OROGENIC PERIOD
OROGENY
TECTONICS
SA ANTLER OROGENY

ACCELERATING AGENT
** *USED (65-66) CATALYST(S) OR CEMENT ACCELERATOR(S).*
USE CATALYST

ACIDITY
** USED (65-66) PH.
USE ACIDITY/BASICITY

ACIDITY/BASICITY
** ADDED JANUARY 1967.
USED (65-66) PH.
NT (76--) NEUTRAL
UF ACIDITY
UF ALKALINITY
NT NEUTRAL
NT PH
BT PHYSICAL PROPERTY
SA BUFFER (CHEMICAL)
SA CHEMICAL INDICATOR

ACIDIZING
** NT (76--) ATOMIZED ACIDIZING
UF ACID TREATING (WELL)
UF WELL ACIDIZING
NT ATOMIZED ACIDIZING
NT HOT ACID TREATMENT
NT JET ACIDIZING
NT SURFACTANT ACIDIZING
SA ACID
SA ACID ADDITIVE
SA ACID CLEANING (WELL)
SA ACID CORROSION
SA ACID FLOODING
SA ACID INHIBITOR
SA ACID SOLUBILITY
SA ACID SOLUBILITY (ROCK)
SA ACID SPILL
SA ACIDIZING EQUIPMENT
SA CHEMICAL INJECTION
SA ETCHING
SA FRACTURING
SA MUD ACID
SA PICKLING
SA RETARDED ACID
SA SCALE REMOVAL
SA SPEARHEAD
SA SPENT ACID
SA WELL COMPLETION
SA WELL STIMULATION
SA WELL WORKOVER

ACIDIZING EQUIPMENT
** ADDED APRIL 1968.
USED (65-67) ACIDIZING PLUS EQUIPMENT.
SA ACIDIZING

ACOUSTIC AMPLITUDE
** USED (65-75).
BT (67-75) ACOUSTIC PROPERTY
USE WAVE AMPLITUDE
PLS SOUND WAVE

ACOUSTIC ATTENUATION
** USED (65-75).
BT (65-75) ATTENUATION
USE WAVE ATTENUATION
PLS SOUND WAVE

ACOUSTIC CEMENT BOND LOG
USE CEMENT BOND LOGGING

ACOUSTIC CONTRAST
** ADDED JANUARY 1965.
BT (76--) ACOUSTIC PROPERTY
BT ACOUSTIC PROPERTY
PHYSICAL PROPERTY

ACOUSTIC DAMPING
** USED (65-75).
BT (65-75) DAMPING
USE WAVE DAMPING
PLS SOUND WAVE

ACOUSTIC DECOUPLING
** SOUND WAVE ABSORPTION BY SURROUNDING MEDIA.

ACOUSTIC DECOUPLING (Cont'd)
USED (65-69) ACOUSTIC PROPERTY
USED (69-75).
USE WAVE ABSORPTION
PLS SOUND WAVE

ACOUSTIC DENSITY LOGGING
** USED (65-69) (76--).
USED (70-75) SONIC LOGGING.
BT (65-69) (76--) ELASTIC WAVE LOGGING
BT ELASTIC WAVE LOGGING
WELL LOGGING

ACOUSTIC DETONATOR
BT DETONATOR

ACOUSTIC DRILLING
USE SONIC DRILLING

ACOUSTIC HOLOGRAPHY
** ADDED MARCH 1974.
USED (65) PHOTOGRAPHY.
USED (65-73) HOLOGRAPHY.
BT (76--) HOLOGRAPHY
BT HOLOGRAPHY
DATA PROCESSING (OPTICAL)
DATA PROCESSING
SA DATA PRESENTATION
SA PHOTOGRAPHY
SA SEISMIC DATA PROCESSING
SA THREE DIMENSIONAL MODEL

ACOUSTIC HORIZON
USE REFLECTING BED

ACOUSTIC IMPEDANCE
** BT (65-66) ELASTICITY
BT ACOUSTIC PROPERTY
PHYSICAL PROPERTY
SA DENSITY
SA ELASTICITY
SA WAVE PROPERTY
SA WAVE VELOCITY

ACOUSTIC IMPEDANCE LOGGING
USE ELASTIC WAVE LOGGING

ACOUSTIC LOG EQUIPMENT
** USED (65-69) ELASTIC WAVE LOGGING PLUS WELL LOGGING EQUIPMENT.
USED (70-75) SONIC LOGGING PLUS WELL LOGGING EQUIPMENT.
USE ELASTIC WAVE LOGGING
PLS WELL LOGGING EQUIPMENT

ACOUSTIC LOGGING
** USED (65-69) ELASTIC WAVE LOGGING.
USE SONIC LOGGING

ACOUSTIC PROPERTY
** NT (67-75) ACOUSTIC AMPLITUDE
NT (76--) ACOUSTIC CONTRAST
NT (67--) ACOUSTIC IMPEDENCE
BT (67--) PHYSICAL PROPERTY
NT ACOUSTIC CONTRAST
NT ACOUSTIC IMPEDANCE
BT PHYSICAL PROPERTY
SA ACOUSTICS
SA CAVITATION
SA SEISMIC WAVE
SA SOUND VELOCITY
SA SOUND WAVE
SA WAVE PROPERTY

ACOUSTIC RECEIVER
** BT (76--) RECEIVER (ELECTRONIC)
BT RECEIVER (ELECTRONIC)
ELECTRONIC EQUIPMENT
ELECTRICAL EQUIPMENT

ACOUSTIC RECEIVER (Cont'd)
SA ELECTROMAGNETIC TRANSDUCER
SA ELECTROMECHANICAL TRANSDUC
SA GEOPHONE
SA HYDROPHONE
SA MAGNETIC TRANSDUCER
SA MICROPHONE
SA TRANSDUCER

ACOUSTICS
UF SONICS
NT ULTRASONICS
SA ACOUSTIC PROPERTY
SA CEMENT BOND LOGGING
SA REFLECTION (SOUND)
SA ULTRASONIC WAVE

ACQUISITION
UF DATA ACQUISITION
WTH DATA
UF PROCUREMENT
UF PURCHASING
BT ADMINISTRATION
BUSINESS OPERATION
SA ABC TRANSACTION
SA ACREAGE
SA AUCTION
SA BID
SA LAND AND LEASING
SA LEASE BONUS

ACREAGE
UF PRODUCTION ACREAGE
WTH PRODUCING
UF PRODUCTIVE ACREAGE
WTH PRODUCING
BT LAND AND LEASING
ECONOMIC FACTOR
SA ARC TRANSACTION
SA ACQUISITION
SA ASSET
SA GAS LEASE
SA MINERAL RIGHT
SA OIL LEASE
SA PROPERTY (REAL)
SA PROVED AREA
SA RESERVE

ACRITARCH
** ADDED MARCH 1965.
SA MICROFOSSIL
SA MICROORGANISM
SA NANNOFOSSIL
SA PALYNOLOGY

ACT
* AUTOMATIC CUSTODY TRANSFER
USE LACT

ACTIVATED ALUMINA
** ADDED AUGUST 1974.
USED (65-74) ALUMINUM OXIDE.
BT (76--) ALUMINA
BT ALUMINA
SA CATALYST

ACTIVATED CARBON
USE ACTIVATED CHARCOAL

ACTIVATED CHARCOAL
** BT (65-66) (70--) CHARCOAL
UF ACTIVATED CARBON
BT CHARCOAL
SA ADSORBENT
SA CARBON BLACK
SA SOLID ADSORBENT

ACTIVATED SILICA
** ADDED APRIL 1965.
USED (65) SILICA.
BT (76--) SILICA
BT SILICA

ACTIVATION
** NT (65-75) REGENERATION
UF ACTUATION
SA ACTIVITY
SA GO DEVIL
SA RADIATION ANALYSIS
SA REGENERATION
SA STARTUP

ACTIVITY
** NT (67--) CORROSIVITY
NT (67--) INERT
NT (67--) REDOX POTENTIAL
BT (67--) PHYSICAL PROPERTY
NT CORROSIVITY
NT INERT
NT REDOX POTENTIAL
BT PHYSICAL PROPERTY
SA ACTIVATION
SA OPTICAL ACTIVITY

ACTIVITY COEFFICIENT
** ADDED JANUARY 1968.
USED (65-67) ACTIVITY PLUS COEFFICIENT(S).
UF DEBYE HUCKEL EQUATION
BT THERMODYNAMIC PROPERTY
PHYSICAL PROPERTY
SA KINETICS

ACTUATION
USE ACTIVATION

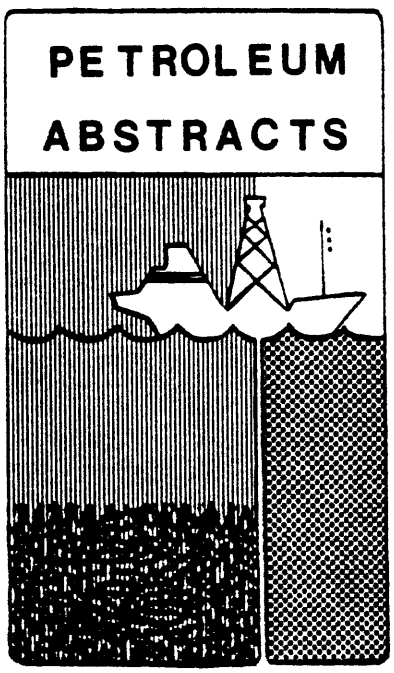
ADDITIVE
** INDEX ALSO BY SPECIFIC CHEMICAL NAMES, IF POSSIBLE. (65-66) INDEX ALSO AS SPECIFIC CHEMICALS.
NT (67--) ACID ADDITIVE
NT (65-66) BACTERIA INHIBITORS
NT (67--) BACTERIOSTAT
NT (67--) COMPLEXING AGENT

NT (67--) DEODORANT
NT (76--) DEPRESSANT
NT (67--) DISPERSANT
NT (67--) EXPANDED PERLITE
NT (67--) FOAMING AGENT
NT (67--) FRACTURING FLUID ADDITIVE
NT (67--) FRICTION LOSS ADDITIVE
NT (67--) GEL BREAKER
NT (67--) GELLING AGENT
NT (67--) INHIBITOR
NT (67--) MUD ADDITIVE
NT (67-75) MUD PRESERVATIVE
NT (67--) NEUTRALIZER
NT (67--) ODORANT
NT (67--) RETARDER
NT (76--) SENSITIZER
NT (67--) SURFACE ACTIVE AGENT
NT (76--) WAX CRYSTAL MODIFIER
NT (67--) WEIGHTING MATERIAL
NT (67--) WETTING AGENT
NT ACID ADDITIVE
NT ANTIFOAMING AGENT
NT ANTIFOULING AGENT
NT ANTIOXIDANT ADDITIVE
NT ANTISTATIC AGENT
NT BACTERIOSTAT
NT CEMENT ADDITIVE
NT COMPLEXING AGENT
NT DEMULSIFIER
NT DEODORANT
NT DEPRESSANT
NT DISPERSANT
NT EXPANDED PERLITE
NT FLOCCULANT
NT FLUID LOSS ADDITIVE
NT FOAMING AGENT

KEY
WORD
OUT OF
CONTEXT

7th Edition
January 1, 1978

KWOC LIST
OF PETROLEUM ABSTRACTS' EXPLORATION & PRODUCTION THESAURUS AND SELDOM-USED DESCRIPTORS FROM THE SUPPLEMENTARY WORD LIST



THE UNIVERSITY OF TULSA
Information Services Division
1133 North Lewis Avenue
Tulsa, Oklahoma 74110

INFORMATION SERVICES KWOC LIST

This KWOC (Key Word Out of Context) list is a quick reference guide to valid multi-word descriptors that contain the same word in common. For example, "Acid Additive" and "Organic Acid" both contain the word "Acid", but these descriptors would not appear together in a listing sorted alphabetically by the primary word. The KWOC list consists of two columns, the right hand column containing the complete valid descriptors, the left hand column listing the individual word components, arranged alphabetically. Thus, a descriptor consisting of three words would appear three times in the KWOC list, cross-referenced alphabetically by each of its component words. For example, "Fluid Flow Equation" appears in the alphabetically sorted list, opposite the words "Equation", "Flow", and "Fluid".

Each page consists of two double columns of words and complete descriptors, or a total of four columns. This list contains only valid descriptors from the E & P Thesaurus and the Engineering Supplemental list. The Supplemental descriptors are specially marked with an asterisk.

Some words within a descriptor have been truncated due to space limitations. Such words are expanded to full length and appear in normal alphabetical order, in the single-word listing. Words within a descriptor which are parenthesized also appear in this listing. Descriptors containing words such as: of, the, to, etc., are not cross-referenced under these words, due to the lack of useful information these words convey. This KWOC list may be used by indexers or searchers to find out what valid descriptors are available, containing a particular word. It does not include words from the Geographic Thesaurus, or the Chemicals, Companies or Geologic Supplemental lists.

A=1	*DOWEX A=1
AADOC	AADOC SPECIFICATION
ABANDONMENT	ABANDONMENT
ABC	ABC TRANSACTION
ABIOGENESIS	ABIOGENESIS
ABOVEGROUND	ABOVEGROUND STOR FACILITY
ABOVEWATER	ABOVEWATER STOR FACILITY
ABRASION	ABRASION (GEOLOGY)
ABRASIVE	ABRASIVE
ABRASIVE	ABRASIVE JET
ABSORBENT	ABSORBENT
ABSORBER	ABSORBER
ABSORBER	SHOCK ABSORBER
ABSORPTION	ABSORPTION
ABSORPTION	ABSORPTION OIL
ABSORPTION	ABSORPTION PROCESS
ABSORPTION	ABSORPTION SPECTROSCOPY
ABSORPTION	ATOMIC ABSORPTION SPECTROS
ABSORPTION	GAMMA RAY ABSORPTION
ABSORPTION	GAS ABSORPTION
ABSORPTION	INFRARED ABSORPTION
ABSORPTION	LEAN OIL ABSORPTION
ABSORPTION	WAVE ABSORPTION
ABSTRACT	ABSTRACT
ABUNDANCE	ABUNDANCE
ABYSSAL	ABYSSAL DEPOSIT
ABYSSAL	ABYSSAL ENVIRONMENT
ABYSSAL	ABYSSAL HILL
ABYSSAL	ABYSSAL PLAIN
ACADEMIC	ACADEMIC
ACADIAN	ACADIAN OROGENY
ACCELERATION	ACCELERATION
ACCELERATOR	ACCELERATOR
ACCELERATOR	CEMENT ACCELERATOR
ACCELERATOR	PARTICLE ACCELERATOR
ACCELEROMETER	ACCELEROMETER
ACCESSIBILITY	ACCESSIBILITY
ACCIDENT	ACCIDENT
ACCOUNTING	ACCOUNTING
ACCOUNTING	ACCOUNTING MACHINE
ACCRETION	ACCRETION
ACCUMULATING	ACCUMULATING
ACCUMULATION	ACCUMULATION RATE
ACCURACY	ACCURACY
ACENTRIC	ACENTRIC FACTOR
ACETATE	ACETATE PEEL
ACID	ACID
ACID	ACID ADDITIVE
ACID	ACID CLEANING (WELL)
ACID	ACID CORROSION
ACID	ACID FLOODING
ACID	ACID INHIBITOR
ACID	ACID OIL EMULSION
ACID	ACID SOLUBILITY
ACID	ACID SOLUBILITY (ROCK)
ACID	ACID SPILL
ACID	HOT ACID TREATMENT
ACID	MUD ACID
ACID	ORGANIC ACID
ACID	RETARDED ACID
ACID	SPENT ACID
ACIDIC	ACIDIC ROCK
ACIDITY	ACIDITY/BASICITY
ACIDIZING	ACIDIZING
ACIDIZING	ACIDIZING EQUIPMENT
ACIDIZING	ATOMIZED ACIDIZING
ACIDIZING	JET ACIDIZING
ACIDIZING	SURFACTANT ACIDIZING
ACOUSTIC	ACOUSTIC CONTRAST
ACOUSTIC	ACOUSTIC DENSITY LOGGING
ACOUSTIC	ACOUSTIC DETONATOR
ACOUSTIC	*ACOUSTIC EMISSION
ACOUSTIC	ACOUSTIC HOLOGRAPHY
ACOUSTIC	ACOUSTIC IMPEDANCE
ACOUSTIC	ACOUSTIC PROPERTY
ACOUSTIC	ACOUSTIC RECEIVER
ACOUSTICS	ACOUSTICS
ACQUISITION	ACQUISITION
ACREAGE	ACREAGE
ACRITARCH	ACRITARCH
ACTINOLITE	*ACTINOLITE
ACTION	FROST ACTION
ACTIVATED	ACTIVATED ALUMINA
ACTIVATED	ACTIVATED CHARCOAL
ACTIVATED	ACTIVATED SILICA
ACTIVATION	ACTIVATION
ACTIVATION	GAMMA ACTIVATION ANALYSIS
ACTIVATION	NEUTRON ACTIVATION ANALYS
ACTIVATION	*PHOTON ACTIVATION ANALYSIS
ACTIVE	SURFACE ACTIVE AGENT
ACTIVITY	ACTIVITY
ACTIVITY	ACTIVITY COEFFICIENT
ACTIVITY	CREW ACTIVITY
ACTIVITY	OPTICAL ACTIVITY
ACTIVITY	SURFACE ACTIVITY
ACTUATOR	VALVE ACTUATOR
ADDITIVE	ACID ADDITIVE
ADDITIVE	ADDITIVE
ADDITIVE	ANTIOXIDANT ADDITIVE
ADDITIVE	CEMENT ADDITIVE
ADDITIVE	FLUID LOSS ADDITIVE
ADDITIVE	FRACTURING FLUID ADDITIVE
ADDITIVE	FRICTION LOSS ADDITIVE
ADDITIVE	LOST CIRCULATION ADDITIVE
ADDITIVE	MUD ADDITIVE
ADDITIVE	ORGANIC MUD ADDITIVE
ADDITIVE	STABILIZER (ADDITIVE)
ADHESION	ADHESION
ADHESIVE	ADHESIVE
ADIABATIC	ADIABATIC CONDITION
ADJUSTABILITY	ADJUSTABILITY
ADJUSTABLE	ADJUSTABLE ANCHOR
ADJUSTMENT	CRUSTAL ADJUSTMENT
ADMINISTRATION	ADMINISTRATION
ADMIX	ADMIX CEMENT
ADMITE	ADMITE
ADSORBENT	ADSORBENT
ADSORBENT	SOLID ADSORBENT
ADSORBER	ADSORBER
ADSORPTION	ADSORPTION
ADSORPTION	ADSORPTION CAPACITY
ADSORPTION	ADSORPTION COLUMN
ADSORPTION	ADSORPTION PROCESS
ADSORPTION	GAS ADSORPTION
ADSORPTION	HEAT OF ADSORPTION
ADVANCE	FRONTAL ADVANCE EQUATION
ADVERTISING	ADVERTISING
AERATED	AERATED MUD
AERATED	AERATED WATER
AERATION	AERATION
AERATOR	AERATOR
AERIAL	AERIAL
AERIAL	AERIAL MAP
AERIAL	AERIAL MAPPING
AERIAL	AERIAL PHOTOGRAPH
AERIAL	AERIAL PHOTOGRAPHY
AERIAL	AERIAL SURVEY
AERIAL	AERIAL TRANSPORTATION
AEROBIC	AEROBIC BACTERIA
AEROBIC	AEROBIC DEPOSIT
AEROBIC	AEROBIC ENVIRONMENT
AERODYNAMICS	*AERODYNAMICS
AEROMAGNETIC	AEROMAGNETIC EXPLORATION
AEROMAGNETIC	AEROMAGNETIC SURVEY
AERORADIOMETRY	AERORADIOMETRY
AEROSPACE	AEROSPACE INDUSTRY
AFMAG	AFMAG METHOD
AFTERFLOW	AFTERFLOW
AGA	AGA SPECIFICATION
AGAR	AGAR AGAR
AGC	AGC
AGE	EARTH AGE
AGE	GEOLOGIC AGE DETERMINATION
AGE	ICE AGE
AGE	RADIOACTIVE AGE DETERMINAT
AGENCY	REGULATORY AGENCY
AGENT	ANTIFOAMING AGENT
AGENT	ANTIFOULING AGENT
AGENT	ANTISTATIC AGENT
AGENT	COLLECTING AGENT
AGENT	COMPLEXING AGENT
AGENT	DRYING AGENT
AGENT	FOAMING AGENT
AGENT	GELLING AGENT
AGENT	OXIDIZING AGENT
AGENT	PLUGGING AGENT
AGENT	REDUCING AGENT
AGENT	REINFORCING AGENT
AGENT	SURFACE ACTIVE AGENT
AGENT	WETTING AGENT
AGGLOMERATE	AGGLOMERATE
AGING	AGING
AGITATED	AGITATED WATER ENVIRONMENT
AGITATING	AGITATING
AGITATOR	AGITATOR
AGRICULTURE	AGRICULTURE
AID	VISUAL AID
AIR	AIR
AIR	AIR CONDITIONING
AIR	AIR COUPLED WAVE
AIR	AIR DRILLING
AIR	AIR FLOW
AIR	AIR FUEL RATIO
AIR	AIR GUN
AIR	AIR HAMMER DRILLING
AIR	AIR INJECTION
AIR	AIR POLLUTION
AIR	AIR SHOOTING
AIR	AIR TURBINE
AIR	AIR WAVE
AIR	FREE AIR ANOMALY
AIR	FREE AIR CORRECTION
AIRCRAFT	AIRCRAFT
AIRY	AIRY WAVE
ALARM	ALARM
ALBERTITE	ALBERTITE
ALCOHOL	ALCOHOL
ALCOHOL	ALCOHOL SLUG PROCESS
ALGA	ALGA
ALGA	CALCAREOUS ALGA

*=THESAURUS ADDENDA

ALGAL
ALGAL
ALGEBRA
ALGEBRA
ALGICIDE
ALGINITE
ALGOL
ALGORITHM
ALICYCLIC
ALIGNMENT
ALIPHATIC
ALITE
ALKALI
ALKENYLATION
ALKYLATION
ALLIED
ALLOCATION
ALLOCHTHON
ALLOPHANE
ALLOWABLE
ALLOWABLE
ALLOWABLE
ALLOWANCE
ALLOWANCE
ALLOY
ALLOY
ALLOY
ALLUVIAL
ALLUVIAL
ALLUVIAL
ALLUVIUM
ALLUVIUM
ALPHA
ALPHA
ALPINE
ALTERATION
ALTERATION
ALTERATION
ALTERATION
ALTERNATING
ALTERNATING
ALTIMETER
ALTITUDE
ALUMINA
ALUMINA
ALUMINOUS
ALUMINUM
ALUMINUM
ALUMINUM
ALUMINUM
ALUMINUM
ALUNITE
AMBIENT
AMINE
AMMETER
AMMONIA
AMORPHOUS
AMPHIBIAN
AMPHIBIOUS
AMPHIBOLITE
AMPHINEURAN
AMPHIPATHIC
AMPLIFIER
AMPLIFIER
AMPLIFIER
AMPLIFIER
AMPLIFIER
AMPLIFIER
AMPLIFIER
AMPLITUDE
AMPLITUDE
AMPLITUDE
AMPLITUDE
AMPLITUDE
AMPLITUDE
ANAEROBIC
ANALCIME
ANALOG
ANALOG
ANALOG
ANALOG
ANALOG
ANALOG
ANALOGY
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS

ALGAL FACIES
ALGAL REEF
MATRIX ALGEBRA
TENSOR ALGEBRA
ALGICIDE
ALGINITE
ALGOL
ALGORITHM
ALICYCLIC HYDROCARBON
ALIGNMENT
ALIPHATIC HYDROCARBON
ALITE
ALKALI VAPOR MAGNETOMETER
ALKENYLATION
*ALKYLATION
URANIUM & ALLIED MINERALS
*ALLOCATION
ALLOCHTHON
ALLOPHANE
ALLOWABLE FORMULA
ALLOWABLE PRODUCTION
FIELD ALLOWABLE
WELL ALLOWABLE
DEPLETION ALLOWANCE
DEPRECIATION ALLOWANCE
ALLOY
FERROUS ALLOY
NONFERROUS ALLOY
ALLUVIAL FAN
ALLUVIAL FAN DEPOSIT
ALLUVIAL PLAIN
ALLUVIAL PLAIN DEPOSIT
ALLUVIUM
BOULDERY ALLUVIUM
ALPHA PARTICLE
LEAD ALPHA DATING
ALPINE OROGENY
ALTERATION
GRAIN ALTERATION
HYDROTHERMAL ALTERATION
*THERMAL ALTERATION
ALTERNATING CURRENT
ALTERNATING FLOW
ALTIMETER
HIGH ALTITUDE
ACTIVATED ALUMINA
ALUMINA
ALUMINOUS CEMENT
ALUMINUM DEPOSIT
ALUMINUM MINERAL
ALUMINUM PELLET
ALUMINUM PIPE
HYDROXY ALUMINUM PROCESS
ALUNITE
AMBIENT
AMINE
AMMETER
LIQUID AMMONIA
AMORPHOUS
AMPHIBIAN
AMPHIBIOUS TRANSPORTATION
AMPHIBOLITE
AMPHINEURAN
AMPHIPATHIC SOLVENT
AMPLIFIER
FEEDBACK AMPLIFIER
FIELD AMPLIFIER
FLUID AMPLIFIER
PLAYBACK AMPLIFIER
RECORDING AMPLIFIER
SEISMIC AMPLIFIER
WIDE BAND AMPLIFIER
AMPLITUDE
AMPLITUDE CHARACTERISTIC
AMPLITUDE CURVE
AMPLITUDE MODULATION
AMPLITUDE RESPONSE
LOW AMPLITUDE WAVE
WAVE AMPLITUDE
ANAEROBIC BACTERIA
ANALCIME
ANALOG
ANALOG COMPUTER
ANALOG RECORDING
ANALOG SIGNAL
ANALOG TELEMETERING
DIGITAL TO ANALOG CONVERTR
ANALOGY
ANALYSIS OF VARIANCE
BUCKLING ANALYSIS
CASH FLOW ANALYSIS
CLUSTER ANALYSIS
*COAL ANALYSIS
CONFORMATIONAL ANALYSIS
CORE ANALYSIS
CORE ANALYSIS DATA
COST ANALYSIS
CUTTINGS ANALYSIS
DATA ANALYSIS
DIFFERENTIAL THERMAL ANAL
DIFFRACTION ANALYSIS
DIMENSIONAL ANALYSIS

ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYSIS
ANALYTICAL
ANALYZER
ANALYZER
ANALYZER
ANALYZER
ANALYZER
ANATASE
ANATOMY
ANCHOR
ANCHOR
ANCHOR
ANCHOR
ANCHOR
ANCHOR
ANCHOR
ANCHOR
ANCHOR
ANCHOR
ANCHOR
ANCHOR
ANCHOR
ANCHOR
ANCHORING
ANCHORING
ANCHORING
ANCIENT
ANDEAN
ANDESITE
ANDESITIC
ANEMOMETER
ANGIOSPERM
ANGLE
ANGLE
ANGLE
ANGLE
ANGLE
ANGLE
ANGLE
ANGULARITY
ANHYDRITE
ANHYDRITE
ANHYDROUS
ANIMAL
ANION
ANISOTROPIC
ANISOTROPIC
ANISOTROPY
ANISOTROPY
ANKERITE
ANNUAL
ANNULAR
ANNULUS
ANODE
ANODE
ANODIC

DRILL STEM TEST ANALYSIS
ELECTRON DIFFRACTION ANALY
ELECTROTHERMAL ANALYSIS
ELEMENTAL ANALYSIS
ELUTRIATION ANALYSIS
EMPIRICAL ANALYSIS
FACTOR ANALYSIS
FOURIER ANALYSIS
FREQUENCY ANALYSIS
GAMMA ACTIVATION ANALYSIS
GAS ANALYSIS
GRAIN SIZE ANALYSIS
HYDROCARBON ANALYSIS
MATHEMATICAL ANALYSIS
MINERAL ANALYSIS
MULTIVARIATE STAT ANALYSIS
NEUTRON ACTIVATION ANALYS
NUMERICAL ANALYSIS
ORSAT ANALYSIS
*PHOTON ACTIVATION ANALYSIS
POINT COUNT ANALYSIS
PRESSURE BUILDUP ANALYSIS
PRINCIPAL COMPONENT ANALYS
RADIATION ANALYSIS
RADIOCHEMICAL ANALYSIS
REGRESSION ANALYSIS
ROCK ANALYSIS
SAMPLE ANALYSIS
SEDIMENT ANALYSIS
SEISMIC WAVE ANALYSIS
SENSITIVITY ANALYSIS
SETTLING TUBE ANALYSIS
SOIL ANALYSIS
SOIL GAS ANALYSIS
SPECTRAL ANALYSIS
STATISTICAL ANALYSIS
STRESS ANALYSIS
STRUCTURAL ANALYSIS
THERMAL ANALYSIS
TIME SERIES ANALYSIS
TRACE ANALYSIS
TRACER ANALYSIS
TREND ANALYSIS
VECTOR ANALYSIS
WATER ANALYSIS
X RAY ANALYSIS
X RAY DIFFRACTION ANALYSIS
ANALYTICAL METHOD
ANALYZER
FREQUENCY ANALYZER
GAS ANALYZER
HOT WIRE GAS ANALYZER
STREAM ANALYZER
*ANATASE
COMPARATIVE ANATOMY
ADJUSTABLE ANCHOR
ANCHOR
ANCHOR (MARINE)
ANCHOR (STRUCTURAL)
ANCHOR (WELL)
ANCHOR CATCHER
ANCHOR HEAD
ANCHOR PACKER
ANCHOR PIPE
ANCHOR SHOE
GAS ANCHOR
PERFORATED ANCHOR
TUBING ANCHOR
WALL ANCHOR
ANCHORING
PIPELINE ANCHORING
SHIP ANCHORING
ANCIENT SHORELINE
ANDEAN OROGENY
ANDESITE
ANDESITIC TUFF
ANEMOMETER
ANGIOSPERM
ANGLE OF REPOSE
CRITICAL ANGLE
EMERGENCE ANGLE
HIGH ANGLE FAULT
LOW ANGLE FAULT
PHASE ANGLE
WIDE ANGLE REFLECTION
GRAIN ANGULARITY
ANHYDRITE
SECONDARY ANHYDRITE
ANHYDROUS
ANIMAL OIL
ANION
ANISOTROPIC INDEX
ANISOTROPIC STRESS
ANISOTROPY
VELOCITY ANISOTROPY
ANKERITE
ANNUAL REPORT
ANNULAR FLOW
ANNULUS
ANODE
SACRIFICIAL ANODE
ANODIC PROTECTION

GEOREF Thesaurus and Guide to Indexing

Second Edition

Edited by
Carol Heckman and others

Published by the
AMERICAN GEOLOGICAL INSTITUTE

Earlier Edition:
GeoRef Thesaurus and Guide to Indexing, First Edition

GeoRef Thesaurus and Guide to Indexing, Second Edition

Library of Congress Catalog Card Number 78-65083
International Standard Book Number 0-913312-07-X
Printed in the United States of America

American Geological Institute
5205 Leesburg Pike
Falls Church, Virginia 22041

The Thesaurus was photocomposed on a Videocomp from a tape generated by SAMANTHA programs. Eterna bold and light fonts were used for the text.

Cover photograph: San Andreas Fault
This is on the Carrizo Plain, about half way between Los Angeles and San Francisco. (Photo by Robert E. Wallace, U.S. Geological Survey)
Reprinted from *Geotimes*, February 1975

CONTENTS

INTRODUCTION

The second edition of the GeoRef Thesaurus and Guide to Indexing contains over 12,500 terms, of which approximately 3000 are new. There are geographic place names, systematic terms (rocks, fossils, minerals, etc.) and non-systematic terms (geologic features, processes, properties, materials, etc.).

The ANSI Z39 Standard, Guidelines for Thesaurus Structure, Construction and Use (1974), has been followed herein.[1]

SOURCE OF THE VOCABULARY

Since May 1978, GeoRef has included five segments, the first three of which are new additions:

(1) Bibliography and Index of North American Geology (1961-1970)
(2) Bibliography of Theses in Geology (1965-1966)
(3) Geophysical Abstracts (1966-1971)
(4) Bibliography and Index of Geology Exclusive of North America (1967-1968)
(5) Bibliography and Index of Geology (1969 to present)

The index terms and sets used in all five segments have much in common. They derive from a common source, the early volumes of the Bibliography and Index of North American Geology. This Thesaurus is based on that indexing vocabulary as it has evolved down the years. It displays, interrelates, and regularizes the vocabulary.

This edition has been derived from terms in GeoRef file Segments 4 and 5. Most of the terms in Segments 1-3 are also included, but we have been unable as yet to study the indexing in those Segments in detail in order to incorporate notes and cross-references for them. We intend to do so. Meanwhile, help in searching Segments 1-3 can be found in List A of the Guide.

INDEXING

Prior to 1977 when the first edition of the Thesaurus appeared, the Guide to Indexing was the only tool available for GeoRef indexers and searchers. The Guide, which consists of structured lists of terms, has been revised and is included herein, with its own Introduction.

GeoRef indexing is in three level sets (see the Introduction to the Guide), which follow definite rules which can be found under each first level term in the Thesaurus.

First and second level terms have been tightly controlled in GeoRef, and few changes have been made in terms on these levels. Level three has been

---

1. Available from the American National Standards Institute, 1430 Broadway, New York, N. Y., 10018. Price $4.50.

more open-ended to accommodate specific locations, minerals, etc. Beginning in 1978, level three has been shortened to a single term. The other terms which had been included in level three became supplemental index terms. This change does not affect searching. Its effect on the printed indexes is evident by a comparison between 1978 and earlier publications. Briefly, the 1978 indexes have a single term plus title on level three instead of a term string. Also in 1978 cross-references were added to the index and selected supplemental terms to the citations.

Over 1500 terms are valid on levels one and two. All are included herein. Also included are all systematic and geographic level three terms used over four times and all non-systematic terms used over 24 times.

AUTOPOSTING

If a term appears in the indexing of a document, it does not necessarily follow that its broader terms will appear. Certain broader terms will be added because they are called for by the set structures. For example, for most geographic, stratigraphic, and fossil narrower terms, one, but not every broader term is required by the set structures. Other broader terms are added to facilitate computer searching.

As of January 1978, selected broader terms are autoposted (automatically added) by the computer. For example, each time Kansas is entered by an editor/indexer, the computer adds United States.

Those broader terms which are autoposted are designated as BA or BZ terms. For example:

apatite
BA phosphates
BT minerals

(Each time apatite is indexed, phosphates is autoposted, but minerals is not autoposted.)

Autoposting is used selectively for:

a. Areas (see List O in the Guide)
b. Age and stratigraphic terms, excluding formations (see List E)
c. Fossils (see List F)
d. Igneous, sedimentary, and metamorphic rocks (see Lists H, I, J)
f. Sediments (see List N)
g. Minerals (see List L)
h. Soils (see List M)
i. Non-systematic terms (in only a few cases, such as faults)

TERM RELATIONSHIPS

In term entries, relationships are indicated by the tags CO, UF, BT, BA, BX, BZ, NT, NA, NX, NZ, and SA.

a. Geographic Coordinates--

In use since September 1977, coordinates are assigned to the principal area(s) studied in a document.

A fix fielded format of thirty characters is used to represent coordinates. For example, the coordinates for Alabama, lat. N30°-N35°, long. W85°-W88°30' are given as:

N300000N350000
W0850000W0883000

Principal geographic areas and a few others have coordinates herein. Any area is eligible and coordinates will be added for more areas. Coordinates for areas are used as needed, whether or not they appear herein.

Coordinates are used in addition to applicable area terms. For more information see inside front cover.

b. Use/Used For--

The use/used for (UF) relationship indicates synonyms or alternate spellings of a term. For example:

columbium
    use niobium

Ezan Cape
    use Esan Cape

Also, inverted forms of multiword terms have been cross-referenced when appropriate. For example:

control, erosian
    use erosion control

c. Broader Term/Narrower Term--

The broader term/narrower term relationship is that of genus to species. The broader term represents a class of which the narrower term is a member. For example:

olivine group
    BA orthosilicates
       silicates
    BT minerals

The narrower term cannot be a part of the broader term, in a part-whole relationship, except in the case of geographic place names and geologic age terms.

Variants of BT-NT introduced in this edition are BA-NA, BX-NX, and BZ-NZ.

BA-NA indicates autoposting (see Autoposting above).

BX-NX shows logical broader terms on the same hierarchical level or from different hierarchies. For example:

Chautauqua County
BX Kansas
New York
BT United States

(Both Kansas and New York have a Chatauqua County.)

BZ-NZ is for a combination of BA-NA and BX-NX. For example:

Hawaii
BZ Pacific Ocean
United States

(The broader terms are from different hierarchies and both are autoposted by Hawaii.)

d. See Also--

The see also (SA) indicates related terms or terms often appearing together in GeoRef indexing other than broader terms and narrower terms. Examples are:

Gallup Sandstone
BT Upper Cretaceous
BT Cretaceous
SA Mesaverde Group
SA New Mexico

geochronology
SA absolute age

NOTES

A note may occur immediately after a term to indicate the following:

a. Date Term Became Valid--If no date is given, the term is valid for GeoRef Segments 4 and 5. If a date is given, this is the year in which the term began to be used in GeoRef. (It is not the year in which the term was added to the Thesaurus.)

b. Set Level--The set level on which the term is currently used may be given. For example:

boudinage
includes use on level 3 under sedimentary structures (1) soft sediment deformation (2)...

(Boudinage can be found under soft sediment deformation, which is a second level term under sedimentary structures.)

All valid index terms can be used on level three. Unless otherwise specified in a note, a term cannot be used on level one or two. List A in the Guide shows the valid first level terms for all segments of GeoRef.

c. Set Structure--For each valid level one term, the Thesaurus shows how the sets are to be structured.

d. Usage--The phrase "includes use", which occurs frequently in the notes, suggests an example of current and significant GeoRef usage, but is not meant as a listing of all possibilities. It means "this is an important use", but not "this is the only use".

e. Reference to the Guide--Notes may refer to the lists in the Guide.

f. Previously Used Term--If a term has had 100 or more postings, but is no longer valid for indexing, a note appears under that term in the Thesaurus and a note to "also search" the term occurs under the preferred term entry.

For invalid terms with a frequency of less than 100, there are notes to "also search" the term in the entry of the preferred Thesaurus term. There may be a UF also if it is appropriate.

g. Geography and Stratigraphy--Brief notes are given for most terms to assist the user in locating an area. Directions are abbreviated in these notes as N, E, S, and W.

h. Combined Terms--Usually only single terms occur on any level of a set. However, a few terms can occur together, separated by commas, such as mineral deposits, genesis. Explanatory notes are provided under each of these terms.

MULTILINGUAL THESAURUS

A multilingual thesaurus in geology is being developed by an IUGS/ICSU AB Working Group, of which G. N. Rassam, Chief Editor of GeoRef, is a member. One decision of this Group was not to use adjectives as terms. We have moved to conform to this decision (see Adjectives, below).

ADJECTIVES

Due to the Multilingual Thesaurus and to the dropping of term strings on level three (see under Indexing), several hundred adjectives have been replaced by nouns. For example:

andesitic	became	andesitic composition
disseminated	became	disseminated deposits
sublittoral	became	sublittoral environment

The only remaining group of adjectives are age terms (see List E).

TERM VALIDATION

The Thesaurus on computer tape is the source of direct access validation files currently in use to check the spelling, capitalization, and level of

terms. Index terms which don't validate can be accepted by overriding the validation. These become candidate Thesaurus terms when they have occurred five or more times.

ALPHABETIZATION

Terms are sorted word-by-word rather than letter-by-letter. Specifically:

- -The sort is on letters, numbers, spaces and hyphens.
- -Spaces sort before hyphens; hyphens sort before letters; letters sort before numbers.
- -An open parenthesis is sorted as if it were a space.
- -All characters, including punctuation marks, other than letters, numbers, hyphens and the open parenthesis, are squeezed out in the sort, i.e., are treated as if they did not exist.
- -A few terms are identical except that one begins with a lower case letter, one with an upper case letter, e.g., alpine and Alpine. When this happens, the term with the lower case letter precedes the other term.

FEEDBACK

The computer file from which the Thesaurus was produced will be regularly updated for future editions. Users are encouraged to send in corrections and comments. Let us hear from you!

ACKNOWLEDGMENTS

The following petroleum companies provided a large portion of the support for the first edition of the Thesaurus:

Amoco Production Company
Atlantic Richfield Company
Chevron Oil Field Research Company
Exxon Production Research Company
Getty Oil Company
Phillips Petroleum Company
Shell Development Company

In particular, we are grateful to William Baum (deceased) and Margaret McLean of ARCO.

Editorial work on this edition was done by Carol Heckman with assistance from G. N. Rassam, Chief Editor, and the editors/indexers. Work on the geographical terms for the first edition was done by Ed Moon. Jack Wolfire handled the programming and photocomposition. Lesa Warren and Hazel S. Kirby typed and formatted the Guide, Introduction and front matter.

John Mulvihill
Manager, GeoRef

A

aa
use aa lava

aa lava
Term introduced in 1978. Before 1978, also search aa AND lava.
UF aa
BT lava
SA pahoehoe
volcanism

Aachen
City near the intersection of the Belgium and Netherland borders.
BT North Rhine-Westphalia
Germany

Aaland
use Aland

Aalenian
Europe. Lowermost Middle or uppermost Lower Jurassic. Includes use on level 3 under age terms(1). See list E.
BA Jurassic
BT Mesozoic
SA Dogger
Lower Jurassic
Middle Jurassic

Aar Massif
BT Switzerland

Aar Valley
River valley in central and N Switzerland. Also search Aare Valley.
UF Aare Valley
BT Switzerland

Aare Valley
use Aar Valley

Aargau
Canton in N.
BT Switzerland

Abakan
Town on Yenisei River SW of Krasnoyarsk in Khakass Autonomous Oblast.
BT Russian Republic
USSR

Abashiri
City in NE Hokkaido.
UF Abasiri
BT Hokkaido
Japan

Abasiri
use Abashiri

Abee
Village in central.
BT Alberta
Canada

Aberdeen
City on North Sea.
CO N565000N574500
W0014500W0041000
BT Scotland
Great Britain
United Kingdom

Aberdeenshire
County in NE.
BT Scotland
Great Britain
United Kingdom

Aberystwyth
Town on Saint Georges Channel.
BT Wales
Great Britain
United Kingdom

Aberystwyth Grits
Upper Llandoverian. Form part of the Ystwyth Stage. N and central Wales and NW England.
BT Silurian
SA England
United Kingdom
Wales

Abilene
Arch in central Kansas.
UF Abilene Arch
BT Kansas
United States

Abilene Arch
use Abilene

Abitibi
County on James Bay.
BT Quebec
Canada

Abkhasia
use Abkhazia

Abkhazia
Abkhaz Autonomous Soviet Socialist Republic. Also search Abkhasia.
CO N422000N432000
E0421500E0400000
UF Abkhasia
BT Georgian Republic
USSR

ablation
Includes use on level 3 under sedimentation(1).
SA glaciers
mass balance
sedimentation
wind erosion
wind transport

Abo
use Turku

abrasion
UF mechanical erosion
SA detritus
erosion
glaciation
grinding
planation

abrasives
General. Includes use as level 3 commodity term under industrial minerals(1). See list C.
SA corundum
diamonds
diatomite
garnet
industrial minerals
pumice
silica

Abruzzi
Autonomous region on the Adriatic Sea.
BT Italy
NT Chieti
Marsica

Absaroka Mountains
use Absaroka Range

Absaroka Range
Range of the Rocky Mountains. Index states as applicable. Also search Absaroka Range.
CO N433000N450000
W1090000W1101500
UF Absaroka Mountains
BT United States
SA Beartooth Mountains
Montana
Rocky Mountains
Wyoming

absarokite
Includes use on level 3 under igneous rocks(1) basalt family(2). See list H.
BA basalt family
BT igneous rocks

absolute age
For radiometric or radiogenic (isotopic) dating methods; for other methods (non-isotopic) see geochronology. Includes use on level 1; on level 2 under orogeny(1). If 1, term set options are:
dates
material [rock group, rock type, mineral name (e.g. charcoal, granite, metamorphic rocks, shells, sediments)]
methods
name of method [Ar/Ar, C-14, H-3, He-4/He-3, Io/Th, K/Ar, Pb-alpha, Pb/Pb, Pb/Th, Pb-210, Re/Os, Sr/Rb, Th/Th, Th/U, U/He, U/Pb, U-238/Pb-206, U-235/Pb-207, U/Pd, U/Th/Pb, uranium disequilibrium]
techniques
subtopic [e.g. instruments, models, sample preparation, sampling]
topic [applications, bibliography, catalogs, interpretation, philosophy]
subtopic
UF actual age (absolute age)
SA age
Ar/Ar
C-14
changes of level
charcoal
dates
diffusion
geochemistry
geochronology
He-4/He-3
Io/Th
Io/U
isochrons
isotopes
K/Ar
new methods
orogeny
Pb-210
Pb/Pb
Pb/Th
radioactive decay
radiometric properties
relative age
Sr/Rb
Th/Th
Th/U
time
U-238/Pb-206
U/He
U/Pb
U/Th/Pb
uranium disequilibrium
whole rock

absorption
Includes use on level 2 under aurora(1); on level 3 under spectroscopy(1) methods(2); on level 3 under geochemistry(1) processes(2).
SA absorption and scattering
adsorption
atomic absorption
aurora
emission spectroscopy
geochemistry
sorption
spectroscopy

absorption and scattering
Includes use on level 2 under aeronomy(1).
SA absorption
aeronomy
aurora
scattering

absorption spectroscopy
Not a valid index term. Use absorption under spectroscopy(1).

Abu Dhabi
Sheikdom. One of federation of 7 states at S end of Persian Gulf. Includes use on level 3 as an area term (list O).
BT United Arab Emirates
Arabian Peninsula

Abukuma Mountains
NE of Utsunomiya in E central Honshu. Also search Abukuma Plateau.
UF Abukuma Plateau
BT Honshu
Japan

Abukuma Plateau
use Abukuma Mountains

abundance
Includes use on level 2 under commodity terms (list C) and under chemical elements (list D); on level 2 under isotopes(1).
SA organic materials

abyssal cones
use submarine fans

abyssal environment
Term introduced in 1978. Before 1978, search environment.
SA deep-sea environment
environment
marine environment
oceanography

abyssal fans
use submarine fans

abyssal plains
Includes use on level 3 under oceanography(1).
SA continental rise
ocean basins
ocean floors
oceanography
plains

Abyssinian Rift valley
use Ethiopian Rift

abyssolith
use batholiths

Ac
use actinium

Acadian
Provincial series, Canada. Includes use on level 3 under age terms(1). See list E.
BA Middle Cambrian
Cambrian
BT Paleozoic
NT Lancara Formation
SA Acadian Phase
Canada

Acadian Orogeny
use Acadian Phase

Acadian Phase
Use Acadian for the age. Before 1978, also search Acadian Orogeny. Also search orogeny AND Acadian.
UF Acadian Orogeny
BT Devonian
SA Acadian
Antler Orogeny
orogeny

Acantharina
Suborder. Includes use on level 2 under Radiolaria(1). See list F.
BA Porulosida
Radiolaria
BT Invertebrata

acanthite
BA sulfides
BT minerals
SA argentite

Acanthodes
Genus. Includes use on level 3 under Pisces(1) Osteichthyes(2).

BA Osteichthyes
Pisces
BT Vertebrata

acanthodians
use Acanthodii

Acanthodii
Subclass. Includes use on level 3 under Pisces(1) Placodermi(2). Also search acanthodians.
UF acanthodians
BA Placodermi
Pisces
BT Vertebrata

acanthopores
SA Bryozoa

Acceglio
Village in S.
BT Italy
SA Piedmont

accelerograms
Includes use on level 3 under seismology(1). Also search acceleration; accelerographs; accelerometers.
SA engineering geology
seismology
seismometers

accessory minerals
Includes use on level 3 under petrology(1). Before 1978, search minerals AND accessory.
BT minerals
SA heavy minerals

Accomac County
use Accomack County

Accomack County
On the Delmarva Peninsula. Also search Accomac County.
UF Accomac County
BT Virginia
United States

Accra
City on the Gulf of Guinea.
BT Ghana

accretion
Term used for sedimentation through 1977. After 1977, term includes use under planetology(1) as genetic concept for the Moon and planets.
SA deposition
Moon
planetology
sedimentation

accumulation
Used as a general term.
SA deposition
glaciers
ice
precipitation
snow

accuracy
Used as a general term.
SA calibration
corrections
efficiency
errors
reliability

Acer
Genus. Includes use on level 3 under angiosperms(1) Dicotyledoneae(2).
BA Dicotyledoneae
angiosperms
BT Plantae

Acheulean
use Acheulian

Acheulian
Archaeologic classification.
UF Acheulean
Acheullian
BA Paleolithic
BT Cenozoic

Acheullian
use Acheulian

achondrites
Includes use on level 3 under meteorites(1).
BA meteorites
SA chondrites
howardites
stony irons

acid mine drainage
Before 1978, also search drainage AND mines.
SA drainage
environmental geology
mines
pollution
sulfuric acid

acidic
A valid level 2 index term through 1977. After 1977, use acidic composition on level 2 under igneous rocks(1).

acidic composition
Term introduced in 1978. Includes use on level 2 under igneous rocks(1). Before 1978, also search acidic.
SA acids
composition
igneous rocks
pH

acidity
use pH

acids
SA acidic composition
amino acids
compounds
fatty acids
fulvic acids
humic acids
pH
sulfuric acid

acmite
BA pyroxene group
chain silicates
silicates
BT minerals
SA aegirine

Aconcagua Province
Central Chile. Also search Aconcagua.
BT Chile
NT La Ligua

acoustic logging
use acoustical logging

acoustic methods
use acoustical methods

acoustic surveys
use acoustical surveys

acoustic waves
use acoustical waves

acoustical
A valid level 2 index term through 1977. After 1977, use acoustical logging on level 2 under well-logging(1).

acoustical logging
Not a valid index term from 1975 to 1977. After 1977, includes use on level 2 under well-logging(1). Before 1978, also search well-logging AND acoustic; acoustic logging.
UF acoustic logging
logging, acoustical
BA well-logging
SA acoustical methods
acoustical surveys

acoustical methods
Includes use on level 2 under geophysical methods(1). Also search acoustic methods; acoustic.
UF acoustic methods
BA geophysical methods
SA acoustical logging
acoustical surveys
deep-tow methods
echo sounding
methods
sonar methods

acoustical properties
Includes use on level 3 under engineering geology(1) or geophysical surveys(1).
SA engineering geology
geophysical surveys
physical properties
properties

acoustical surveys
Includes use on level 2 under geophysical surveys(1). Also search acoustic surveys; acoustic.
UF acoustic surveys
BA geophysical surveys
BT surveys
SA acoustical logging
acoustical methods
sonar methods

acoustical waves
Also search acoustic AND waves; acoustical AND waves; sonic waves; sound waves.
UF acoustic waves
sonic waves
sound waves
SA waves

Acqui
Town in SE.
BT Italy
SA Piedmont

acquisition, data
use data acquisition

acritarchs
Hystrichosphaerids are included here and under Dinoflagellata. Includes use on level 2 under palynomorphs(1). See list F.
BA palynomorphs
NA Baltisphaeridium
NZ Hystrichosphaeridae
SA Dinoflagellata

actinium
Includes use on level 1 and 2 as a chemical element (list D).
UF Ac
SA elements

actinolite
BA amphibole group
chain silicates
silicates
BT minerals
SA actinolite facies
asbestos

actinolite facies
Term introduced in 1978.
BT facies
SA actinolite
metamorphic rocks

Actinopterygii
Includes use on level 3 under Pisces(1) Osteichthyes(2). See list F.
BA Osteichthyes
Pisces
BT Vertebrata
NA Amiidae
SA Cyprinidae
fish

action, frost
use frost action

activation analysis
Including field applications and instruments. Includes use on level 3 under chemical analysis(1) methods(2). Also search activation.
UF radioactivation analysis
SA analysis
chemical analysis
isotopes
neutron activation analysis

activation energy
SA energy
particles

active faults
BA faults

active layer
As of 1978, term is used on level 2 under permafrost(1).
UF annually thawed layer
layer, active
mollisol
SA permafrost
soils

activity
Includes use on level 3 under geochemistry(1).
SA geochemistry

activity, igneous
use igneous activity

actual age (absolute age)
use absolute age

Acungui Group
BT Precambrian
SA Brazil
Parana

Ada County
SW Idaho.
BT Idaho
United States

Adak Island
In central part of Aleutian Islands SW of Alaska Peninsula.
BT Alaska
United States

Adalia
use Antalya

Adamawa
Administrative region in N.
BT Cameroon

adamellite
Includes use on level 3 under igneous rocks(1) granite-granodiorite family(2). See list H.
BA granite-granodiorite family
BT igneous rocks

Adamello Massif
In Rhaetian Alps in N.
BT Italy

adamite
BA arsenates
BT minerals

Adamow Mine
In W central part of country.
BT Poznan
Poland

Adams County
Index states as applicable.
BX Colorado
Idaho
Illinois
Indiana
Iowa
Mississippi
Nebraska
North Dakota
Ohio
Pennsylvania
Washington
Wisconsin
BT United States

Adana
Province in S Anatolia. Also a city.
BT Turkey
Middle East

WHAT GEOSYSTEMS DO

GEOSYSTEMS

Geosystems are geoscience information specialists and publishers of geoscience bibliographies derived from **GeoArchive**, their computerised database. **GeoArchive** has been under development since 1966 and with over 500,000 references is now the world's most comprehensive and best-indexed geoscience database. The information in **GeoArchive** can be accessed through publications, by online retrieval, by means of current or retrospective profiles, or from leased magnetic tapes.

INFORMATION SOURCES

Geosystems index more than 100,000 references each year. Apart from current literature, **GeoArchive** is being systematically updated with references dating back to the seventeenth century. A lead-in to this earlier literature is being provided by a current project to index 10,000 geoscience bibliographies; in addition, the more important journals are being indexed from the first issues.

Geosystem's criteria for inclusion of material in **GeoArchive** are that the source should be in the public domain and should have information content, even if the reference is to a small news item in a magazine. More than 10,000 geoscience serials have been identified by Geosystems and included in a computerised file called **Geoserials**; about 5,000 of these are currently being published and are indexed for **GeoArchive**. Books from more than a thousand publishers are also included. Geosystems are the only organisation to process geoscience conference material systematically: several hundred conferences are covered each year. About 100,000 geological maps from the Institute of Geological Sciences libraries are being indexed and added to **GeoArchive**. Doctoral dissertations are also included.

To achieve such comprehensive coverage of the literature, Geosystems use the resources of many large specialised libraries, ensuring unbiased international coverage. The budgetary constraints on acquisition experienced by a single library are also avoided.

INDEXING

Geosystems have developed **Geosaurus**, a sophisticated modern thesauro-classification of geoscience which has subject, geographical and stratigraphic thesauri arranged hierarchically, with an alphabetical index of over 5,000 terms. Following more then twelve years of development, **Geosaurus** has become a leading indexing system for geoscience, with many advantages over other systems which lack proper hierarchical control of terms.

5500	**SEDIMENTOLOGY**	:		:	
5530	Clastic sediments	(7000)	**AMERICAS**	(550)	**MESOZOIC**
5531	Rudaceous rocks	(7010)	**NORTH AMERICA**	:	
5532	Arenaceous rocks & sediments *Used for psammites, arenites*	:		(600)	**JURASSIC**
		(7100)	**CANADA**	:	
5533	Sandstones	:		(670)	Upper Jurassic
	Includes glauconitic sands, greensands *For metamorphic quartzites, see 5497* *See also: 4570 Sand & gravel (economic)*	(7180)	Interior Plains	(675)	Oxfordian
		:		(680)	Kimmeridgian
		(7440)	Prairie Provinces	(685)	Tithonian
5534	Arkoses	(7443)	Alberta		
5535	Greywackes *Includes turbidites*	(7447)	Saskatchewan	*Extracts from subject, geographical and stratigraphic thesauri.*	
		(7480)	Manitoba		
5536	Argillaceous rocks	:			

Geosaurus provides the facility for carrying out general or highly specific retrievals. From the extract above, for example, a retrieval on sandstones and arkoses could be achieved using 5533/5534 to give very specific references, or 5532/5534 to include papers on arenaceous rocks in general, or broadened still further to 5530 – 5532/5534. Terms included in the scope notes are automatically included in the search so that a retrieval on 5535 Greywackes would also retrieve references on turbidites. A search may be further refined by introducing geographical and stratigraphic constraints; the geographical and stratigraphic thesauri may also be used independently to carry out retrievals on specific areas or geological periods. Thus a highly specific search for references on a precisely defined topic – for example, Upper Jurassic sandstones of Saskatchewan – may be accomplished quickly and accurately by using the appropriate codes in logical combination: 5533 and (7447) and (670/685).

Geosystem's editorial team is composed of geologists who have been specially trained in indexing. They scan the original publications and assign appropriate terms from **Geosaurus** so that relevant retrieval is assured in response to a request. Certain categories of data are extracted and tagged for subsequent special retrieval; it has been found that such specific indexing is more useful than inclusion of a free-format abstract, and so the tagging system is being expanded. At present, for example, the names of new taxa, minerals and stratigraphic names can be retrieved, as well as pertinent bibliographical data from geological maps.

COVERAGE

Citations relating to all aspects of the geosciences are indexed by Geosystems, including, but not limited to, the following subjects:

Regional geology
Geological maps & atlases
Economic geology
Mineral exploration
Mining & petroleum production
Environmental geology
Geomechanics
Oceanology
Energy sources
Mineral deposits
Hydrology & hydrogeology
Mineralogy
Petrology
Sedimentology
Paleontology
Geochemistry
Geophysics
Physical geology
Tectonics
Structural geology
Geomorphology
Geochronology
Stratigraphy
Paleogeology
Methodology
Documentation

PRODUCTS AND SERVICES

GEOSYSTEMS

Geosystems have designed an integrated, comprehensive, multi-media information system for geoscience and can therefore offer bibliographical publications, computer output on microfilm or microfiche (COM) cumulations, computer retrieval, leased magnetic tapes, and several special services. All work by Geosystems is performed in confidence, and no disclosure is made to third parties.

PUBLICATIONS

Geotitles Weekly is the world's most comprehensive bibliography of geoscience ; the main part of the bibliography is arranged by subject, and there are serial source, author, geographical and stratigraphic indexes in each issue. It is sent by air.

Geocom Bulletin is a bimonthly bibliography of economic geology, with special emphasis on mathematical methods and computer applications. It covers the whole field of applied geology, including mining, petroleum, engineering geology, geophysics and geochemistry.

Geoscience Documentation is a bimonthly journal for geology librarians, information specialists and research workers. It is the only journal in this field and contains papers, news items and Geodoc Index, which gives information on new literature in the field and lists new geoscience serials.

Bibliography of Vertebrate Paleontology is a quarterly journal published in association with the Society of Vertebrate Paleontology, and continues their **Bibliography of Vertebrate Paleontology and Related Subjects.** The new series started in September 1973.

Geoserials is a computer listing of more than 10,000 geoscience serial publications identified by Geosystems, arranged by title abbreviation.

Geosaurus is Geosystems' thesaurus for geoscience and is the basis of the indexing system used for **GeoArchive** and the derived publications. It is available as a separate publication, but is sent free to all **Geotitles Weekly** subscribers.

Geotitles Repertorium is a computer output on microfilm (COM) cumulated index to **Geotitles Weekly** from 1969. Further information is available on request.

GEOARCHIVE

GeoArchive, the computerised database, may be accessed three ways :

1. GeoArchive Online is made available by Geosystem through the Lockheed DIALOG Information Retrieval Service. Further information on DIALOG can be obtained from Lockheed Information Systems, Code 5020/201, 3251 Hanover Street, Palo Alto, California 94034, USA, or local DIALOG representative in New York, Washington, Los Angeles, and London.

2. GeoArchive Profiles are available from Geosystems in London. Users submit search questions and their profile is run against **GeoArchive** (retrospective profiles), or against new additions to the database (current profiles). Profiles can be modified as required.

3. GeoArchive Magnetic Tapes are available for lease.

SPECIAL SERVICES

1. Hard Copy Service : Geosystems recognise that supplying relevant references to the literature may not always be sufficient. Where a reference is required urgently and is not available locally, Geosystems will usually be able to help obtain it

2. GeoData Service : Geosystems staff see more current geoscience literature than any other organisation ; special monitoring of a defined topic or geographical area can therefore be arranged, with information forwarded daily, or less frequently, as required.

3. Literature Review Service : Geosystems can provide reviews of the available literature on a topic, following clients' instructions.

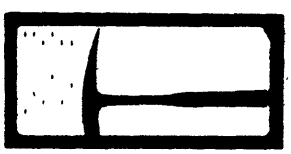
4. Consultancy Service : Geosystems experience in the design, indexing and operation of information systems has lead to the establishment of a consultancy service. Experienced senior staff are available for assignments, such as information systems design, library automation, indexing, editing, and training geologists, librarians and information scientists at all levels in geoscience information work.

GEOSYSTEMS

P.O. Box 1024, Westminster, London SW1, England

ANNUAL SUBSCRIPTIONS AND FEES

		US$
1. Publications		
1.	Geotitles Weekly (includes Geosaurus)	$450 by air
2.	Geocom Bulletin	$90
3.	Geoscience Documentation	$60
4.	Bibliography of Vertebrate Paleontology	$36
5.	Geoserials	$25
	ALL GEOSYSTEMS PERIODICALS	$600
6.	Geosaurus	$50
7	Geotitles Repertorium	Please enquire
2. Geoarchive		
1.	Online service via the Lockheed DIALOG Information Retrieval Service (telecommunication charges are extra)	$70/hour
	Offline printing of references via DIALOG, each	$ 0.15
2.	Profiles service	
	Retrospective search	$50
	Current profile, per year	$100
	Each reference printed	$0.15
3.	Magnetic tape leasing	Please enquire
3. Special Services		
1.	Hard copy service	From $5
2.	Geodata service	From $50/month
3.	Literature review service	From $100
4.	Consultancy service	Please enquire



GEOSYSTEMS
PO Box 1024, Westminster
London SW1 England
Telephone 01-222 7305
Telex 915771 GEOSYS-G
Cable : GEOSCI. LONDON SW1

APPENDIX 3

Reference Manual for machine-readable bibliographic descriptions

Prepared by
the UNISIST/ICSU-AB Working Group on Bibliographic Descriptions
with the assistance of ICSU and ICSU-AB member services

Compiled by M.D. Martin

Unesco, Paris 1974

Acknowledgements

The preparation of the UNISIST *Reference Manual* has involved the participation of a large number of individuals and organizations, whose assistance is gratefully acknowledged. They include all those individuals who served as members or observers of the UNISIST/ICSU-AB Working Group on Bibliographic Descriptions; the member services of ICSU-AB, and other organizations represented on the Working Group; the University of Sheffield Postgraduate School of Librarianship and Information Science, which was responsible for testing the first draft of the *Manual;* and all organizations which contributed time and effort in carrying out the test.

The preparation of the *Manual* was undertaken with the financial support of Unesco and ICSU.

Introduction

This *Reference Manual*, prepared by the UNISIST/ICSU-AB Working Group on Bibliographic Descriptions, represents the results of some four years' work by an international group brought together within the framework of UNISIST, the ICSU-UNESCO joint project to study the feasibility of a world science and technology information network.

The Working Group (referred to hereafter as 'WGBD') has been a special concern of the ICSU Abstracting Board in co-operation with Unesco. It has included direct or indirect representation of all the ICSU-AB member services, together with other experts serving in an individual capacity or as representatives of organizations with special interests in mechanized information processing, including ISO, FID, IFLA, IATUL, INIS and OECD.

The scope and purpose of the WGBD's work has been to define, for most types of scientific and technical literature commonly covered by secondary information services, a set of data elements which will constitute an adequate bibliographic citation. For each type of literature, an essential minimum set is identified, together with additional supplementary elements. It cannot be emphasized too strongly, however, that the sets of data elements defined in the *Manual* are not to be regarded as exclusive. The WGBD has been well aware that for many applications the bibliographic description must be supplemented with additional information. The group's purpose has been to define a minimum set of data elements which could be agreed upon by abstracting and indexing services, to facilitate the exchange of information between services, and to enable them to present their computer-based products to the user in a more compatible and therefore more easily usable form. It is hoped, nevertheless, that this *Manual* will find other applications in the wider field of information processing and exchange.

The scope of the WGBD's recommendations is further limited to defining the representation of these data elements as they should appear in a machine record for exchange purposes between two or more computer-based systems. Nothing in the *Reference Manual* should be interpreted as attempting to lay down standards for input or display formats. A local system may choose any input format which is convertible by computer programme to the exchange format; and the exchange format has been designed with the aim of retaining the highest degree of flexibility for deriving different types and arrangements of output, whether in the form of computer printout or printed publications such as abstracts journals and indexes.

It has been the policy of WGBD to work as closely as possible within the framework of ISO recommendations wherever they exist. Some aspects of the group's work have been or will be submitted to ISO for consideration as international recommendations; and reference is made to current and forthcoming ISO recommendations and standards, wherever possible.

In particular, the bibliographic exchange format described in the *Manual* is an implementation of an international standard ISO 2709: 'Documentation - Format for bibliographic information interchange on magnetic tape' [1].

A first draft of the *Reference Manual* was completed early in 1972, and was the subject of a test conducted by an independent expert organization (University of Sheffield, Postgraduate School of Librarianship and Information Science), with the co-operation of an international group of libraries and secondary information services. A report was submitted to a Working Group meeting in November 1972, and the results of the test and subsequent discussions have been incorporated in an extensive revision of the *Manual*.

It must be emphasized that the *Manual* does not set out to be a training manual for staff who are unfamiliar with bibliographic problems or computer applications in this field; nor is it intended as a cataloguing manual to be placed in the hands of library or information staff engaged in the actual preparation of bibliographic descriptions on a day-to-day basis.

It is to be regarded as a specification manual for technical management and systems design staff in information centres, abstracting and indexing services, and libraries, to assist them in designing local systems in such a way that they can exchange files in either direction with other centres which have adopted the *Reference Manual* format. The reader of the *Manual* is therefore expected to be already familiar with the fundamentals of bibliographic data handling in mechanized and manual systems.

It also needs to be emphasized that the *Reference Manual* does not represent a single monolithic standard which must be applied unvaryingly to all situations. There are various degrees of freedom in the application of the conventions which it describes: and it is expected that individual users or other groups will select a level of implementation which is appropriate to their functional requirements. Areas of implementation choice are identified as they arise in Parts 1 and 2 of the *Manual*.

The *Reference Manual* is presented in four parts.

Part 1 defines in broad outline the format and content of bibliographic records, the notions of literature type and bibliographic level, and the sets of data elements regarded as essential for each type of literature.

Part 2 gives detailed definitions of each individual data element and, where necessary, guidance on how the data element content is to be selected and entered.

Part 3 provides more detailed specifications of the record format, character coding and other aspects which are primarily of concern to computer system designers.

Part 4 consists of a set of examples showing complete bibliographic descriptions prepared in accordance with the conventions described in the Manual.

Additional background information is given in a series of appendices.

Part 1

Chapter 1.1

BIBLIOGRAPHIC RECORDS

For the purposes of the *Reference Manual*, a *bibliographic record* is defined as a collection of information which pertains to a single document, and which is stored in machine-readable form as a self-contained and unique logical structure. A bibliographic record is likely to include a bibliographic description of the document in question; some form of classification and/or indexing applied to the subject content of the document; an abstract or summary; and other information. The *Reference Manual* is concerned only with that part of the record which constitutes the bibliographic description. Additional user-defined data fields will be required in order to carry such other information as may be needed for a particular application.

From the computer system point of view, it should be noted that the *Reference Manual* definition of a bibliographic record constitutes a logical record, with no special assumptions regarding the breakdown into physical records or blocks on a recording medium.

Documents

A *document* is any published item which is to be described in a bibliographic record. Since the *Reference Manual* is primarily designed for secondary information services which provide access to current and past literature, a document need not be a single physical piece. It may be an article, chapter or other contribution; it may be a volume or monograph; or it may be a (non-serial) collection which is to be treated as a single item for purposes of recording.

Specific classes of document ('literature types') which are covered in the present *Manual* are:

- Serials (including serial contributions)
- Books (including book chapters, and collective works)
- Conference publications (including individual conference papers)
- Reports (including report chapters)
- Theses and dissertations
- Patent documents

Bibliographic description

The *bibliographic description* of a document is a collection of information which is intended to provide a unique and unambiguous reference, such as will enable a librarian to identify and retrieve the document, or an intending purchaser to order it from the publisher or other source. It must be borne in mind that the prime function of secondary information services is to inform their users of the existence of relevant documents, and to provide this information in such a form as to enable the user (a) to retrieve relevant references (b) to assess the likely value of the documents referred to and (c) to obtain original documents on the basis of the references given.

The most important function of the bibliographic description is to meet objective (c), although some data elements (title, author name, author affiliation, etc.) may be considered equally important for retrieval or relevance assessment. It is important to draw a clear distinction between 'bibliographic description' and 'bibliographic record'. The term 'bibliographic description' refers to the information which is required in order to describe a given document. A bibliographic description is made up of a number of 'data elements'. The term 'bibliographic record', properly speaking, refers to the structure within which the bibliographic description is stored in machine-readable form. A bibliographic record is made up of a number of 'data fields'.

Data elements

A *data element* is a piece of information forming part of the bibliographic description and having a specific functional relationship with the content of the document to which the record refers. Examples of data elements are: title, author name, patent number.

Data elements are separately identified within the machine record so that each element can, if desired, be independently accessed and manipulated by computer programme. This is achieved by dividing the bibliographic record into a series of *data fields*, identified by *field numbers* or *tags*. Data fields are further subdivided into subfields, introduced by subfield identifiers. Each data element normally occupies a given subfield of a tagged data field.

Data fields

More details of the format and structure of the machine record are given in Part 3. For the purposes of Parts 1 and 2 of the *Manual*, however, it is important to have a basic understanding of the layout of data fields.

The machine record has three distinct parts: a fixed-length leader (the content of which is described in Part 3); a variable-length directory; and variable-length data fields. The directory may be regarded as a list of field numbers or tags identifying the data fields which are present in the record, and providing pointers to the location of the fields within the variable-length data part of the record. Thus the field number or tag which identifies the data field is not contiguous with the data field itself.

Each data field begins with two or more indicator characters, followed by one or more subfields, followed by a field separator.

The number of indicator characters at the beginning of each field is predetermined for a given implementation of the *Reference Manual*: the *Manual* requires a minimum of two, but additional indicators may be included at the user's discretion. Each subfield consists of a subfield

also be a finite collection of such items (i.e. a multi-volume work), published simultaneously or during a predetermined period of time.

A book may contain individual chapters or parts by separate authors and/or covering separate topics, so that in secondary information services it may be appropriate to treat such chapters or parts as 'documents' in their own right.

Reports

'Reports' are also particularly difficult to define: again, the following are suggested as guidelines.

A report is a published item, usually *not* available to be purchased through normal commercial channels, but obtainable from the organization responsible for its issue or from a clearinghouse such as the United States Government NTIS. It is usually - but not always - identified by a report number; and may exhibit some of the characteristics of a serial, in that the numbering scheme often has a component for 'report series', and there may sometimes be a series title.

A report may contain individual chapters or parts by separate authors and/or covering separate topics, so that in secondary information services it may be appropriate to treat such chapters or parts as 'documents' in their own right.

Theses and dissertations

Theses and dissertations may be defined as treatises which have been submitted to a university or other educational institution in fulfilment of the requirements for a higher degree course. Most frequently they are not 'published' in a conventional sense, but they may be available through the university concerned or through a clearinghouse system. Some theses are subsequently published in book form, and it would be recommended that these should be treated as 'books', with the option of including data elements appropriate to a thesis as part of the bibliographic description.

Patent documents

Patent documents are documents published or laid open for public inspection by a patent office, and falling into one of the following categories: patents, inventors' certificates, utility models or certificates, and applications therefor. Since the legal definitions of these different types depend on differing national practices, and since they will generally be well understood by those services which cover patent documents, no fuller definition will be attempted in the *Manual*. A list of patent documents arranged by type of document is given in Appendix D.

Conference publications

Conference publications are a special category, in that they do not in themselves constitute a separate literature type. Papers presented at a conference may be published in any of a number of forms: as books, as contributions to or issues of a serial, or as reports.

For the purposes of the *Reference Manual*, individual papers which happen to have been presented at a conference are not necessarily to be regarded as conference publications, although some users may consider it worthwhile to include a reference to the conference in such cases. Reference to the conference is regarded as *essential* if and only if the document(s) are explicitly described as constituting the official publication of the conference proceedings. This may, again, apply to a book, a serial issue, or a report.

Consequently, 'conference publication' is never a *complete* description of the literature type: the document(s) concerned must also be identified as belonging to one of the other categories named in the last paragraph.

For any document identified as belonging to a conference publication, a small set of additional data elements is defined, to be *added to* the set of essential elements required for whatever main literature type is invoked.

Literature type codes

In the bibliographic record, the literature type or types to which the document is considered to belong are represented by codes in the leader position of the record (see Part 3 for details).

The following literature type codes may be used either in isolation, or in combination if the document has characteristics of more than one type:

Serial, Book, Report, Thesis or Dissertation, Patent.

The following literature type code may be used *only* in combination with another code:

Conference publication.

Note, however, that it is not obligatory to use more than one literature type code if the document has characteristics of more than one type. It is equally permissible, as an implementation option, to assign a document to a single main type, while including in the bibliographic description some data elements which describe aspects of a different type. For example, if a report belongs to a report series, it is permissible to include an ISSN and a series title in the record without formally identifying the document as being of type 'serial'.

The selection of *essential* data elements for the bibliographic description is dependent first on the assignment of the document to a given literature type or types; and secondly, on a decision as to the *bibliographic level* at which the document is to be treated. The notion of bibliographic level is defined in the next chapter.

Chapter 1.3

BIBLIOGRAPHIC LEVEL

The notion of 'bibliographic level' may be novel to some users, but it is increasingly widely employed in mechanized information systems such as INIS and MARC.

Its purpose is to define unambiguously the different types of record which are required when the document to be recorded is:

(a) a part of a larger physical piece: for example, an article in an issue of a journal; a chapter in a book; a section in a report.

(b) a single piece in its own right: for example, an issue or part of a serial; a book in one volume; a report; a patent document.

(c) a collection of physical pieces: for example, a multi-volume work issued at one time, or over a predetermined and finite period of time.

When the document selected for recording in the machine system is a part of a larger physical piece, the record is said to be at the *analytic* level.

When the document is a single piece in its own right, the record is said to be at the *monographic* level.

When the document is a collection of physical pieces, the record is said to be at the *collective* level.

Tag	Field name	Serial		Book			Report		Thesis	Patent
		A	M	A	M	C	A	M	M	A/M
Aø1	International Standard Serial Number (ISSN)	E	E							
Aø2	CODEN (interim alternative to ISSN)	*	*							
Aø3	'Short title' of serial	E	E							
Aø4*	Series designation									
Aø5	Volume number	E	E	E[1]	E[1]					
Aø6	Issue or part number	E	E	E[1]	E[1]					
Aø7	Other identification of issue or part	E	E							
Aø8	Title of contribution (analytic)	E		E			E			
Aø9	Title of volume, monograph or patent document		E	E	E		E	E	E	E
A1ø	Title of collection			E[1]	E[1]	E				
A11	Person associated with a contribution	E		E			E			
A12	Person associated with a monograph		E	E	E			E	E	
A13	Person associated with a collection					E				

1. For books (at analytic and monographic levels) fields Aø5, Aø6 and A1ø are essential only if the item is part of a collection having numbered parts.

* Tags marked with an asterisk indicate data elements which are never designated as essential.

Tag	Field name	Serial		Book			Report		Thesis	Patent
		A	M	A	M	C	A	M	M	A/M
A14	Affiliation - contribution	E		E			E			
A15	Affiliation - monograph		E							
A16*	Affiliation - collection									
A17	Corporate author - contribution	E		E			E			
A18	Corporate author - monograph		E		E			E		
A19	Corporate author - collection					E				
A2ø	Page numbers	E	E	E			E			
A21	Date of issue or imprint	E	E	E	E	E	E	E	E	
A22	Date of publication[2]									E
A23	Language(s) of text	E	E	E	E	E	E	E	E	
A24*	Language(s) of summaries									
A25	Publisher: name and location (monograph or collection)			E	E	E				
A26	International Standard Book Number[3] (ISBN)			E	E	E				
A27	Edition			E	E	E				

2. Field A22 may be used for any literature type where the actual date of publication is known to differ from the nominal date of issue.
3. Field A26 (ISBN) may be used for any type of literature if the publisher has chosen to assign an ISBN to the piece being recorded.

* Tags marked with an asterisk indicate data elements which are never designated as essential.

The category 'essential' is defined as meaning that any data element so described must be included in the bibliographic description if it is either present on or derivable from the original piece (in some instances, with the assistance of an external authority: for example, a serial title code - either ISSN or CODEN - is an essential element for serials, although it will usually be necessary to refer to ISDS or CODEN services in order to obtain the code).

In this context, the designation 'essential' must not be taken to mean that it is necessarily valid in computer systems design to incorporate checks which require the inclusion of 'essential' data elements in all records for a particular literature type. In many cases, valid circumstances may arise in which an 'essential' data element is absent (e.g. authorship may be unidentified; a report may be unnumbered). The category 'supplementary' is defined as meaning that:

(a) Any data element so described is regarded as being relevant to the literature type in question, and likely to provide useful information, worthy of inclusion in the bibliographic record.

(b) The data element is not, however, an absolute requirement for complete, unambiguous bibliographic description, and its inclusion is therefore optional, at the discretion of the individual user or system designer.

The fact that a data element is not designated as either 'essential' or 'supplementary' for a given literature type does not mean that it cannot or should not be included in bibliographic records of this type, provided that it is present on or derivable from the piece. This again is an area where users of the *Manual* are presented with a free choice. The designation 'supplementary' is primarily intended to draw attention to data elements whose inclusion is recommended, but not regarded as obligatory.

Thus, the fact that a blank ('–') appears against a particular data element in the tables in this chapter does not necessarily mean that the element in question is 'illegal' in the given context.

In particular, where an individual piece has the characteristics of more than one literature type, some users may wish to include whatever additional data elements are necessary for a full description. Others may prefer to limit the bibliographic record to the essential data elements for one particular literature type, depending on the functional requirements of their data base. Either approach is an equally valid implementation of the *Reference Manual*.

Section 1.5.1: SERIALS

Bibliographic level

The scope of the *Reference Manual* does not extend to the cataloguing of serials at the collective level (for which see, for example, *International Standard Bibliographic Description for Serials* [3] and *Guidelines for ISDS* [2]).

Since the main concern of the *Reference Manual* is with the bibliographic description of individual scientific and technical documents, as covered in secondary information services, provision is made only for the description of *serial contributions*, at the analytic level, and *serial issues or parts*, at the monographic level, in the event that the issue or part is to be treated as a single document.

Data element matrix for serials

This matrix is a subset of the full data element matrix given in Chapter 1.4, showing those items which are considered to be essential data elements for serials, and those which are considered to be supplementary data elements. Detailed definitions of each element are given in Part 2 of the *Manual*, which can be referenced by the tag code shown in the matrix. Status code 'E' means that the data element must be included if present on or derivable from the original document (thus, for example, a serial title code — either ISSN or CODEN – is an essential data element even though it may not appear on the piece). Status code 'S' means that the data element is not a required bibliographic data element, and that its inclusion is at the discretion of the individual user.

Description	Tag	Status	
		A*	M
Serial title code			
either ISSN	AØ1	E	E
or CODEN	AØ2	E	E
'Short title' of serial	AØ3	E	E
Series designation	AØ4	S	S
Volume number	AØ5	E	E
Issue or part number	AØ6	E	E
Other identification of issue or part	AØ7	E	E
Title of contribution	AØ8	E	–
Person associated with a contribution	A11	E	–
Affiliation - contribution	A14	E	–
Corporate author - contribution	A17	E	–
Title of volume or monograph	AØ9	–	E
Person associated with a volume or monograph	A12	–	E
Affiliation - monograph	A15	–	E
Corporate author - monograph	A18	–	E
Page numbers	A20	E	E
Date of issue or imprint	A21	E	E
Date of publication (if different from date of issue)	A22	S	S
Language(s) of text	A23	E	E
Language(s) of summaries	A24	S	S
Number of references	A45	S	S

*A = Analytic M = Monographic

Section 1.5.2: 'BOOKS' (NON-SERIAL COLLECTIONS AND MONOGRAPHS)

Bibliographic level

In this section, the notion of bibliographic level is used to distinguish between bibliographic records which refer to:

(a) A collection of books, treated as a single entity (collective)

(b) A monograph or single volume from a collection (monographic)

(c) A chapter in, or contribution to, a volume or monograph (analytic)

Section 1.5.4: THESES AND DISSERTATIONS

Bibliographic level

Theses and dissertations are regarded as exclusively monographic publications; the analytic and collective levels are not used.

Data element matrix for theses or dissertations

This matrix is a subset of the full data element matrix given in Chapter 1.4, showing those items which are considered to be essential data elements for theses and dissertations, and those which are considered to be supplementary data elements. Detailed definitions of each element are given in Part 2 of the *Manual*, which can be referenced by the tag code shown in the matrix.

Status code 'E' means that the data element must be included if present on or derivable from the original document. Status code 'S' means that the data element is not a required data element, and that its inclusion is at the discretion of the individual user.

Description	Tag	Status M*
Title of volume or monograph	AØ9	E
Person associated with a monograph	A12	E
University (or other educational institution)	A41	E
Degree level	A42	S
Date of submission	A21	E
Collation: description of monograph	A29	E
Language(s) of text	A23	E
Availability of document	A43	E
Number of references	A45	S

*M = Monographic

Section 1.5.5: PATENT DOCUMENTS

Definition

'Patent documents' include patents, inventors' certificates, utility models or certificates, and applications therefor. A list of patent documents arranged by type of document is given in Appendix D. Throughout this section, the term 'patents' is to be read as including all types of patent document as here defined.

Coverage of patents by abstracting and indexing services

Those abstracting and indexing services which cover patent documents may do so from either or both of two points of view: either in order to provide a comprehensive coverage of patents in a particular subject field, in sufficient detail to satisfy legal as well as scientific interests; or more selectively, from the point of view of scientific and technical information content.

The *minimum* set of essential bibliographic data elements defined in the *Reference Manual* is designed to satisfy the requirements of this second approach. Some supplementary data elements are also included, but services which aim at a comprehensive coverage of patents as legal documents may need to add further data elements to this

Relationship between the Reference Manual and ISO proposals

In preparing this section of the Reference Manual, due account has been taken of ISO/TC 46 (Secr.-611) 1072E (Fifth Draft ISO Proposal: Patents and like documents: bibliographic references: essential and complementary elements) [4]. All elements defined in the ISO Proposal as essential for 'short' bibliographic references to patent documents have been incorporated into the recommendations of the *Reference Manual*.

Relationship between the Reference Manual and ICIREPAT recommendations

This section of the *Reference Manual* has been prepared after full consultation with representatives of the World Intellectual Property Organization (WIPO), and every effort has been made to retain a strict correspondence with the relevant recommendations of ICIREPAT* for the identification and presentation of bibliographic data elements appearing on patent documents.

INID codes

An ICIREPAT recommendation [5] provides for a numeric encoding scheme whereby the various data elements appearing on the first page of a patent document can be identified without knowledge of the languages used for the laws of the country in question. The scheme is already successfully applied by a number of Patent Offices.

This encoding scheme has been given the acronym 'INID' (ICIREPAT Numbers for Identification of Data).

INID codes are printed against relevant data items on the first page of a patent document. They are frequently enclosed in a small circle (see example below); or they may be printed in parentheses or brackets.

(54) **Méthode et appareil pour faire des plaques optiques en fibres conductrices d'image fusionnées ensemble.**

(72) Invention de : Frederik Harwood Norton.

(33) (32) (31) Priorité conventionnelle : *Demande de brevet déposée aux Etats-Unis d'Amérique le 20 juin 1969, n° 835.113 au nom de Frederik Harwood Norton.*

Example

As far as possible, a close correspondence has been maintained between UNISIST recommended data elements and ICIREPAT recommendations. The INID codes are included in the matrix of data elements for patent documents. It should be noted, however, that the conversion is not always on an exact one-to-one basis: see data element definitions in Part 2 for full details.

A complete list of INID codes is given in Appendix E.

*Paris Union Committee for International Co-operation in Information Retrieval among Patent Offices.

Part 2

DATA ELEMENT DEFINITIONS

Part 2 of the *Reference Manual* provides detailed definitions of data elements, arranged in alphanumeric order of data field codes.

Each data element is defined in terms of:

(a) A brief summary of the essential features *(Field definition)*

(b) A detailed description of the data content *(Data description)*

(c) *Examples*, wherever necessary and appropriate.

However, where a group of fields shares an identical structure, the *field definition* is given in full for each one, but the *data description* is given only under the first, and an additional section defining the *use* of the individual fields is provided.

General conventions

The following conventions are applicable to all fields:

(a) *Indicators*

Indicator positions 1 and 2 are reserved for the uses indicated in the *Manual*. Where they are not so used, they are entered as zeros. If either or both of the indicator positions is used, the value zero is never assigned a specific meaning; but, in general, the user system has the option of entering a zero indicator with the meaning 'not specified' (see, for example, field AØ8).

In the examples, only two indicator positions are shown. In a specific implementation, one or more extra indicator positions would be inserted, if required, after indicator position 2 and before the first subfield identifier.

(b) *Subfield identifiers*

As defined in Part 3, a subfield identifier consists of the ISO character IS_1 and one other symbol (usually a numeric digit). For the purposes of illustration, the IS_1 code is represented by the symbol '@'. Expressions of the form 'subfield Ø', 'subfield 1' are used to designate 'the subfield introduced by the identifier @Ø', 'the subfield introduced by the identifier @1' and so on.

(c) *Field separators*

The field separator character IS_2 is omitted in all examples, but should be understood as being present in the bibliographic record as the character immediately following the end of the data string shown in any example.

(d) *Character coding*

No attempt is made in the examples to reproduce the code structures which would be used in the machine record: all data strings are shown as plain text.

(e) *Representation of 'zero' and 'space'*

To avoid ambiguity, the symbol 'Ø' is used for the number 'zero'. 'Space' or 'blank' is represented by 'b'.

(f) *Implementation options*

Where a number of user options exist, it has not always been possible to show all alternatives in the set of examples chosen for a particular data field. In such cases, the selection of a particular option does not imply that this is a 'preferred' implementation.

(g) *'Notes' subfield*

The 'notes' subfield (identifier @N) is an optional subfield which may be included in any data field to incorporate additional free-form information which the user wishes to associate specifically with the content of the field. For this reason, it is shown as a permitted subfield in all data fields, although it will be obvious that its use in connexion with some fields which are themselves free-form is rather improbable. It may, however, have some application in a situation where the user system needs to enter additional information which must be suppressed for the purposes of a particular output, such as a printed publication.

AØ1: ISSN

1. *Field definition*

Tag: AØ1
Indicators: Not used: entered as zeros
Subfields: Ø: ISSN: fixed length, eight characters. Character set restricted to numerals only, except for the last character which may be a numeral or letter 'X'.
N: Notes
Repeatable: No

2. *Data description*

Field AØ1 is used to enter the International Standard Serial Number (ISSN) as a unique identification of a serial title.

The assignment and dissemination of ISSN are the responsibility of the International Serials Data System, based on an International Centre in Paris (Centre International pour l'Enregistrement des Publications en Série: CIEPS) and National or Regional Centres.

The format and basic requirements for the assignment of ISSN are defined in an ISO Standard [6]; fuller details of ISSN assignment and the operation of ISDS are given in *Guidelines for ISDS* [2].

The ISSN is an 8-digit number, the last figure being a check character. (Because of the method of check-digit calculation, the last character may be either

2 'Short title' *not* derived from ISDS.
NB: even though a locally constructed short title may have been prepared in accordance with the relevant ISO Standard, indicator 1 should not be used unless the title has been checked against ISDS lists.

3. *Examples*

```
(Example 1)

Key title:  "Teoreticheskaya i
             Eksperimentalnaya Khimiya"

Abbreviated key title:  "Teor. Eksp. Khim."

Contents of field AØ3:

Ø1ØØTeor.ØEksp.ØKhim.
```

```
(Example 2)

Key title:  "Annals of Physics (New York)"

Abbreviated key title:  "Ann.Phys.(New York)"

Contents of field AØ3:

Ø1ØØAnn.ØPhys.Ø(NewØYork)
```

```
(Example 3)

Key title:  "Nature" (no abbreviated form)

Contents of field AØ3:

Ø1ØØNature
```

```
(Example 4)

Original title:  "Geophysical Journal of the
                  Royal Astronomical Society"

Locally constructed abbreviation:
                  "Geophys. J. R. Astron. Soc"

Contents of field AØ3:

Ø2ØØGeophys.ØJ.ØR.ØAstron.ØSoc.
```

AØ4: SERIES DESIGNATION

1. *Field definition*

Tag: AØ4
Indicators: Not used: entered as zeros
Subfields: Ø: Series designation
N: Notes
Repeatable: No

2. *Data description*

Field AØ4 is used to record a series designation which distinguishes between successive issues of the same serial title: i.e. a *chronological* series designation. It should not be confused with a series designation which differentiates between two or more parts published concurrently (e.g. 'Special Series'; 'Series A: Physics'); in the latter case the two parts will be distinguished by separate and unique serial codes and the series designation will be regarded as an integral part of the title, in accordance with ISDS practice.

A series designation may be alphabetic or mixed alphanumeric (e.g. 'New Series', 'Third Series', 'Series 2'). It should be entered as subfield Ø, in the original language and precise wording shown on the piece, if necessary transliterated in accordance with UNISIST recommendations.

A chronological series designation is seldom, if ever, an element which is absolutely required in order to distinguish between issues of a serial. This field is therefore regarded as optional.

3. *Example*

```
Series designation:  "New Series"

Contents of field AØ4:

ØØØØNewØSeries
```

AØ5: VOLUME NUMBER

1. *Field definition*

Tag: AØ5
Indicators: Not used: entered as zeros
Subfields: 1: 'Caption'
2: Volume number
3: Year: fixed length, four-digit number
4: Subdivision of volume
N: Notes
Repeatable: No

2. *Data description*

Field AØ5 is used to record a volume number, and any other information relating to the numbering of volumes or parts of volumes other than individual issues.

The field is divided into four subfields:

1 This subfield may be used if it is desired to enter a 'caption' (e.g. 'Vol', 'Tom', etc.). Captions should be entered exactly as given on the original, transliterated if necessary. Captions are regarded as an optional element.
2 This subfield is used to enter only the volume number itself, without 'captions' (e.g. 'Vol', 'v', 'Tom', 'Band'). If the volume number is numeric (whether arabic or roman, cardinal or ordinal) it should be entered as an arabic number without suffixes such as 'th', 'ème'. If the volume number is non-numeric, it should be entered exactly as given on the original, transliterated if necessary. If the volume number is a multiple number (e.g. 1-2), the two numbers should be entered in subfield 2, separated by a hyphen.
3 This subfield may be used to enter a "year used as volume number". The year is entered in full as a four-digit numeric. The year should also be included in field A21, as part of the date of issue.
4 This subfield is used to identify any part or subdivision of, or supplement to, a volume, other than an individual issue. Any entry made in the subfield should be in the original language and precise wording of the primary journal, transliterated if necessary.

Some journals carry a continuous volume number in spite of title changes, as well as a volume number referring to the present title, e.g. 'Tom XV (XLVI)'. In such cases, use only the number which refers to the present title.

recorded here, but would be entered in subfield 4 in field AØ5 or subfield 3 in field AØ6.

The required title or other descriptive information should be entered in subfield Ø in the original language and precise wording of the piece, transliterated if necessary in accordance with UNISIST recommendations.

3. *Example*

```
Issue outside normal numbering sequence:

"Special Issue, June 1970"

Contents of field AØ7:

ØØØSpecial␣Issue

(Date of issue would be entered in field A21,

and not field AØ7).
```

AØ8: TITLE OF CONTRIBUTION (ANALYTIC)

1. *Field definition*

Tag: AØ8
Indicators: Position 1 not used: entered as zero
Position 2 may take any of the values Ø, 1, 2, 3, 4
Subfields: 1: Title
2: Language code (optional)
N: Notes
Repeatable: Yes, if it is required to enter more than one form of title (e.g. parallel titles, original and translated titles)

Note that the definition of field AØ8 applies also to field AØ9 (TITLE OF MONOGRAPH), A1Ø (TITLE OF COLLECTION) and A3Ø (NAME OF MEETING).

2. *Data description*

Field AØ8 is used to enter the title of a contribution (paper, article letter, book chapter, etc.). It is used only for records at the *analytic* level; but note that the description given below applies also to fields AØ9, A1Ø and A3Ø.

The title should always be entered in full, including sub-titles and relevant footnotes.

The title may be entered exactly as given on the original, or it may be translated, transliterated or otherwise modified. The original piece may carry a single title, or parallel titles (e.g. in different languages); or a translated or transliterated title may appear on the piece in a 'less prominent' position (e.g. in a footnote).

To allow for various combinations of these cases to be entered unambiguously in a single record, the following conventions may be applied:

(a) Any title which appears on the piece is to be regarded as an 'original' title, even if the language or alphabet differs from that of the text.
(b) Any modification made by the cataloguer may be distinguished by the use of indicator position 2.
(c) Field AØ8 may be repeated, with the same or different indicators, to allow for the inclusion of parallel titles, or the original and a modified title.

The text of the title is entered in subfield 1, following accepted standards for capitalization and punctuation in the language concerned.

Indicators

Indicator position 2 should be used in accordance with the following table of values:

Ø Exact nature of title not specified
1 'Original' title: i.e. the title, or one of the titles, given on the piece, entered in the original language and alphabet.
2 Title in original language and alphabet, but modified in content as part of the cataloguing process.
3 Title transliterated or transcribed as part of the cataloguing process.
4 Title translated (with or without modification of content) as part of the cataloguing process.

Language of title

An additional subfield (subfield 2) is provided to enable a language code to be entered if the user so desires, in order to identify the language of the title where this differs from either the language of the document as given in field A23 or the language of the data base.

The language code should be derived from the relevant ISO Standard (in preparation): see Appendix B.

The use of subfield 2 is optional.

3. *Examples*

```
(Example 1)

Original title: "Exploratory experimental

studies comparing on-line and off-line

programming performance"

Modified title entered in field AØ8:

Ø2Ø1Comparing␣on-line␣and␣off-line␣

programming␣performance
```

```
(Example 2)

Original title:

ОРГАНИЗАЦИЯ▽КОНТРОЛЯ▽В▽АВТОМАТИЗИРОВАННОМ▽

СПРАВОЧНО-ИНФОРМАЦИОННОМ▽ЦЕНТРЕ▽ПО▽ЭЛЕКТРОТЕХНИКЕ

Transliterated title entered in field AØ8:

Ø3Ø1Organizatsiya␣kontrolya␣v␣avtomatizirovannom␣

spravochno-informatsionnom␣tsentre␣po␣

ehlektrotekhnike

Translated title entered in field AØ8 (tag

repeated in same record):

Ø4Ø1Organization␣of␣control␣at␣an␣automated␣

electrical␣engineering␣reference␣information␣

centre
```

(Example 1)

Authorship as shown on the piece:

"By Richard P. Wendt, Mohammed Shamin, Loyola University, New Orleans, Louisiana, for Office of Saline Water, C.M. Wong, Director; W. Sherman Gilliam, Assistant Director, Research; W.H. McCoy, Chief, Chemical Physics Division".

Contents of personal name fields:

First author: ∅1∅1Wendt,∅Richard∅P.

or ∅1∅1Wendt,∅R.P.

Second author: ∅1∅1Shamin,∅Mohammed

or ∅1∅1Shamin,∅M.

(see below for details of indicators and subfield codes)

Other names cited in this example are not to be entered as authors.

3. *Data description (all 'personal name' fields)*

This section is applicable to fields A11, A12, A13 and A34, except where otherwise noted.

Indicators

Indicator position 2 is used to define the relationship between the person whose name has been entered in the bibliographic record, and the item to which the record refers. Most commonly, this relationship will be that of *author* or *editor*, but provision is made for other possibilities, in accordance with the table* below:

∅ Relationship not specified (may be any of those listed below)
1 Author
2 Editor
3 Compiler
4 Translator
5 Illustrator
6 Preface or introduction by
X Other (specifically *not* one of those listed above)

Subfields

The field structure for personal names provides a number of subfields (1 to 6) for entering alternative forms of an author name. Any of the following forms may be included (but only subfield 1 is an essential element):

1. *Name as derived from the piece*, unaltered except for transliteration if necessary. It is also permissible to enter here a name in which an initial has been expanded to a full forename (by reference to an authority file), or forenames replaced by initials, provided the name has not otherwise been altered.

* This table of indicator values applies to fields A11, A12 and A13, but not to field A34 (q.v.)

authority file, where this differs from the form given in the primary publication by something more than the substitution of a forename for an initial, or vice-versa. An example would be where a non-Russian name has been transliterated into Cyrillic, and when retransliterated in accordance with UNISIST recommendations, it emerges in an incorrect form (e.g. 'Courtois' - 'Kurtoa'). It is important to retain under subfield 1 the form derived directly from the primary publication, since users may not know the original form of the name.

3. *'Real name'*, where the name given on the piece (and recorded under subfield 1) is a pseudonym.
4. *'Pseudonym'*, where the individual whose real name is given on the piece (and recorded under subfield 1) is known to have published under another name.
5. *'Former name'* where a change of name is known to have occurred, e.g. maiden name for a married woman author, or former name if the person cited actually changed the name by which he was known, for example on moving to take up residence in another country.
6. *'Subsequent name'* where a change of name is known to have occurred, e.g. married name for a woman author writing under her maiden name, or subsequent name if the author later changed the name by which he was known at the time of writing the item in question.

Subfield 9 is used as follows:

9. *'Rôle'*: in the event that the relationship between the person cited and the bibliographic item cannot be adequately defined by any of the specific indicators listed above, this subfield may be used to enter a free-form description of the relationship.

Elements in a personal name

The conventions described under this and subsequent sections apply equally to any of subfields 1 to 6, except as otherwise noted.

The elements in an individual name may be defined as follows:

'Key' name or names	'K'
Forename and/or initials	'F'
Suffix	'S'
Title	'T'

All names are to be entered in the following form:

K,∅F,∅S∅(T)

Commas are used to separate the 'key' names (surnames) from the forename and/or initials, and to separate the forenames from any suffix (such as 'Jr', 'III'). A title, if required, is entered in parentheses at the end of the name. For example:

'Rutherford (Lord)'
'Rutherford, James D., Jr.'
'Rutherford, J.D.'

'Key' names

The 'key name' element (K) corresponds to the surname in a Western name. The term 'key name' is used rather than 'surname', however, since there may be occasions when it is not clear that the content of this element really represents a surname in the Western sense. (Also, it is envisaged that there may be an exact

(Example 6)

Authorship as shown on the piece:

"Note de Mlle. EDITH DEVIN et. M. ROBERT LOCQUENEUX, présentée par M. Louis de Broglie"

Contents of personal name fields:

First author: ∅1∅1Devin,∅Edith

or ∅1∅1Devin,∅E.

Second author: ∅1∅1Locqueneux,∅Robert

or ∅1∅1Locqueneux,∅R.

Terms which indicate affiliation with religious orders (e.g. Sister, Brother) are not retained unless only the forename(s) are given:

(Example 7)

Authorship as given on the piece:

"Sister Helen Therese Nyberg, O.P."

Contents of personal name field:

∅1∅1Nyberg,∅Helen∅T.

or ∅1∅1Nyberg,∅H.T.

Honorific titles are normally omitted, but may be retained if they constitute an indispensable part of the name:

(Example 8)

Authorship as given on the piece:

"LORD TODD"

Contents of personal name field:

∅1∅1Todd∅(Lord)

Spelling

Individual author names are to be entered in the vernacular, as they appear on the original piece, except:

(a) If transliteration from a non-roman alphabet to roman alphabet is required, UNISIST recommended transliteration schedules are to be used.

(b) If an 'established form' of the name is known to the originator of the bibliographic description, and if this form differs from what has been derived from the original, then the 'established form' may be entered in subfield 2.

This is particularly likely to arise where a non-Russian name is transliterated into Cyrillic for publication in a Russian journal, and is subsequently re-transliterated to the roman alphabet.

In all cases, the name as given on the piece (transliterated if necessary) should be regarded as the primary form for entry in a bibliographic description, since the use of the 'established form' depends on prior knowledge which may not be accessible to all users of a bibliographic data base. Subfield 1 should always carry the name as derived from the piece.

(Example 9)

Authorship as shown on the piece:

"St. BOYADJIEW"

In this case a known alternative (and preferred) transliteration exists: "Boyadzhiev"

Contents of personal name field:

∅1∅1Boyadjiew,∅St.∅2Boyadzhiev,∅St.

Surname prefixes

All surname prefixes are retained in personal author names. A prefix and the name to which it is affixed are together regarded as forming a single 'key' name. Examples of frequently used prefixes are:

van	la	lo	van der
von	della	du	vander
de	le	des	
da	del	de la	

See note below on "Special symbols used in author names", and examples given in that section.

Compound surnames

Compound surnames are the rule for most Spanish and Portuguese authors, and are occasionally found among almost all nationalities.

If the surname is a compound containing a hyphen (e.g. 'Litvak-Gorskaya, L.B.'), the whole compound name should be entered as a single 'key' name.

If it is apparent that the surname is a compound which is not hyphenated, both names should be entered as 'key' names, (e.g. 'J. Hunter Dunn'). If in doubt, enter only the final element as a 'key' name and treat the first element as a forename.

Names that indicate marital status

In certain languages a married woman author's name is the same as her husband's with the addition of one or more letters, or a different word-ending. For example, in Hungarian the suffix '-ne' may be applied to either a forename or a surname. Names of this kind should be entered exactly as they appear on the contribution without modification, and in accordance with the rules previously defined:

(Example 13)

Authorship as shown on the piece:

"DEREK J. DE SOLLA PRICE"

Contents of personal name field:

Ø1@1de=Solla⊬Price,⊬Derek⊬J.

or Ø1@1de⊬Solla⊬Price,⊬Derek⊬J.

or Ø1@1de=Solla⊬Price,⊬D.J.

or Ø1@1de⊬Solla⊬Price,⊬D.J.

(Example 14)

Authorship as shown on the piece:

"LUIS RIVERA OYOLA and R.A.LEE"

Contents of personal name fields:

First author: Ø1@1Rivera⊬Oyola,⊬Luis

or Ø1@1Rivera⊬Oyola,⊬L.

Second author: Ø1@1Lee,⊬R.A.

Note on multiple authors and affiliations

There are two obvious approaches for dealing with the problem of entering a theoretically unlimited number of individual names in a single record:

(a) to allow unlimited repetition of subfields;
(b) to allow unlimited repetition of personal name fields.

The second alternative has been recommended, for the following overriding reason. UNISIST proposals for authors' affiliation call for only a single affiliation to be entered as the minimum requirement in a bibliographic record, but it is recognized that some systems may want to enter all, or a larger number, of affiliations. In this case, it is essential that the record and field format should be hospitable to a convenient means of linking individual names and their affiliations. It is suggested that this can best be done by repeating personal name and affiliation fields as many times as are required, and using indicator position 1 to link related names and affiliations.

A12: PERSON ASSOCIATED WITH A MONOGRAPH

1. *Field definition*

Tag: A12
Indicators: Position 1 not used: entered as zero (but see note at end of section on field A11)
Position 2 may take any of the values Ø, 1, 2, 3, 4, 5, 6, X
Subfields: 1, 2, 3, 4, 5, 6, 9, N (see field A11 for definition of subfields)
Repeatable: Yes: each different person to whom reference is made in the bibliographic record requires a separate repetition of field A12

2. *Use of field A12*

Field A12 is used to enter the name of a person who is associated with an item at the monographic level, e.g.

(a) Book published as a single piece;
(b) Volume forming part of a series or collection of books;
(c) Report;
(d) Thesis or dissertation.

Field A12 is *not* used in connexion with patent documents, since these require a separate treatment of the 'author' relationship: see field A34 (PERSON ASSOCIATED WITH A PATENT DOCUMENT).

Although field A12 always refers to a monographic item, it may occur in a record at the analytic level, for example when the record refers to a chapter of a book.

Selection of names to be entered in the bibliographic record

(a) Authors:
The names of all individual authors associated with a given item at the monographic level are to be entered in the bibliographic record, unless there is a clear indication on the original that the chief responsibility for authorship lies with only one (or less than all) of the persons cited, in which case only those indicated as chief contributors are to be entered. See Example 1 under field A11.

(b) Other persons associated with a monograph:
Provision has been made to enter the names of persons associated with a monograph, other than the authors. These may include: editor, compiler, translator, illustrator, author of preface or introduction. None of these was specifically identified as 'essential' during the discussions of the Working Group on Bibliographic Descriptions, but it is expected that for monographic items it would be normal practice to regard editors' names as an essential element, and most others as optional.

The relationship ('author', 'editor', etc.) between the person named and the bibliographic item is defined by a code in indicator position 2: see field A11.

3. *Data description*

See field A11.

(d) Words may be abbreviated in accordance with UNISIST recommendations.

2 *Address of organization.* The address or location of the organization should be entered in subfield 2. The address should be entered in the fullest available form, ignoring any redundancy which may arise where the place name forms part of the name of the organization (e.g. 'Cambridge University, Cambridge, England'). However, an incomplete address may be entered where no fuller information is available.

3 *Country code.* The country of the affiliation may optionally be entered in subfield 3, using an ISO Standard country code (see Appendix A).

(It will be noted that the option is deliberately left open for country names to be entered 'informally' as part of the address, or to be encoded in a specific subfield if there is a requirement that a file be searchable automatically by country. It is expected that any individual service, or parties to an exchange, would adopt a consistent policy across the data base concerned.)

Selection of the affiliation

The minimum requirement for a bibliographic citation is considered to be the inclusion of a single organizational affiliation, selected wherever possible as giving the location where the work described in the piece was done. The rules on following pages are intended to aid selection of a single affiliation in cases where this criterion cannot readily be applied by reference to the information given on the piece.

(a) One author: only one address given. This address is to be entered:

(Example 2)

Authorship as shown on the piece:

"THOMAS C. LOWE

Informatics Inc., Bethesda, Maryland"

Contents of affiliation field:

ØØ●1Informatics⌀Inc.●2Bethesda,⌀Maryland●3 1Ø1

or ØØ●1Informatics⌀Inc.●2Bethesda,⌀Maryland●3USA

or ØØ●1Informatics⌀Inc.●2Bethesda,⌀Maryland,⌀USA

(b) One author: several addresses given. One address only is to be selected, in accordance with the following descending sequence of preferences: location where the work was done; author's affiliation at the time of the work; first organization cited:

(Example 3)

Authorship as shown on the piece:

"JESSE H. KATZ*

International Business Machines Corp.,

Los Angeles, Calif.

*Present address: Computer Processes,

Inc., 10889 Wilshire Blvd., Los Angeles,

Calif."

Contents of affiliation field:

ØØ●1IBM⌀Corp.●2Los⌀Angeles,⌀Ca.●3 1Ø1

or ØØ●1IBM⌀Corp.●2Los⌀Angeles,⌀Ca.●3USA

or ØØ●1IBM⌀Corp.●2Los⌀Angeles,⌀Ca.,⌀USA

(c) More than one author: only one address given. This address is to be entered:

(Example 4)

Authorship as shown on the piece:

"STANLEY R. PETRICK, PAUL M. POSTAL AND

PETER S. ROSENBAUM, IBM Thomas J. Watson

Research Center, Yorktown Heights, New York".

Contents of affiliation field:

ØØ●1IBM⌀Corp.,⌀Thomas⌀J.⌀Watson⌀Research⌀Center●2Yorktown⌀Heights,⌀NY●3 1Ø1

or ØØ●1IBM⌀Corp.,⌀Thomas⌀J.⌀Watson⌀Research⌀Center●2Yorktown⌀Heights,⌀NY●3USA

or ØØ●1IBM⌀Corp.,⌀Thomas⌀J.⌀Watson⌀Research⌀Center●2Yorktown⌀Heights,⌀NY,⌀USA

(a) Fields A14, A15 and A16 should not be used for this purpose.
(b) Locally-assigned, repeatable field tags should be allocated to differentiate between 'address at the time of the work', 'present address', etc.
(c) Indicator position 1 should be used to link personal names and the related affiliations.
(d) Fields A14, A15 and A16 should be reserved for the 'preferred' affiliation as defined in this section. Where necessary, the 'preferred' affiliation would be derivable by algorithm from the entries made in locally-assigned fields.

See also the note on multiple authors and affiliations at the end of the section on field A11.

A15: AFFILIATION – MONOGRAPH

1. *Field definition*

Tag: A15
Indicators: Not used: entered as zeros
Subfields: 1: Name of organization
2: Address or location
3: Country code (optional element): fixed length, two or three characters (alphabetic or numeric, depending on the code adopted)
N: Notes
Repeatable: No

2. *Use of field A15*

Field A15 is used to enter the name and address of a single organization to which one or more of the individuals cited as authors (or editors, etc.) of a monograph are affiliated. Monographic items include:
(a) Book published as a single piece;
(b) Volume forming part of a series or collection of books;
(c) Report;
(d) Thesis or dissertation.

Field A15 is *not* used for the affiliation of individuals associated with a patent document.

Although field A15 always refers to a monographic item, it may occur in a record entered at the analytic level, for example when the record refers to a chapter in a book.

3. *Data description*

See field A14.

A16: AFFILIATION – COLLECTION

1. *Field definition*

Tag: A16
Indicators: Not used: entered as zeros
Subfields: 1: Name of organization
2: Address or location
3: Country code (optional element): fixed length, two or three characters (alphabetic or numeric, depending on the code adopted)
N: Notes
Repeatable: No

2. *Use of field A16*

Field A16 is used to enter the name and address of a single organization to which one or more of the individuals cited as authors (or editors, etc.) of a *non-serial* collection are affiliated.

Although field A16 always refers to persons associated with the authorship of a collective item, it may occur in a record at the monographic or analytic levels, for example when the record refers to a single volume forming part of a collection, or to a chapter in a book which is itself part of a collection.

3. *Data description*

See field A14.

A17: CORPORATE AUTHOR (CONTRIBUTION)

1. *Field definition*

Tag: A17
Indicators: Not used: entered as zeros
Subfields: 1: Name of corporate author
2: Address of corporate author (optional element)
3: Country code (optional element): fixed length, two or three characters depending on the code adopted
N: Notes
Repeatable: Yes: if there is more than one corporate author associated with a contribution, each one cited in the bibliographic record requires a separate repetition of field A17.

Note that the definition of field A17 applies also to fields A18 (CORPORATE AUTHOR – MONOGRAPH), A19 (CORPORATE AUTHOR – COLLECTION) and A35 (CORPORATE BODY ASSOCIATED WITH A PATENT DOCUMENT).

2. *Use of field A17*

Field A17 is used to enter the name and, optionally, the address and country of a corporate author of a contribution (paper, article, letter, book chapter, etc.)

Field A17 is used only for records at the *analytic* level. Where more than one corporate author is cited in connexion with a contribution, field A17 may be repeated as many times as required.

3. *Data description (all 'corporate author' fields)*

Subfields

1 *Name of corporate author.* Where several levels of the organization are cited (e.g. laboratory, faculty, university), they should be entered in descending order of scale, from the larger unit to the smaller. For large and complex organizations, such as some university or government departments, discretion may be exercised in omitting intermediate levels, the inclusion of which does not add significant information to the entry, provided always that the most specific unit is cited and that the entry provides an unambiguous identification of the organization:

3: Country code (optional element): fixed length, two or three characters (alphabetic or numeric, depending on the code adopted)
N: Notes

Repeatable: Yes: if there is more than one corporate author associated with a collection, each one cited in the bibliographic record requires a separate repetition of field A19.

2. *Use of field A19*

Field A19 is used to enter the name and, optionally, the address and country of a corporate author associated with a *non-serial* collection.

Although field A19 always refers to a collection of items, it may occur in a record at the monographic or analytic levels, for example when the record refers to a single volume forming part of a collection, or to a chapter in a book which is itself part of a collection.

Where more than one corporate author is cited in connexion with a non-serial collection, field A19 may be repeated as many times as required.

3. *Data description*

See field A17.

A20: PAGE NUMBERS

1. *Field definition*

Tag: A20
Indicators: Not used: entered as zeros
1: Page numbers
2: 'Page fragment': numeric only
3: Additional information
N: Notes
Repeatable: No

2. *Data description*

Field A20 is used to enter the page numbers of an individual contribution (e.g. a journal article or a paper in a conference proceedings). 'Page numbers' may be represented by a single number if the contribution is contained entirely within one page; or by first and last page numbers if the contribution occupies a continuous 'run' of pages; or by a string of single numbers and/or pairs of numbers in the case of discontinuous pagination.

Field A20 occurs only in records at the *analytic* level.

Subfields

1 *Page numbers*. Subfield 1 is used to enter the page numbers as described above. The numbers should be entered exactly as given on the piece, transliterated if necessary where letters are used as part of the page number. If roman numerals are used, they should not be converted into arabic numerals, since the distinction may often be significant within a single publication.

All numbers (including first and last numbers of a sequence such as 1234-1235) should be entered in full. A hyphen is used to separate the first and last page numbers of a continuous sequence. Commas are used to separate individual page numbers or pairs of numbers where pagination is discontinuous, as '27-40, 44, 46-57, 53, 55'. Note that ambiguity could occur if the page numbering on the piece included hyphens (if pages were numbered within chapters or issues as 123-41, 123-42, 123-43, etc.). In such a case it is recommended that these hyphens be changed to full points (as 123.41, 123.42, etc.).

2 *'Page fragment number'*. Subfield 2 is used to define a 'page fragment' if several short contributions are contained within a single page, or several contributions begin on a single page. The contents of subfield 2 will always be taken as modifying the first page number cited in subfield 1. When several contributions begin on a single page, they are to be assigned 'page fragment numbers' 1, 2, 3, etc., in a sequence based on scanning the page strictly column by column, from top to bottom within each column and from left to right across the page. This 'page fragment number' and nothing else, should be entered in subfield 2.

3 *Additional information*. Subfield 3 is used to enter additional or alternative page numbers, or pagination which cannot be expressed in the manner defined for subfield 1. Examples are:

(a) Serials which carry page numbering both within issue and within volume. In such cases the page numbering within the *larger* unit (usually volume or year) is to be regarded as the preferred numbering, and will be entered in subfield 1. The issue page numbering may be entered in subfield 3, but is not regarded as an essential element.

(b) Items whose only page numbering is within the individual contribution. In such cases subfield 3 may be used in free form to describe the pagination.

3. *Examples*

```
(Example 1)

Paper occupies page 1234 only, and no

other paper begins on that page.

Contents of field A20:  ØØ●11234
```

```
(Example 2)

Paper occupies pages 1234 to 1246, and

no other paper begins on page 1234.

Contents of field A20:  ØØ●11234-1246
```

(Example 2)*

"July-Dec. 1969"

Contents of date field: ∅∅∅1196912∅∅∅3July-
Dec.∅1969

(Example 3)

"Printemps 1970"

Contents of date field: ∅∅∅1197∅∅∅∅∅∅2Printemps

(Example 4)

1969 Nr. 6 Marz (II)

Contents of date field: ∅∅∅1196903∅∅∅2II

(Example 5)*

1969-70

Contents of date field: ∅∅∅1197∅∅∅∅∅∅31969-197∅

(Example 6)*

27th June - 3rd July 1971

Contents of date field: ∅∅∅1197107∅3∅327∅June∅-
∅3∅July∅1971

A22: DATE OF PUBLICATION

1. *Field definition*

Tag: A22
Indicators: Position 1 not used: entered as zero.
Position 2 may take any of the values ∅, 1, 2, 3, 4, 5, 6 (for patent documents only: otherwise entered as zero)
Subfields: 1: 'Normalized date', entered in ISO Standard format: fixed length, eight-digit numeric.
2: 'Date part'
3: Date in full/non-Gregorian date
N: Notes
Repeatable: No

2. *Use of field A22*

Field A22 is used to record
(a) The actual date of publication of a serial issue, report, or other item, if this is different from the nominal date of issue, and the information is available on the piece.
(b) The date of publication of a patent document.

When used under (a) above, field A22 is in all respects identical to field A21.

Date of publication of a patent document

When field A22 refers to a patent document, indicator position 2 may optionally be used to distinguish between different circumstances and methods of publication, in accordance with the following table:

∅ Mode of publication not specified.
1 Date of making available to the public by viewing, or copying on request, an unexamined document, on which no grant has taken place on or before the said date.
2 Date of making available to the public by viewing or copying on request, an examined document on which no grant has taken place on or before the said date.
3 Date of publication by printing or similar process of an unexamined document, on which no grant has taken place on or before the said date.
4 Date of publication by printing or similar process of an examined document, on which no grant has taken place on or before the said date.
5 Date of publication by printing or similar process of a document, on which grant has taken place on or before the said date.
6 Date of making available to the public by viewing, or copying on request, a document on which grant has taken place on or before the said date.

The following table shows the relationship between these indicators and ICIREPAT INID Codes for publication dates.

Indicator	*INID Code*
∅	any of 41-45, 47
1	41
2	42
3	43
4	44
5	45
6	47

For patent documents, only subfield 1 (date in ISO Standard format) will normally be used.

3. *Data description*

For all other aspects of field A22 format and contents, see field A21.

A23: LANGUAGE(S) OF TEXT

1. *Field definition*

Tag: A23
Indicators: Not used: entered as zeros
Subfields: ∅: Language code or codes
N: Notes
Repeatable: No

2. *Date description*

Field A23 is used to enter one or more fixed-length codes indicating the language or languages in which the text of the item appears. The codes used should be in accordance with the relevant ISO Standard (in preparation); see Appendix B.

Pending the availability of an ISO Standard, an interim coding scheme may be adopted as agreed by the parties to an exchange of bibliographic information.

If the original text appears in more than one language, all languages concerned should be cited in

* Not applicable to field A32: see examples under field A32.

(c) Title identifier
(d) Check character

Components (a), (b) and (c) are of variable length (within the overall fixed length of the number), and are made up of arabic digits Ø to 9. Component (d) is a single character, which may be the letter X or any of the digits Ø to 9.

In written or printed form, the four components are conventionally separated by spaces or hyphens. In the machine record, the number should be stored in packed form, without separators.

Calculation of check character

The check character is calculated on modulus 11, as described in the following example:

(a) Write the digits of the number without check character: Ø 5 7 1 Ø 8 9 8 9
(b) Write the constant weights associated with each position of the number: 10 9 8 7 6 5 4 3 2
(c) Multiply each digit by its associated weight: Ø 45 56 7 Ø 40 36 24 18
(d) Add the product of these multiplications: Ø+45+56+7+Ø+40+36+24+18 = 226
(e) Divide the sum by modulus 11 to find the remainder: 226÷11 = 20, plus a remainder of 6
(f) Subtract the remainder from modulus 11 to find the required check digit: 11-6 = 5
If the result of this subtraction is 10, use check character X. If there is no remainder, the check digit is Ø.
(g) Append the check digit to make the full ten-digit ISBN: Ø 571 Ø8989 5.

3. *Example*

```
ISBN as shown on the piece:

"ISBN Ø 571 Ø8989 5

Contents of field A26:  ØØØØ571Ø89895
```

A27: EDITION

1. *Field definition*

Tag: A27
Indicators: Not used: entered as zeros
Ø: Edition number: variable-length numeric only
N: Notes
Repeatable: No

2. *Data description*

Field A27 is used to enter the edition number of a monograph or collection. Subfield Ø should contain one or more numeric digits, and nothing else. Roman numerals should be converted to arabic, and ordinals should be entered as pure numbers, without suffixes such as "th". Any other information concerning the edition or editions should be entered in free form in subfield N.

Field A27 is applicable only to an item at either the monographic or collective level, but it may also appear in a record at the analytic level, for example when the record describes a chapter in a book.

3. *Example*

```
Edition as indicated on the piece:

"XIIth edn."

Contents of field A27:  ØØØ12
```

A28: COLLATION: DESCRIPTION OF NON-SERIAL COLLECTION

1. *Field definition*

Tag: A28
Indicators: Not used: entered as zeros
1: Number of pieces: variable-length, numeric only
2: Other descriptive information (optional element)
N: Notes
Repeatable: No

2. *Data description*

Field A28 is used to describe the physical pieces which together constitute a non-serial collection to which the bibliographic record refers.

Although field A28 always refers to a collective item, it may be included in a record at the monographic or analytic levels, for example when the record describes a single volume belonging to a collection, or a chapter in a book which is itself part of a collection.

Subfields

1 *Number of pieces:* in the simplest case, the or description required may be the number of pieces or volumes which together constitute the collection. This number, and nothing else, is entered in subfield 1, as one or more numeric digits.
2 *Other descriptive information:* any other descriptive information regarding the physical composition of the collection (e.g. format, collation of individual volumes, plates, maps, inserts) may optionally be entered in subfield 2, in free form.

3. *Example*

```
"Twenty-four vols."

Contents of field A28:  ØØ@124
```

A31: LOCATION OF MEETING

1. *Field definition*

Tag: A31
Indicators: Not used: entered as zeros
1: Location of meeting
2: Country code (optional element): fixed length, two or three characters depending on the code adopted
N: Notes
Repeatable: No

2. *Data description*

Field A31 is used to enter the location of a meeting, the name of which has been entered in field A3Ø.

Subfields

1 *Location of meeting*, entered in free form. The amount of detail required will be dictated partly by the nature of the location, and partly by the information available on the piece. If the country is given in the form of a code in subfield 2, it should *not* be included in subfield 1.
2 *Country code*. The country in which the meeting was held may optionally be entered in subfield 2, using an ISO Standard country code (see Appendix A).

Field A31 may be used in records at all bibliographic levels.

3. *Example*

```
Location of meeting as given on the piece:

"Reading, Berks., England"

Contents of field A31:

   ØØ●1Reading,ßBerks.●2344

or ØØ●1Reading,ßBerks.●2GBR

or ØØ●1Reading,ßBerks.,ßEngland
```

A32: DATE OF MEETING

1. *Field definition*

Tag: A32
Indicators: Not used: entered as zeros
Subfields: 1: 'Normalized date': fixed length, eight-digit numeric
2: 'Date part'
3: 'Date in full'
N: Notes
Repeatable: No

2. *Data description*

Field A32 is used to enter the date (or inclusive dates) of a meeting, the name of which has been entered in field A3Ø.

The format and method of use for field A32 is as described for field A21 (DATE OF ISSUE OR IMPRINT), except that where inclusive dates are cited for a meeting, the 'normalized date' in subfield 1 should be derived from the *starting date* of the meeting, not the end date (see Examples).

Field A32 may be used in records at all bibliographic levels.

3. *Examples*

```
(Example 1)

Dates of meeting:

"June - July 1969"

Contents of field A32:

ØØ●11969Ø6ØØ●3JuneßßJulyß1969
```

```
(Example 2)

Date of meeting:

"27th June - 3rd July 1971"

Contents of field A32:

ØØ●11971Ø627●327ßJuneßß3ßJulyß1971
```

A33: IDENTIFICATION OF PATENT DOCUMENT

1. *Field definition*

Tag: A33
Indicators: Not used: entered as zeros
1: Country code: fixed length, two or three characters depending on the code adopted
2: Type of patent document (ICIREPAT code): fixed length, two characters
3: Type of patent document (CODEN): fixed length, six characters (this subfield is an *alternative* to subfield 2)
4: Type of patent document, as a free text description (optional element)
5: Document number
N: Notes
Repeatable: No

2. *Data description*

Field A33 is used to enter the full identification of a patent document.

The *preferred* form of identification consists of the following subfields:
1 Country code
2 ICIREPAT code (see Appendix D)
5 Document number

Alternative forms of identification may consist of

either	1	Country code	*or*	1	Country code
	3	CODEN		4	Type of document, as a free text description
	5	Document number		5	Document number

The relationship between the above-mentioned indicators and the ICIREPAT INID Codes is as shown in the table below; but note that the ICIREPAT scheme does not differentiate between individuals and corporate bodies – field A35 must be used for inventors, applicants, grantees and assignees which are corporate bodies.

Indicator position 2	*INID Code*
Ø	any of 71-73, 75, 76
1	72
2	71+72; or 75
3	72+73
4	71+72+73; or 76
5	71
6	73
7	71+73

If an inventor is also an applicant, or is also an applicant and a grantee, he may be identified on a patent document (a) by INID 75 or 76, or (b) by INID 71 used together with 72, or with 72 and 73, or (c) by repeating the name and using a different INID Code for each mention of the name. In situation (c) *all* the INID Codes associated with each name must be considered in order to determine the correct indicator to be used. A similar situation arises in the case of an applicant, who may be an inventor and a grantee, and in the case of a grantee, who may be an inventor, or an inventor and an applicant.

3. *Examples*

```
(Example 1)

Individual named on the piece (United States
Patent - no mention of assignee):

Inventor:  Joseph P. Segre, 45 Wusbond Road,
Acton, Mass. 01720

Contents of field A34:

   ∅4∅1Segre,∅Joseph∅P.

or ∅4∅1Segre,∅J.P.
```

```
(Example 2)

Individuals named on the piece (United States
Patent - assignee named):

Inventors:  Herbert S. Polin and Gustavo
Kuhn, both of Veyrier, Switzerland

Contents of field A34 (repeated three times):

First individual:  ∅2∅1Polin,∅Herbert∅S.

              or   ∅2∅1Polin,∅H.S.

Second individual:  ∅2∅1Kuhn,∅Gustavo

              or   ∅2∅1Kuhn,∅G.

Third individual:  ∅6∅1Vogel,∅Paul

              or   ∅6∅1Vogel,∅P.
```

```
(Example 3)

Individual named on the piece (French Patent):

Applicant:  Cinqualbre, Paul

Grantee:    Idem

Inventor:   Not named

Contents of field A34:

   ∅7∅1Cinqualbre,∅Paul

or ∅7∅1Cinqualbre,∅P.
```

A35: CORPORATE BODY ASSOCIATED WITH A PATENT DOCUMENT

1. *Field definition*

Tag: A35
Indicators: Position 1 not used: entered as zeros
Position 2 may take any of the values Ø, 1, 2, 3, 4, 5, 6, 7
Subfields: 1: Name of corporate body
2: Address of corporate body (optional element)
3: Country code (optional element): fixed length, two or three characters depending on the code adopted
N: Notes
Repeatable: Yes: if more than one corporate body is cited on a patent document, field A35 may be repeated as many times as required

(Note that in general, field A35 follows the same format and conventions as are defined for field A17).

2. *Data description*

Field A35 is used to record the names of corporate bodies cited on a patent document as inventors, applicants, grantees or assignees. While corporate inventorship is rare, it is nevertheless provided for in the laws of some countries.

Field A35 may be repeated as many times as are necessary in a single record to enter the names of all corporate bodies cited in the above-mentioned capacities.

Field A35 may be used in records at the monographic or analytic levels, depending on whether the record is derived from the patent document itself or from an entry in an official gazette.

Corporate names are to be recorded generally according to the conventions specified for field A17, using the same set of subfield codes.

Subfield 1 (name of corporate body) is the only essential element: all others are optional.

Indicators

In field A17 and other 'corporate author' fields the indicator positions are not used. In field A35, however, it may be necessary to define the relationship between the corporate body and the patent document cited, and for this purpose indicator position 2 is used exactly as described under field A34. The

2. *Date description*

Field A37 is used to enter details of a priority application which is cited on the patent document to which the bibliographic record refers. It is regarded as an optional element in the bibliographic description of a patent document.

The field is divided into three subfields, to record respectively the country of the priority application, the application number, and the date, all of which must be entered.

A patent document may cite more than one priority application, in which case field A37 may be repeated as many times as required.

Field A37 may appear in a record at either the monographic or analytic level, depending on whether the bibliographic record is derived from the patent document itself or from an entry in an official gazette, treated as a serial 'contribution'.

Subfields

1 *Country* where the priority application was made. The country should be entered using one of the ISO Standard country codes (see Appendix A).
Subfield 1 corresponds to ICIREPAT INID 33.

2 *Number assigned to the priority application*. The number must be recorded in full, including any prefixes or suffixes. It should be entered without commas or spaces, but punctuation marks which link a prefix or suffix to the number should be retained. Note that the application number to be entered in this subfield should not be confused with:
(a) the application number associated with the patent document to which the record refers: this number is entered in field A36.
(b) the document number (if known) assigned to a patent document arising from the priority application: this number is not a required data element in the bibliographic description.
Subfield 2 corresponds to INID 31.

3 *Date of filing* of priority application: to be entered in ISO Standard format, as an eight-digit number of the form YYYYMMDD, where
YYYY represents the year in full
MM " the month expressed as a two-digit number with leading zero where required
DD " the day of the month expressed as a two-digit number with leading zero where required.
Subfield 3 corresponds to INID 32.

3. *Example*

```
"Application made in France (No.29624) on
27 Aug. 1965"

Contents of field A37:

   ##1332296243196508 27 .

or ##1FRA2296243196508 27
```

A38: REFERENCE TO A LEGALLY RELATED DOMESTIC DOCUMENT

1. *Field definition*

Tag: A38
Indicators: Position 1 not used: entered as zero
Position 2 may take any of the values Ø, 1, 2, 3, 4
Subfields: 1: Country code: fixed length, two or three characters depending on the code adopted (optional element)
2: Type of patent document (ICIREPAT code: fixed length, two characters
3: Type of patent document (CODEN): fixed length, six characters (this subfield is an *alternative* to subfield 2)
4: Type of patent document, as a free text description (optional element)
5: Document number
6: Application number (this subfield is an *alternative* to subfield 5, when the document number is not known)
N: Notes
Repeatable: Yes: if more than one legally-related domestic document is cited. Field A38 may be repated as many times as required

2. *Data description*

Field A38 may be used to record details of a patent document (a) legally related to the document to which the bibliographic record refers, and (b) published in the same country.

Field A38 is regarded as an optional element in the bibliographic description of a patent document.

The preferred form of reference to a legally related domestic document consists of the following subfields:
1 Country code (optional, since by definition it must be the same as the country code in field A33)
2 ICIREPAT code (see Appendix D)
5 Document number (or subfield 6: application number may be used when the document number is not known).

The definitions and form of entry for subfields 1 to 5 are identical to those given under field A33: other forms of reference than the 'preferred' form may be used as in field A33. Conventions for recording an application number in subfield 6 are as described under field A36, subfield 1.

Field A38 may be repeated if more than one legally-related domestic document is cited.

Indicators

Indicator position 2 may be used to distinguish between different types of legal relationship between the document cited and the document to which the bibliographic record refers, in accordance with the following table of values:
Ø Relationship not specified: may be any of those given below
1 Relation due to addition(s)
2 " " " division(s)
3 " " " continuation(s) – including continuation(s)-in-part
4 " " " reissue(s)

1: Name of organization
2: Address or location (optional element)
3: Country code: fixed length, two or three characters, depending on the code adopted (optional element)
N: Notes

Repeatable: Yes: if more than one organization is cited, field A4Ø may be repeated as many times as required

2. *Data description*

Field A4Ø is used to enter the name of an organization responsible for performing the whole or part of the work which is the subject of a report, if and only if this organization is different from the corporate author or author affiliation.

The format of field A4Ø is identical to that defined for field A17 (CORPORATE AUTHOR). Only subfield 1 (name of organization) is an essential element: others are optional.

Field A4Ø may be repeated as required, if more than one organization is cited as responsible for the work.

Field A4Ø occurs only in records describing report literature, and may be used at either the monographic or analytic level.

A41: UNIVERSITY (OR OTHER EDUCATIONAL INSTITUTION)

1. *Field definition*

Tag: A41
Indicators: Not used: entered as zeros
1: Name of university, or other institution
2: Address or location (optional element)
3: Country code: fixed length, two or three characters, depending on the code adopted (optional element)
N: Notes
Repeatable: No

2. *Data description*

Field A41 is used to enter the name of the university, university department, or other degree-granting institution, to which a thesis or dissertation was submitted.

The format of field A41 is identical to that defined for field A17 (CORPORATE AUTHOR). Only subfield 1 (name of university, or other institution) is an essential element: others are optional.

Field A41 occurs only in records describing a thesis or dissertation, and therefore can be used only at the monographic level.

3. *Example*

```
"Queen Mary College, University of London"

Contents of field A41:

   ØØ@1University␣of␣London,␣Queen␣Mary␣College
or ØØ@1Univ.␣London,␣Queen␣Mary␣Coll.
or ØØ@1Univ.␣London,␣Queen␣Mary␣Coll.@3GBR

      (and other permitted variations)
```

A42: DEGREE LEVEL

1. *Field definition*

Tag: A42
Indicators: Not used: entered as zeros
Subfields: Ø: Degree level
N: Notes
Repeatable: No

2. *Data description*

Field A42 is used, in a record which refers to a thesis or dissertation, to enter a note of the level of the degree for which the thesis or dissertation was presented. This information may be entered in free form.

Field A42 is an optional data element. It is used only at the monographic level.

3. *Example*

```
"Ph.D."

Contents of field A42:

ØØ@ØPh.D.
```

A43: AVAILABILITY OF DOCUMENT

1. *Field definition*

Tag: A43
Indicators: Not used: entered as zeros
Subfields: Ø: Availability note
N: Notes
Repeatable: No

2. *Data description*

Field A43 is used to enter the source of availability of the document to which the bibliographic record refers, together with any other notes relevant to the process of obtaining the original document (e.g. restrictions on availability, price, order number).

An entry in field A43 may be made in free form, but should include the name (and, optionally, the address) of the organization from which the document is available. Abbreviations, if used, should be in accordance with UNISIST recommendations.

Field A43 may be used in records at all bibliographic levels. It is particularly relevant for reports and any other items which are not available through normal commercial channels.

3. *Example*

```
"Available from US Patent Office $0.50"

Contents of field A43:

ØØ@ØUS␣Pat.␣Off.,␣$Ø.5Ø
```

Part 3

Chapter 3.1

RECORD FORMAT

ISO Standard

UNISIST proposals for a standardized bibliographic description in machine-readable form are to be regarded as a specific implementation of the International Standard ISO 2709 [1] for a communication format for bibliographic records. This Standard is a generalized derivative of the MARC II record structure, but independent of the data element definitions and tagging scheme used for Library of Congress MARC data bases.

Record format: general

The UNISIST/ICSU-AB Working Group on Bibliographic Descriptions has recommended the adoption of the record format defined by ISO 2709. The WGBD's objective has been to define an implementation of this standard which would be suited to the needs of abstracting and indexing services, information centres and others.

The record structure defined by ISO 2709 will be referred to hereafter as the 'ISO bibliographic record'.

The ISO bibliographic record is divided into three sections: a fixed length leader occupying this first 24 characters or bytes; a variable length directory; and data fields of fixed or variable length. Some aspects of the record structure are described below, but for full details the reader should consult ISO 2709. A diagrammatic representation of the record format is attached at the end of Part 3.

Record format: leader

The table below shows the contents of the fixed leader at the beginning of each record, as specified by ISO and as applied in the proposed UNISIST implementation (an asterisk in the right-hand column indicates exact correspondence with the ISO Standard):

Characters (or bytes)	ISO Standard	UNISIST implementation
0 to 4	Record length	*
5	Record status character (e.g. new; amended)	Record status character (to be defined by agreement between parties to an exchange: if not used, enter as zero)
6 to 9	Implementation codes	Character positions 6-8: literature type codes (see notes below) Character position 9: bibliographic level code (see notes below)
10	Indicator length	Indicator length: *minimum* 2 for UNISIST exchange records; but additional indicator positions may be defined by agreement between parties to an exchange; see below.
11	Identifier length	"2": see below
12 to 16	Base address of data	*
17 to 19	For user systems	*
20, 21	Directory map	*
22, 23	For future use	*

maximum flexibility of assignment, and effectiveness of table-oriented programme design. An intellectual structuring of groups of tags assigned to 'related' data elements may be useful for some purposes, but this structuring should be reflected in the contents of the tables used to interpret the tags, not in the tag representations themselves. The usefulness of such intellectual groupings is solely for input or output, not for exchange between machine systems.

The alphanumeric format with base AØØ was chosen to avoid confusion with the widely-known MARC systems which use tags in the range 100-999.

Nesting of sub-records

Certain situations may arise in which it is desirable, for bibliographic reasons, to treat a record as including one or more sub-records. For example, if a paper is a translation of an item which has been published elsewhere, it may be necessary to include a citation of the original source as a sub-record within the main record referring to the translation. In general, this situation will normally arise whenever reference must be made in a bibliographic record to one or more related documents, or where it is necessary to treat a collective work at more than one bibliographic level.

A number of techniques may be suitable in different circumstances for dealing with this type of problem:

(a) Use of a 'notes' field. Where the information regarding related items is required solely for display, and need not be processed in a structured way, it may be included in free form as part of a notes field; but this approach renders it useless for computer processing.

(b) Cross-referencing between records. In some circumstances the related items may be entered as separate bibliographic records, with pointers in each direction and an indication of the nature of the relationship between them.

(c) Nesting of sub-records. One or more sub-records using the same data elements as the main record, may be nested within the bibliographic record, to form a hierarchical structure.

A procedure for structuring a record into a number of sub-records is referred to in ISO 2709, but is not fully defined. It is based on the use of tag ØØ2 as a "sub-record directory", containing pointers to the main directory. This procedure has been adopted in some systems, including, for example, INIS. It is widely regarded by existing users as being less than wholly satisfactory. At the present time, therefore, the *Reference Manual* does not embody any recommendations on the technique to be employed for this purpose.

Physical tape standards

It should be noted that the assumption is made throughout Part 3 of the *Reference Manual* that the basic medium for exchange will be nine-track, half-inch magnetic tape recorded at 800 bpi in NRZI mode in an industry-compatible form, complying where applicable with relevant ISO Recommendations. Extension of the UNISIST exchange format to nine-track tape recorded in other modes or at other packing densities is trivial; extension to physical formats or media which differ in other respects may require more work to define a suitable representation of the exchange record.

Standard separators

The following standard separators or delimiters are used in the ISO bibliographic record format, and therefore in the UNISIST exchange format:

Record separator (terminates a complete bibliographic record)	IS_3 (see Table 1)
Field separator (terminates a complete data field)	IS_2
Subfield identifier flag (introduces a subfield identifier)	IS_1

Chapter 3.2

REPRESENTATION OF EXTENDED CHARACTER SETS

ISO Standard

At the time of writing, a Working Group of ISO/TC46 is developing a comprehensive draft standard for character sets to be used in bibliographic information exchange. When the results of its work become available in the form of an ISO Standard, it is expected that users of the *Reference Manual* will be advised to adopt them, and this chapter will be amended accordingly.

Interim Recommendations

The UNISIST/ICSU-AB Working Group on Bibliographic Descriptions developed its own detailed proposals for the representation of extended character sets. These were based on an existing ISO Recommendation, R646 [12], shown in Table 1 at the end of this chapter, and an existing USSR Standard, GOST 13052-67 [13] (Table 2). The WGBD proposals have been taken into account in the work now being undertaken within ISO/TC46; and in the interim it is recommended that character coding should be based on the ISO and USSR standards referred to above. In the light of the ISO/TC46 developments it is considered inappropriate to lay down any separate guidelines for the representation of extended character sets.

TABLE 1: ISO set

	0	1	2	3	4	5	6	7
0	NUL	TC_2	SP	0	@	P	`	p
1	TC_1	DC_1	!	1	A	Q	a	q
2	TC_2	DC_2	"	2	B	R	b	r
3	TC_3	DC_3	£	3	C	S	c	s
4	TC_4	DC_4	$	4	D	T	d	t
5	TC_5	TC_8	%	5	E	U	e	u
6	TC_6	TC_9	&	6	F	V	f	v
7	BEL	TC_{10}	'	7	G	W	g	w
8	FE_0	CAN	(	8	H	X	h	x
9	FE_1	EM	)	9	I	Y	i	y
10	FE_2	SUB	*	:	J	Z	j	z
11	FE_3	ESC	+	;	K	[	k	
12	FE_4	IS_4	,	<	L		l	
13	FE_5	IS_3	-	=	M	]	m	
14	SO	IS_2	.	>	N	^	n	—
15	SI	IS_1	/	?	O	_	o	DEL

EXAMPLES OF COMPLETE BIBLIOGRAPHIC RECORDS

This section embodies examples of each type of literature treated by the *Reference Manual*.

Each example is in three parts:

- the original data derived from the piece;
- implementation codes entered in the leader part of the record to identify literature type and bibliographic level;
- data fields required for the bibliographic description.

Except where otherwise noted, the data fields in these examples have been limited to those identified in Part 1 of the *Manual* as *essential* for the given literature type.

The conventions for representing data fields are identical to those used elsewhere in the *Manual*, and defined in Chapter 1.1 and at the beginning of Part 2.

Where the *Reference Manual* allows certain degrees of freedom, the selection of a particular option in the examples does not imply that it is a 'preferred' form.

Example 1: *SERIAL CONTRIBUTION*

Communications of the ACM, Volume 8, Number 5, May 1965, pages 300-305. 'BLNSYS - A 1401 Operating System with Braille Capabilities'. J.B. LANDWEHR, C. MCLAUGHLIN, H. MUELLER, M. LICHSTEIN AND S.V. POLLACK. University of Cincinnati, Medical Computing Center, Cincinnati, Ohio.

Implementation codes in leader, character positions 6 to 9:
Character position 6: bit position 7 = 1, other bits = zero
" " 7, 8: all zero
" " 9: bit position 7 = 1, other bits = zero
These codes indicate literature type = serial, bibliographic level = analytic.

Data fields

A02	ØØ@ØCACMA2	CODEN
A03	Ø1@ØCommun.ÞACM	'Short title', derived from ISDS
A05	ØØ@28	Volume number
A06	ØØ@25	Issue number
A08	Ø1@1BLNSYSÞ-ÞaÞ14Ø1Þop	Title of contribution
	eratingÞsystemÞwithÞBr	(original language
	ailleÞcapabilities	and alphabet)
A11	Ø1@1Landwehr,ÞJ.B.	Author names (field
A11	Ø1@1McLaughlin,ÞC.	A11 repeated)
A11	Ø1@1Mueller,ÞH.	
A11	Ø1@1Lichstein,ÞM.	
A11	Ø1@1Pollack,ÞS.V.	
A14	ØØ@1UniversityÞofÞCinn	Author affiliation
	cinnati,ÞMedicalÞCompu	
	tingÞCenter@2Cincinnat	
	iÞOhio@3USA	
A20	ØØ@13ØØ-3Ø5	Page numbers
A21	ØØ@119651Ø5ØØ	Date of issue
A23	ØØ@ØEN	Language of text*

Example 2: *'BOOK' (MONOGRAPH)*

'An Insight into Management Accounting'. John Sizer. Penguin Books, Harmondsworth, Middlesex, England. 1969. 341 pp. ISBN 0 14 021087 3.

Implementation codes in leader, character positions 6 to 9:
Character position 6: bit position 6 = 1, other bits = zero
" " 7, 8: all zero
" " 9: bit position 6 = 1, other bits = zero
These codes indicate literature type = 'book', bibliographic level = monographic.

Data fields

A09	Ø1@1AnÞinsightÞintoÞma	Title of monograph
	nagementÞaccounting	(original language
		and alphabet)
A12	Ø1@1Sizer,ÞJ.	Author name
A21	ØØ@119691ØØØØ	Date of imprint
A23	ØØ@ØEN	Language of text*
A25	ØØ@1PenguinÞBooks@2Har	Publisher name
	mondsworth,ÞEngland	and location
A26	ØØ@ØØ14Ø21Ø873	ISBN
A29	ØØ@1341	Collation

Example 3: *REPORT (MONOGRAPHIC)*

'Erosionskorrosion i vattenledningar av kopparör'. Lage Knutsson, Einar Mattsson & Bengt-Eric Ramberg. Statens institut för byggnadsforskning, Stockholm: Rapport R23:1971, 29 pp.

English title also given: 'Erosion corrosion in copper water tubing'.

Implementation codes in leader, character positions 6 to 9:
Character position 6: bit position 5 = 1, other bits = zero
" " 7, 8: all zero
" " 9: bit position 6 = 1, other bits = zero
These codes indicate literature type = report, bibliographic level = monographic.

* The code 'EN' is employed here to represent 'English' by way of example only, pending the availability of a standard coding scheme.

Example 6: *CONFERENCE PAPER*

(This example refers to an individual paper from a conference proceedings published as a monograph).

W.D. Kingery, Editor: 'Ice and Snow: Properties, Processes and Applications'. Proceedings of a Conference held at The Massachusetts Institute of Technology, February 12-16, 1962. The M.I.T. Press, Cambridge, Massachusetts, 1963. (xv+684pp.) 'On the Metamorphism of Snow', M.R. de Quervain, pp. 377-390, 11 references.

Implementation codes in character positions 6 to 9:

Character position 6: bit position 6 = 1, bit position 2 = 1, other bits = zero
" " 7, 8: all zero
" " 9: bit position 7 = 1, other bits = zero

These codes indicate literature type = conference proceedings published in 'book' form, bibliographic level = analytic (since the record refers to a single paper).

Data fields

A09	␣1@1Ice␣and␣snow:␣properties,␣processes␣and␣applications	Title of monograph
A12	␣2@1Kingery,␣W.D.	Editor
A21	␣␣@11963␣␣␣␣	Date of imprint
A25	␣␣@1M.I.T.␣Press@2Cambridge,␣Mass.	Publisher name and location
A29	␣␣@1699@2xv+684	Collation (supplementary element)*
A08	␣1@1On␣the␣metamorphism␣of␣snow	Title of paper
A11	␣1@1de=Quervain,␣M.R.	Author
A2␣	␣␣@1377-39␣	Page numbers
A23	␣␣@␣EN	Language of text**
A45	␣␣@␣11	Number of references (supplementary element)
A3␣	␣1@1Conference␣on␣ice␣and␣snow:␣properties,␣processes␣and␣applications	Name of meeting (optional, since identical to field A␣9)
A31	␣␣@1M.I.T.,␣Cambridge,␣Mass.	Location of meeting
A32	␣␣@11962@212@312-16␣Feb.␣1962	Date of meeting

* The use of subfield 2 in field A29 is by way of example, and not necessarily a recommended practice.

** The code 'EN' is employed here to represent 'English' by way of example only, pending the availability of a standard coding scheme.

letter number	Cyrillic char.				Used in						Proposed UNISIST translit.
	printed		manuscript		Russian	Ukrain.	Belorus.	Serbian	Macedo	Bulgar.	
7	Ђ	ђ						X			dj
8	Ґ	ґ							X		g
9	Е (Ѐ)	е (ѐ)			X	X	X	X	X	X	e
10	Є	є				X					je
11	Ж	ж			X	X	X	X	X	X	zh
12	З	з			X	X	X	X	X	X	z
13	Ѕ	ѕ							X		dz
14	И	и			X	X		X	X	X	i
15	І	і			X	X	X				yi
16	Ї	ї				X					yi
17	Ј	ј						X	X		j
18	Й	й			X	X	X			X	j
19	К	к			X	X	X	X	X	X	k
20	Л	л			X	X	X	X	X	X	l
21	Љ	љ						X	X		lj
22	М	м			X	X	X	X	X	X	m
23	Н	н			X	X	X	X	X	X	n
24	Њ	њ						X	X		nj
25	О	о			X	X	X	X	X	X	o
26	П	п			X	X	X	X	X	X	p
27	Р	р			X	X	X	X	X	X	r
28	С	с			X	X	X	X	X	X	s
29	Т	т			X	X	X	X	X	X	t

Appendix D

ICIREPAT CODES FOR PATENT DOCUMENTS

In fields A33 and A38, reference is made to the ICIREPAT code as the preferred means of identifying 'type of patent document'. This Appendix embodies an ICIREPAT paper which defines a 'standard code for identification of different kinds of patent document', and lists a substantial number of known types of document.

It will be noted that in fields A33 and A38 the ICIREPAT code is specified as a two-character fixed-length code. This Appendix defines only the first character, which is always a letter of the Roman alphabet. The second character, which is numeric, will be defined by national patent offices. If only the first character is known, it is recommended that the second character position be entered as '0' (blank or space).

WIPO

ICIREPAT Manual

Ref: Shared Systems--SI.8 (E) | page: 4.3.8.1(E)

STANDARD CODE FOR IDENTIFICATION OF DIFFERENT KINDS OF PATENT DOCUMENTS

Introduction

1. The recommendation provides for groups of letter codes in order to distinguish patent documents. The letter codes also facilitate the storage and retrieval of such documents.

2. If any Office wants to amplify the information contained in the letter code, this letter code may be optionally associated with a numerical code. The meaning of such numerical code should then be defined by each Patent Office availing itself of this option.

3. The code also provides for a letter for non-patent literature documents (N) and for documents to be restricted to the internal use of Patent Offices (X) (e.g. confidential documents, not to be disclosed outside the Office). See in this respect also SI.1 (ICIREPAT Manual pages 4.3.1.1 to 4.3.1.4).

Definitions

4. For the purposes of this recommendation, the expression "patent documents" includes patents for inventions, inventors' certificates, utility certificates, utility models, patents or certificates of addition, inventors' certificates of addition, utility certificates of addition and published applications therefor.

5. For the purposes of this recommendation, the term "entry in an official gazette" means at least one comprehensive announcement in an official gazette regarding the making available to the public of the complete text, claims (if any) and drawings (if any) of a patent document.

6. For the purposes of this recommendation, the terms "publication" and "published" are used in the sense of

(i) making available to the public for inspection or copying on request

(ii) reproducing in multiple copies

(iii) printing

of a patent document.

Explanation: If, at a particular procedural stage, a copy of the document is first made available to the public for inspection or copying and is then, at the same procedural stage, printed or reproduced in multiple copies, only a single publication is considered to have occurred. If, on the other hand, printing or multiple reproduction results from a new procedural stage, this printing is considered to be a further publication of the document, even if the texts at the two stages are identical.

7. According to certain national patent laws or regulations, the same patent application may be published at various procedural stages. For the purposes of this recommendation, a publication level is defined as the level corresponding to a procedural stage at which normally a document is published under a given national patent law.

Recommendation

8. It is recommended that the code:

(a) be used for the recording of the "kind of document" in machine-readable data carriers, such as 80-column punched cards, magnetic tapes, aperture cards, etc.;

(b) be used on the first page of patent documents, preferably near the document number, if these have been published in the sense of paragraph 6;

Appendix I

List of Patent Documents, Past and Currently Published, and Intended to be Published in the Future, Divided in Accordance with this Code

Code: A Patent Documents Numbered in Primary or Major Series - First Publication Level

Examples:	Austria	Patent Application published in the sense of paragraph 6(i)
	Belgium	Brevet d'invention/Uitvindingsoctrooi
	Belgium	Brevet de perfectionnement/Verbeteringsoctrooi
	Bulgaria	Opisanie na izobretenie po patent
	Canada	Patent
	Cuba	Patent Application published in the sense of paragraph 6(i)
	Czechoslovakia	Patent Application published in the sense of paragraph 6(i)
	Czechoslovakia	Inventors' Certificate Application published in the sense of paragraph 6(i)
	Denmark	Patent Application published in the sense of paragraph 6(i)
	Egypt	Patent specification
	Europat	Document published after 18 months
	Finland	Patent Application published in the sense of paragraph 6(i)
	France	Brevet d'invention (old law)
	France	Brevet d'invention, première et unique publication
	France	Certificat d'addition à un brevet d'invention, première et unique publication
	France	Certificat d'utilité, première et unique publication
	France	Certificat d'addition à un certificat d'utilité, première et unique publication
	France	Demande de brevet d'invention, première publication
	France	Demande de certificat d'addition à un brevet d'invention, première publication
	France	Demande de certificat d'utilité, première publication
	France	Demande de certificat d'addition à un certificat d'utilité, première publication
	German Democratic Republic	Patentschrift (Ausschliessungspatent)
	German Democratic Republic	Patentschrift (Wirtschaftspatent)
	Germany, Federal Republic of	Offenlegungsschrift
	Hungary	Patent Application published in the sense of paragraph 6(i)
	India	Patent specification
	Ireland	Patent specification
	Italy	Brevetto per invenzione industriale
	Japan	Kokai tokkyo koho
	Luxembourg	Brevet d'invention
	Luxembourg	Certificat d'addition à un brevet d'invention
	Netherlands	Ter inzage gelegde octrooiaanvrage
	Norway	Patent Application published in the sense of paragraph 6(i)
	Pakistan	Patent specification

Code: C (continued)

Examples:	Norway	Patent
	Sweden	Patentskrift

Code: E Patent Documents Numbered in Secondary Series - First Publication Level

Examples:	France	Certificat d'addition à brevet d'invention (old law)
	United States	Reissue

Code: H or I Patent Documents Numbered in Further Series

Example:	United States	Defensive publication

Code: M Medicament Patent Documents

Examples:	France	Brevet spécial de médicament
	France	Addition à un brevet spécial de médicament

Code: U Utility Model Documents Numbered in Series other than the Documents of Group I - First Publication Level

Examples:	Germany, Federal Republic of	Gebrauchsmuster
	Japan	Kokai jitsuyo shinan koho
	Spain	Utility Model Application published in the sense of paragraph 6(i)

Code: Y Utility Model Documents Numbered in Series other than the Documents of Group I - Second Publication Level

Examples:	Japan	Jitsuyo shinan koho
	Spain	Modelo de utilidad

/Appendix II follows/

Appendix E

INID NUMBERS FOR IDENTIFICATION OF PATENT DATA ELEMENTS

This Appendix embodies an ICIREPAT paper which defines a set of codes for identification of bibliographic data on the first page of a patent document and in entries in an official gazette. These codes, known as INID numbers, have been referred to in Chapter 1.5 and in the descriptions of individual patent data elements in Part 2.

INID numbers are organized into decimal groups (1Ø,2Ø, etc.), each of which is subdivided into a number of specific items (12, 13, 14, 21, 22, 23, etc.).

The individual codes are used only with the precise meanings defined on subsequent pages. If none of the specific item definitions is applicable, the generic code for the group (ending in Ø) may be used.

This Appendix is included for reference purposes only, to assist in creating bibliographic records for patent documents which use the INID system. INID numbers are not themselves used in UNISIST exchange records.

ICIREPAT

Recommendation concerning Bibliographic Data

(Identification by INID Codes and Minimum Required)

on the First Page of a Patent Document and in Entries in an Official Gazette

Introduction

1. The recommendation STAC III No. 62d of September 1967 provides for means whereby the various data appearing on the first page of a patent document can be identified without knowledge of the language used and the laws applied. This recommendation is already successfully applied by various Patent Offices.

2. The recommendation STAC III No. 77a of September 1967 likewise provides for means whereby the various data appearing in entries in official gazettes and like publications can be identified.

3. It was considered necessary to revise these recommendations in certain respects in the light of experience with their use.

4. It was also considered necessary to include in the recommendation an indication of the minimum bibliographic data to be provided on the first page of such a document, and in an entry in such a gazette, in order to give the information required for subject-matter and legal patent searches, including finding patent families, and for documentation purposes, such as the compiling of indexes.

Definitions

5. "Patent documents" includes patents, inventors' certificates, utility models or certificates, and applications therefor. "Documents" means patent documents unless otherwise stated.

6. "Making available to the public" means *(a)* publication by printing or similar process or *(b)* laying open for public inspection and copying on request.

7. "Entry in an official gazette" means at least one comprehensive announcement in an official gazette, regarding the making available to the public of the complete text, claims (if any) and drawings (if any) of a patent document.

8. "INID" is an acronym for "ICIREPAT Numbers for the Identification of Data."

General

9. The list of definitions of bibliographic data elements with their corresponding INID codes is given below. The INID codes which are preceded by a single asterisk (*) relate to those data elements which are considered to be the minimum elements which should appear on the first page of a document, and in an entry in an official gazette. The INID codes which are preceded by a double asterisk (**) relate to those data elements which are considered to be minimum elements in circumstances specified in the accompanying notes.

10. The INID codes should be associated with the corresponding data elements in so far as these elements normally appear on the first page of the document or in the entry in the official gazette. The INID codes should preferably be indicated using Arabic numerals within small circles or — if this is not feasible — in parentheses, immediately before the corresponding data element. Provided the presentation of bibliographic data elements in entries in an official gazette is uniform INID codes may be applied to the data elements in a representative specimen entry in each gazette issued, instead of being included in each entry.

11. If data elements to which INID codes are assigned in accordance with this recommendation do not appear on the first page of a document or in an entry in an official gazette — because they are not applicable (e. g. when no priority is claimed) or for some other reason — it is not necessary to call attention to the non-existence of such elements (e. g. by leaving a space or by providing the relevant INID code followed by a dash).

12. Two or more INID codes may be assigned to a single data element when necessary.

13. The list of data elements has been organized into categories (10, 20 . . . 70) to facilitate grouping of related elements. Each category has two or more sub-divisions to each of which an INID code has been assigned. If none of the specific codes can be assigned to a data element which clearly falls within the category definition, the relevant category code, ending in 0, should be used.

14. In order that the users of patent documents and official gazettes may be enabled to make maximum use of these INID codes, it is recommended that a list of the codes be published in Patent Office or other official publications, e. g. official gazettes, at regular intervals.

Implementation

15. It is, of course, open to each Patent Office to implement this recommendation either in its entirety or to some lesser extent, whichever it finds more convenient.

(10) Document identification

- ***(11) Number of the document**
- ****(19) ICIREPAT country code, or other identification, of the country publishing the document**

(** Minimum data element for documents only)

(20) Domestic filing data

- ***(21) Number(s) assigned to the application(s), e. g. "Numéro d'enregistrement national", "Aktenzeichen"**
- ***(22) Date(s) of filing application(s)**
- ***(23) Other date(s) of filing, including exhibition filing date and date of filing complete specification following provisional specification**

TABLE 1:

	C Pos 1	O Pos 2	D Pos 3	E Pos 4	N Pos 5
Character	Pos 1	Pos 2	Pos 3	Pos 4	Pos 5
A	11	7	5	3	1
B	22	14	1Ø	6	2
C	33	21	15	9	3
D	1Ø	28	2Ø	12	4
E	21	1	25	15	5
F	32	8	3Ø	18	6
G	9	15	1	21	7
H	2Ø	22	6	24	8
I	31	29	11	27	9
J	8	2	16	3Ø	1Ø
K	19	9	21	33	11
L	3Ø	16	26	2	12
M	7	23	31	5	13
N	18	3Ø	2	8	14
O	29	3	7	11	15
P	6	1Ø	12	14	16
Q	17	17	17	17	17
R	28	24	22	2Ø	18
S	5	31	27	23	19
T	16	4	32	26	2Ø
U	27	11	3	29	21
V	4	18	8	32	22
W	15	25	13	1	23
X	26	32	18	4	24
Y	3	5	23	7	25
Z	14	12	28	1Ø	26

TABLE 2:

Total	Check Character	Total	Check Character	Total	Check Character	Total	Check Character
Ø	9	24	X	48	N	72	D
1	A	25	Y	49	O	73	E
2	B	26	Z	5Ø	P	74	F
3	C	27	2	51	Q	75	G
4	D	28	3	52	R	76	H
5	E	29	4	53	S	77	I
6	F	3Ø	5	54	T	78	J
7	G	31	6	55	U	79	K
8	H	32	7	56	V	8Ø	L
9	I	33	8	57	W	81	M
1Ø	J	34	9	58	X	82	N
11	K	35	A	59	Y	83	O
12	L	36	B	6Ø	Z	84	P
13	M	37	C	61	2	85	Q
14	N	38	D	62	3	86	R
15	O	39	E	63	4	87	S
16	P	4Ø	F	64	5	88	T
17	Q	41	G	65	6	89	U
18	R	42	H	66	7	9Ø	V
19	S	43	I	67	8	91	W
2Ø	T	44	J	68	9	92	X
21	U	45	K	69	A	93	Y
22	V	46	L	7Ø	B	94	Z
23	W	47	M	71	C	95	2

Items marked with an asterisk (*) are considered *essential* for users of the *Reference Manual*.

*1 ISO 2709 - 1973: Documentation - Format for bibliographic information interchange on magnetic tape.

2 UNISIST International Serials Data System: *Guidelines for ISDS*, Unesco: Paris 1973.

3 IFLA: International Standard Bibliographic Description for Serials (in preparation).

4 ISO/TC46 fifth draft proposal: Patents. Bibliographical references. Essential and complementary elements.

5 ICIREPAT Recommendations concerning bibliographic data on the first page of a patent document and in entries in an official gazette. (Incorporated in Appendix E).

*6 ISO DIS 3297 - 1973: International Standard Serial Numbering.

7 *CODEN for Periodical Titles*, ASTM Data Series DS23B, American Society for Testing and Materials: Philadelphia 1970 (2 vols).

*8 ISO/R4 - 1972: Documentation - International code for the abbreviation of titles of periodicals.

*9 ISO 833 - 1973: Documentation - International list of periodical title-word abbreviations.

10 ISO/R2014 - 1971: Writing of calendar dates in all-numeric form.

*11 ISO 2108 - 1972: International Standard Book Numbering.

12 ISO/R646 - 1973: 7-bit coded character sets for information processing interchange.

13 GOST 13052-67 (USSR standard for 7-bit coded character sets).

WELL DATA TAPE STORAGE FORMAT

10/27/75

This document is intended to provide a quick reference to the WHCS format. Users will find this a handy reference when interrogating WHCS microfiche, data listings or in defining search criteria for a computer retrieval. Detail data content and codes employed in each record and data element are described in the WHCS Manual.

Well History Control System is a copyrighted scheme and format for the storage of well information on magnetic tape. The master file is sequenced by State-County-API Unique Well Number for each of eleven regional systems. The associated 10002 line formats columns 6-25 show the WHCS well and record controls that are available to clients. The master storage file is sequenced by State-County-API Unique Well Number as shown on the second 10002 line format on the right.

A WHCS well history is based on well units that may contain all or part of the individual records or lines that are outlined in this document. A well unit is denoted and controlled by the Hole Change code that is part of the control code for each well record. A well unit is constructed for the original drilling history (hole change=00) and for each subsequent well entry that changes the depth or production status of the well. The hole change is incremented by 01 for each such operation.

Individual records or lines are defined by a 5 character number in columns 1-5 of each record. The first position in the line number indicates the general data category as follows:

0 - Internal system operation - Petroleum Information Corporation.
1 - Fundamental well information, i.e., location, ownership, mechanical, principal depths, class, status and a general summary of experience, including codes.
2 - Is subdivided into two major groups: 201 through 249 reserved for Initial Potential cycles; 250 through 299 reserved for formation tops and bases.
3 - Core data cycles.
4 - Formation test cycles.
5 - Production test cycles.
6 - Miscellaneous data.
7 - Reserved for system expansion.
8 - Reserved for internal use of participating company.
9 - Narrative and chronology of well experience, only used in Well Record Service (WRS) when well is on report.

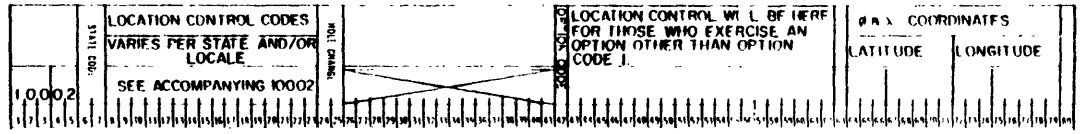
The XX notation in either the second and third or fourth and fifth characters is used to accommodate multiple data sets such as drillstem tests or repeated lines of the same type or format such as formation tops as described below:

a. Multiple data sets: In the case of drillstem tests (4XX01-4XX99), the first drillstem test would be recorded with 40101-40199 lines; the second drillstem test would use the 40201-40299 lines, etc. Some wells record more than 99 cores. In such cases, an alphameric sequencing is employed in the XX position. This sequence is described in the WHCS Manual.
b. Repeated lines: In the case of formation tops (all log tops are recorded in 250XX lines). The first three formations and depths are recorded in the 25001 line; the next three formations and depths in the 25002 line, etc. The accompanying formats show the data element positions within each WHCS record. This document includes several record formats that are marked "Permian Only". Several new data elements have been included on pre-existing WHCS records and a few new record types added to accommodate unique data for Permian WHCS.

Petroleum Information. CORPORATION

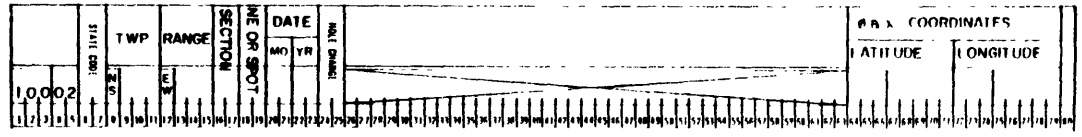
CONTROL CODES AND OPTIONS

GENERALIZED MASTER LOCATION CONTROL

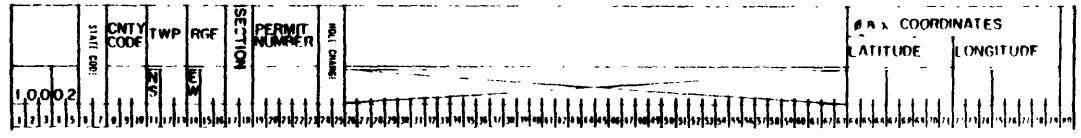


MASTER WELL CONTROL - ALL WHCS FILES

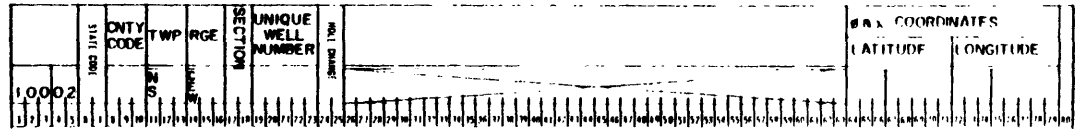
LOCATION CONTROL OPTION-FOR ROCKY MOUNTAIN REGION



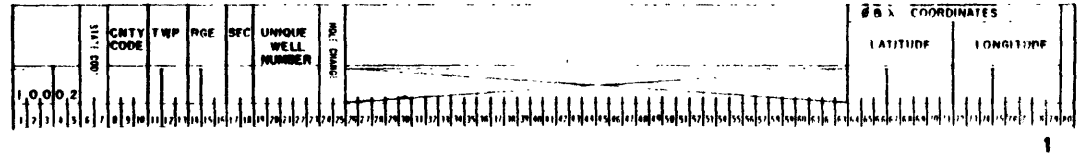
LOCATION CONTROL OPTION-FOR MICHIGAN, ILLINOIS & INDIANA



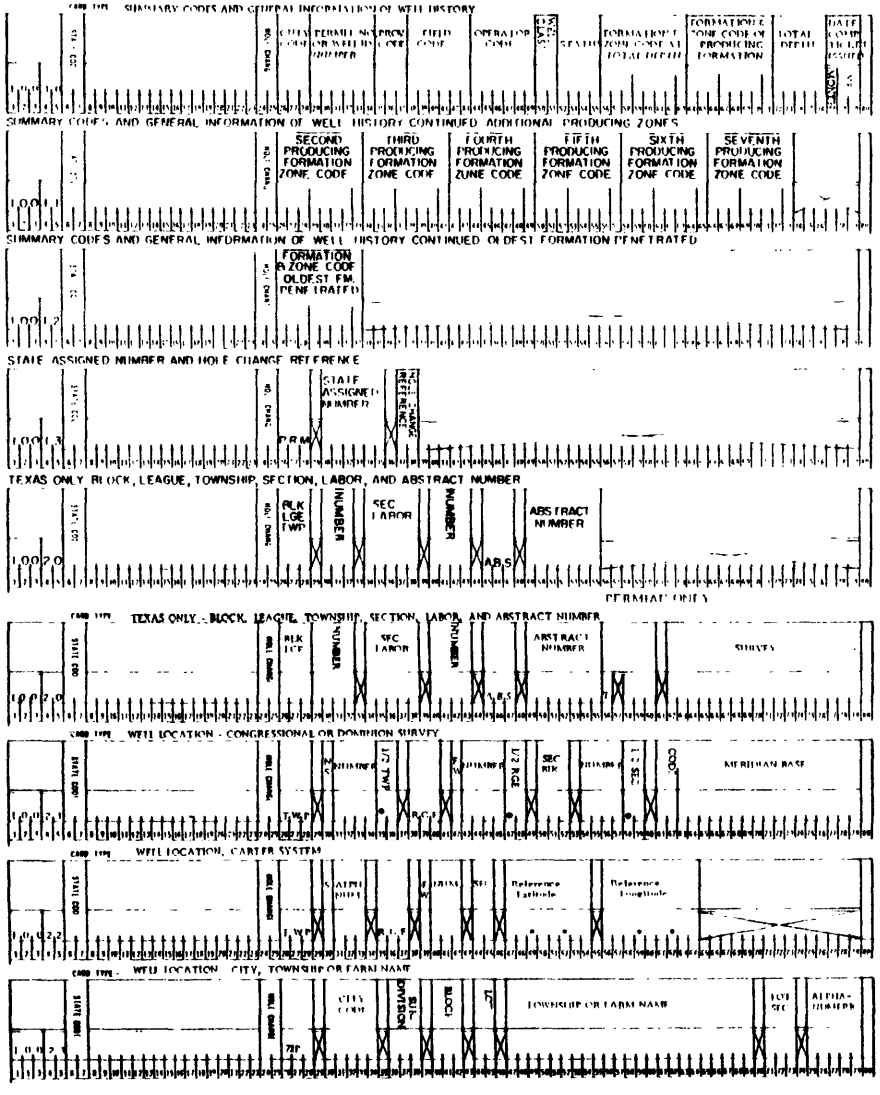
LOCATION CONTROL OPTION-FOR MID-CONTINENT REGION (EXCLUDING TEXAS)

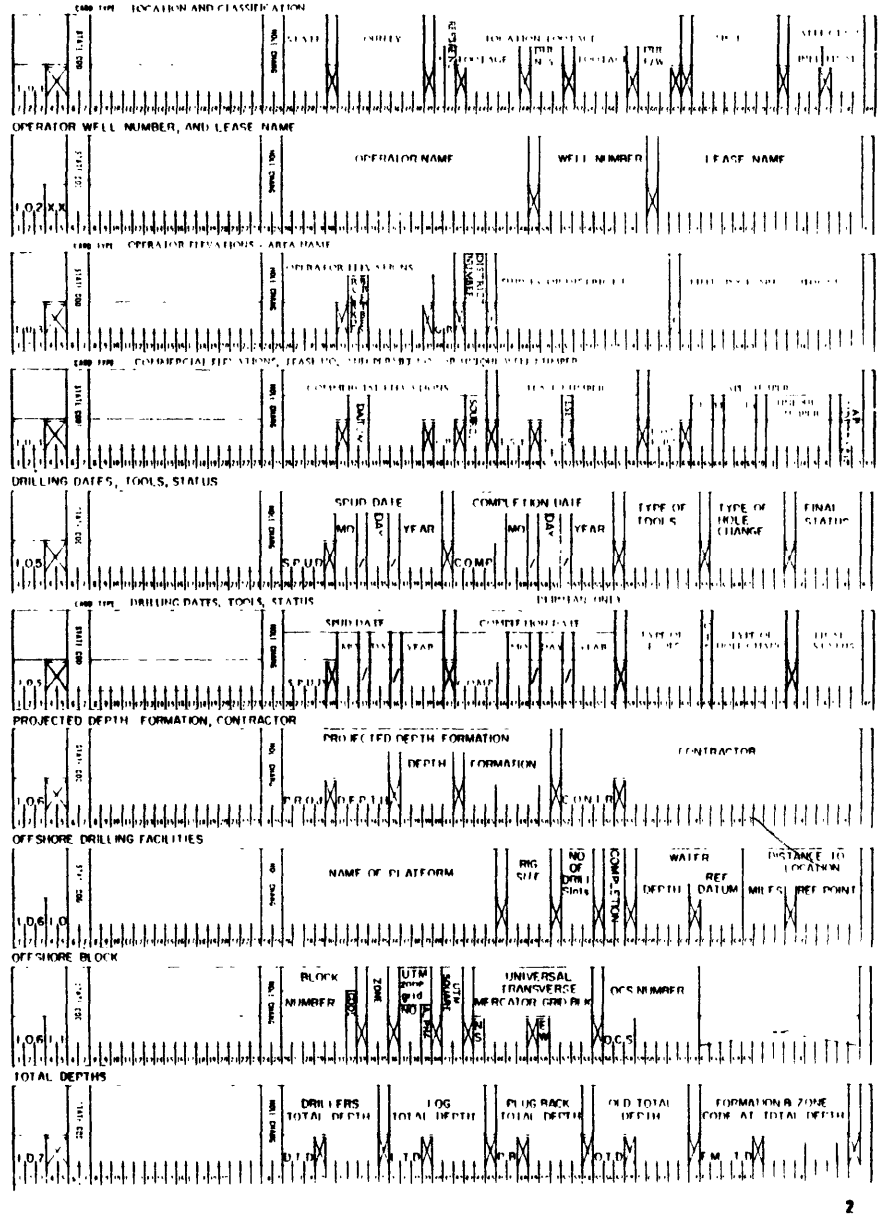


LOCATION CONTROL OPTION-FOR MISSISSIPPI, ALABAMA, FLORIDA, SO CAROLINA & GEORGIA



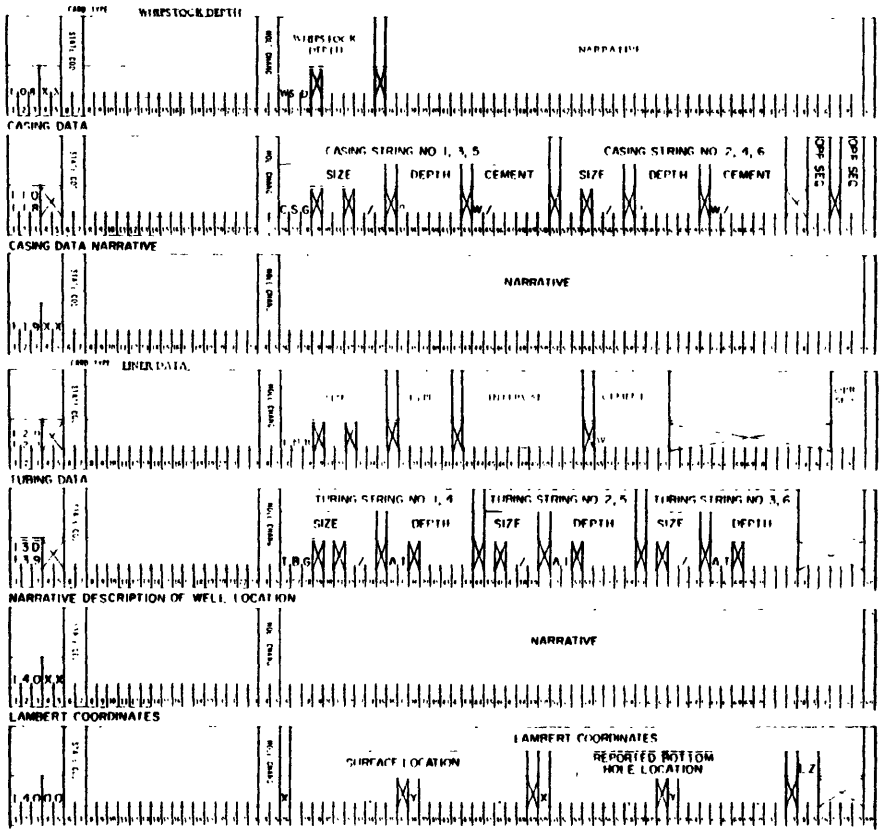
GENERAL INFORMATION AND WELL IDENTIFICATION





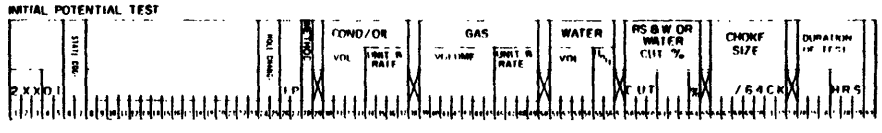
Petroleum Information.
CORPORATION

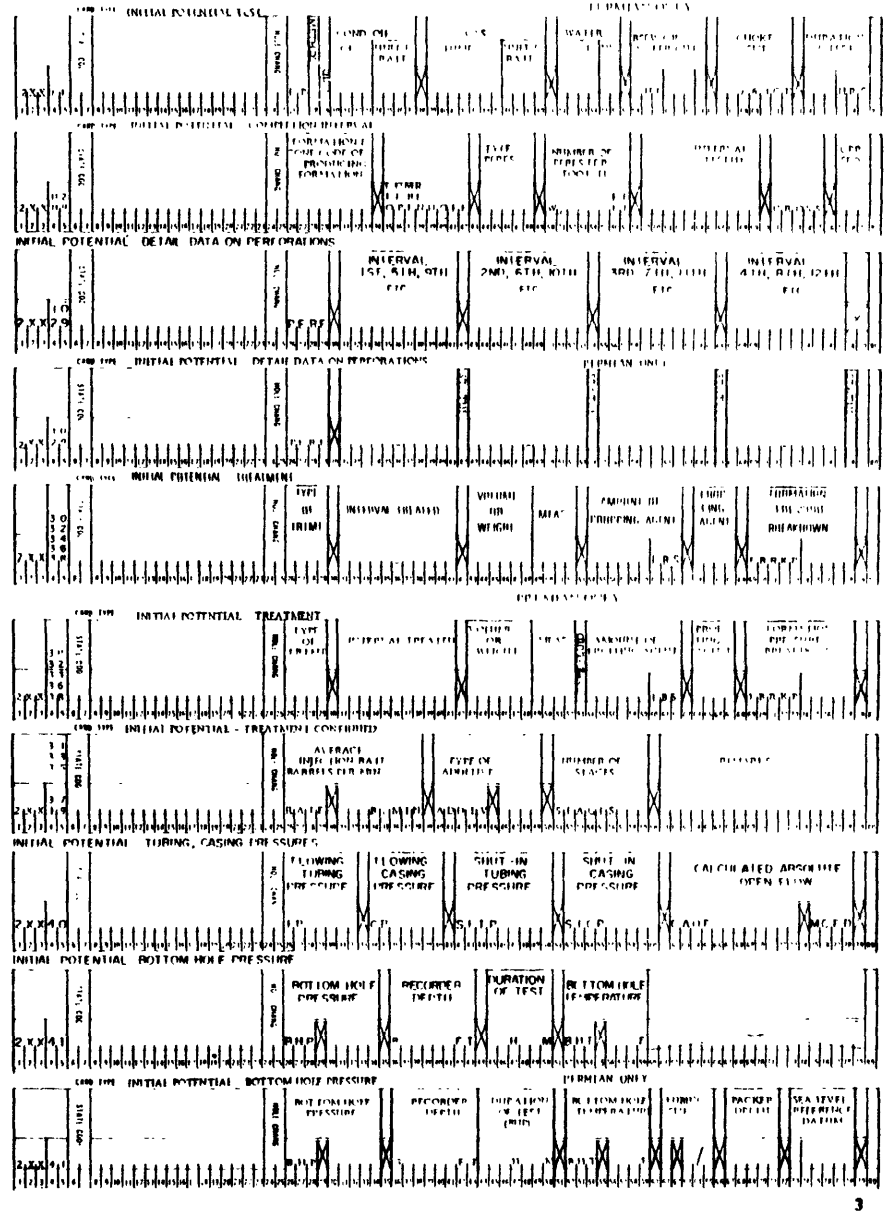
GENERAL INFORMATION AND WELL IDENTIFICATION (CONT'D)



INITIAL POTENTIAL AND PRODUCTION TEST DATA

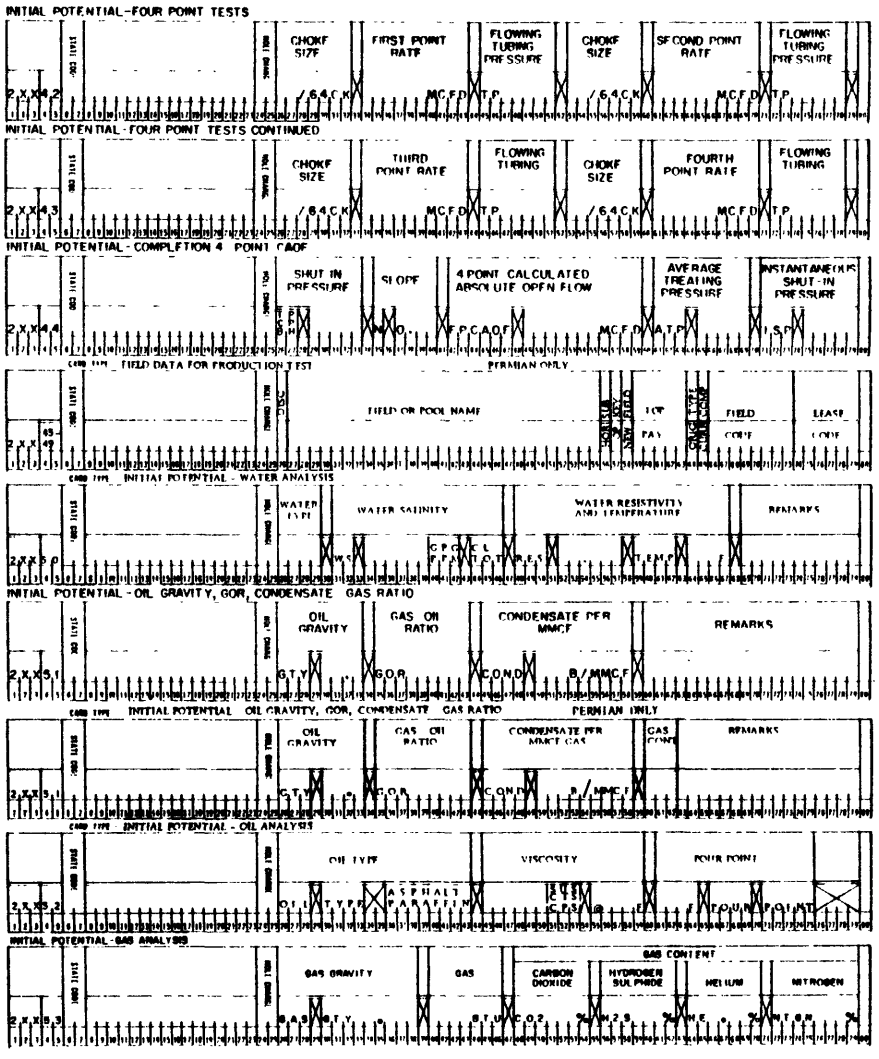
APPLIES ONLY TO ROCKY MOUNTAIN, MICHIGAN BASIN, AND MID-CONTINENT PROGRAMS

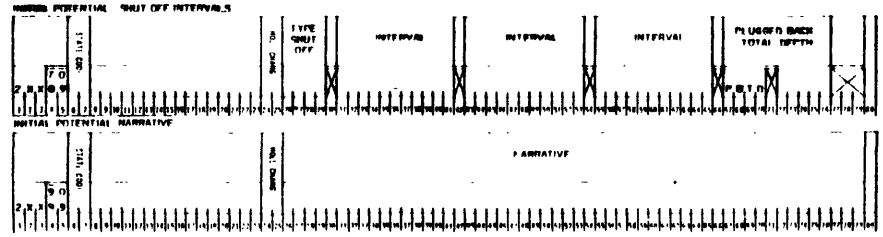




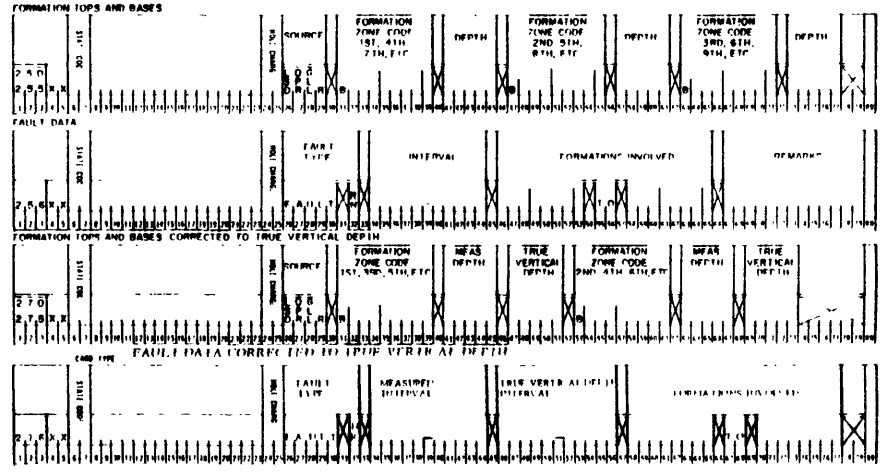
Petroleum Information.
CORPORATION

INITIAL POTENTIAL AND PRODUCTION TEST DATA (CONT'D)

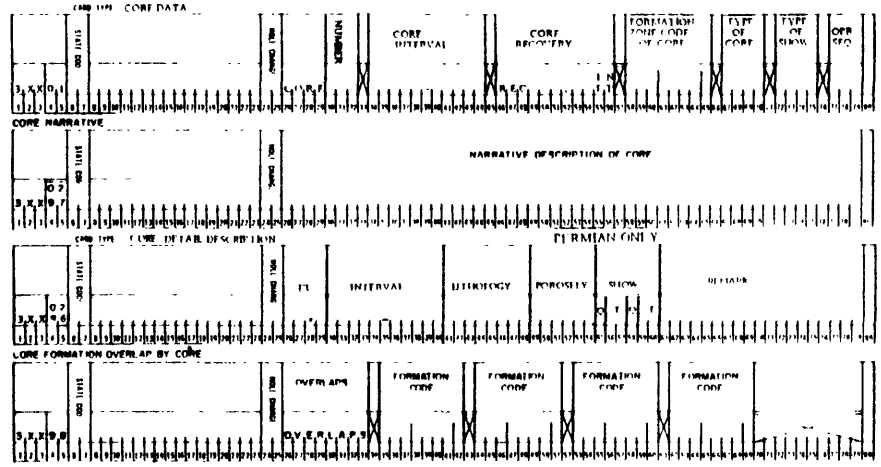




FORMATION TOPS AND BASES

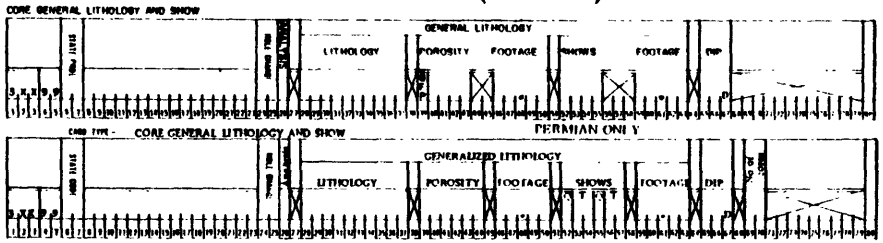


CORE DATA

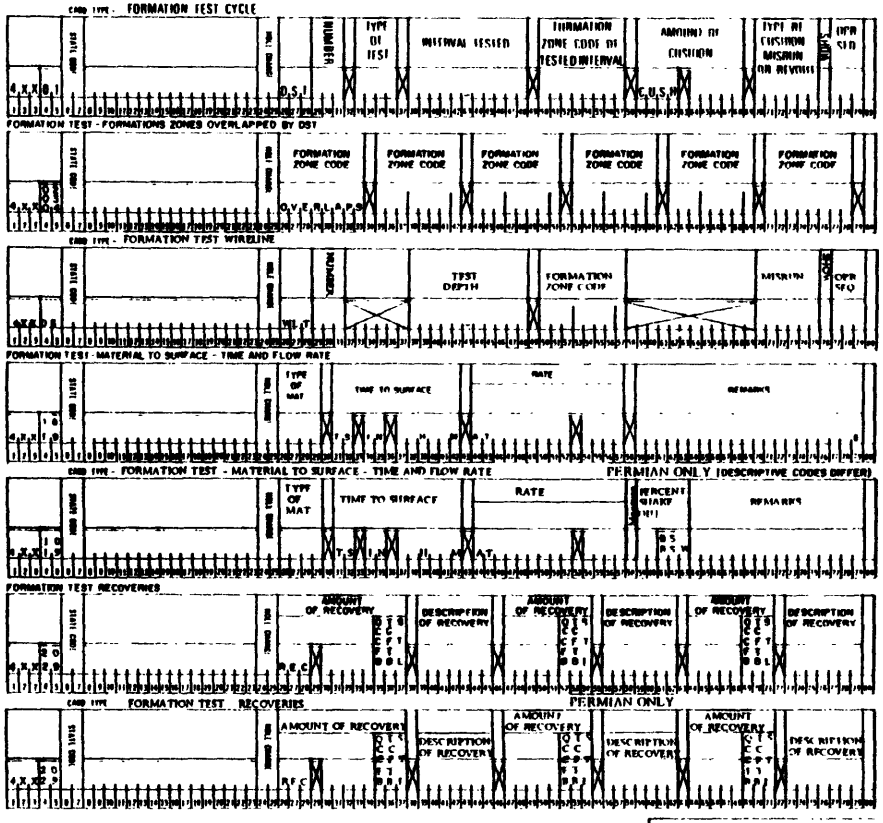


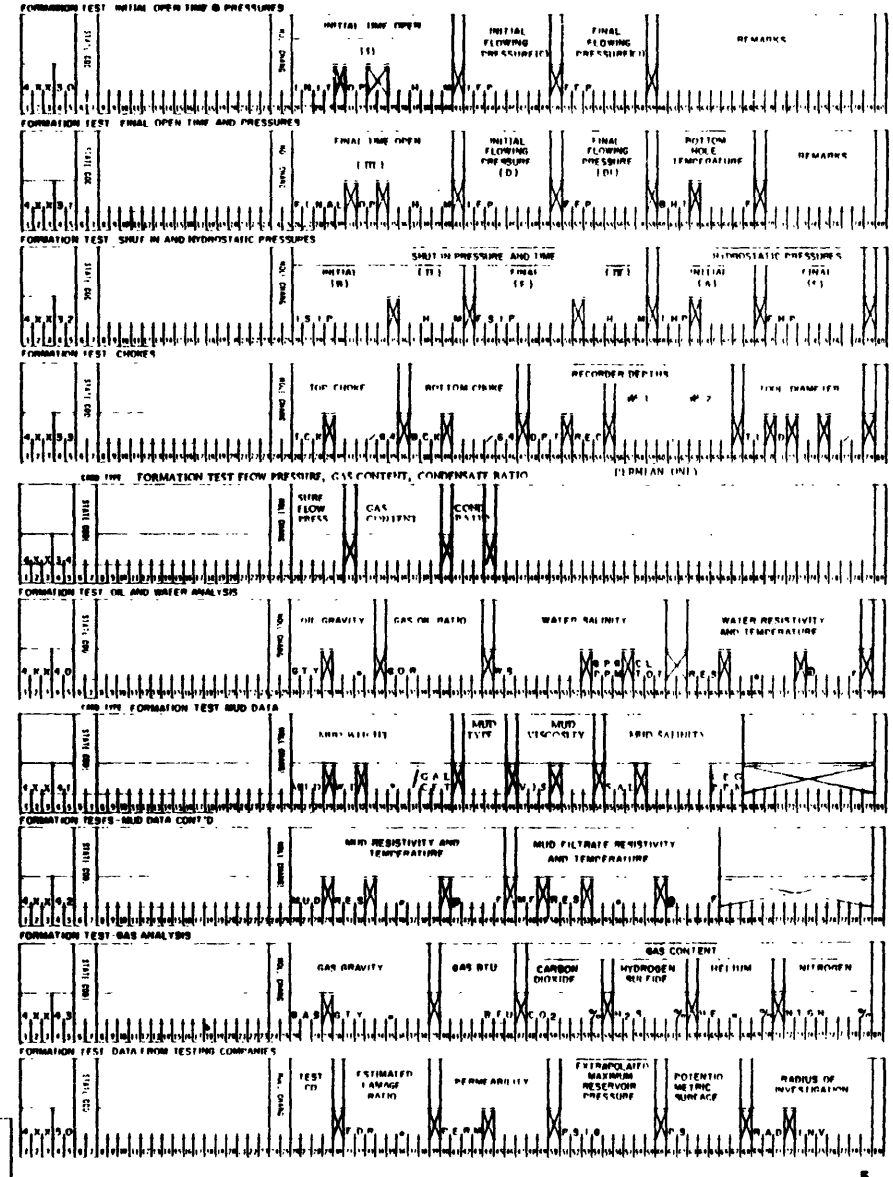
Petroleum Information.
CORPORATION

CORE DATA (CONT'D)

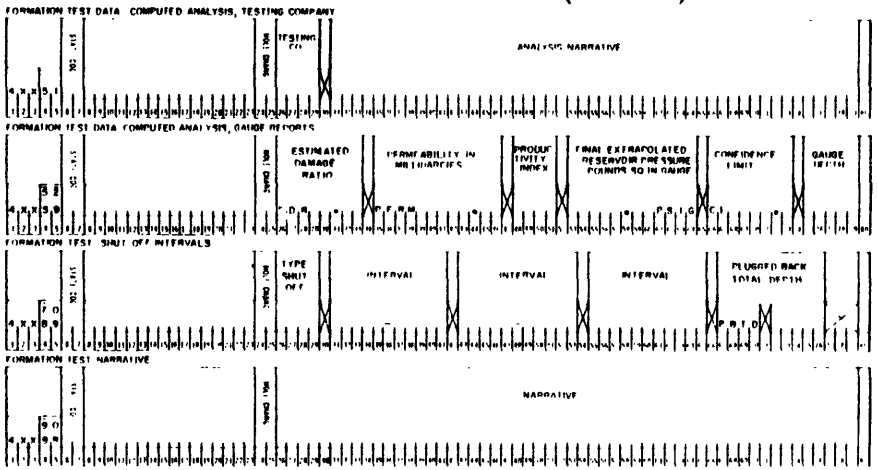


FORMATION TEST DATA

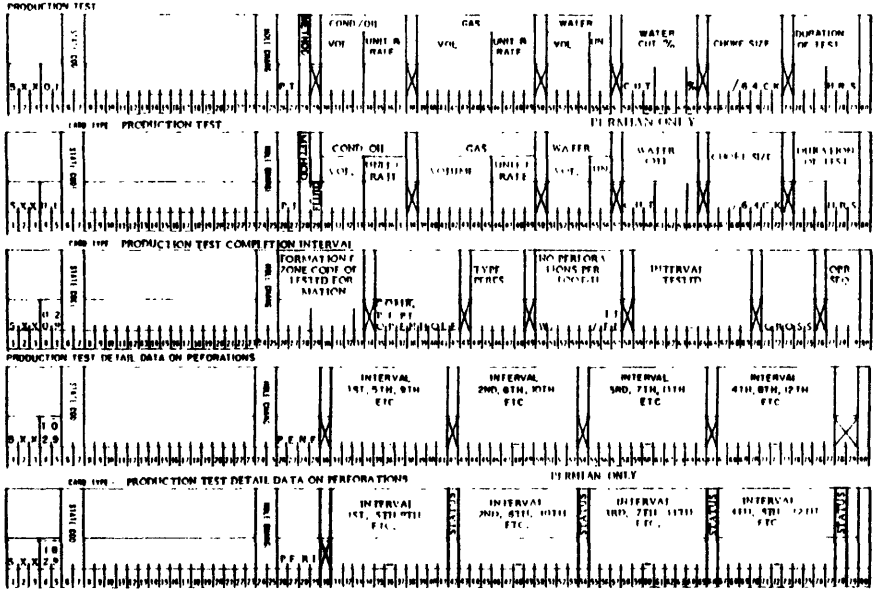


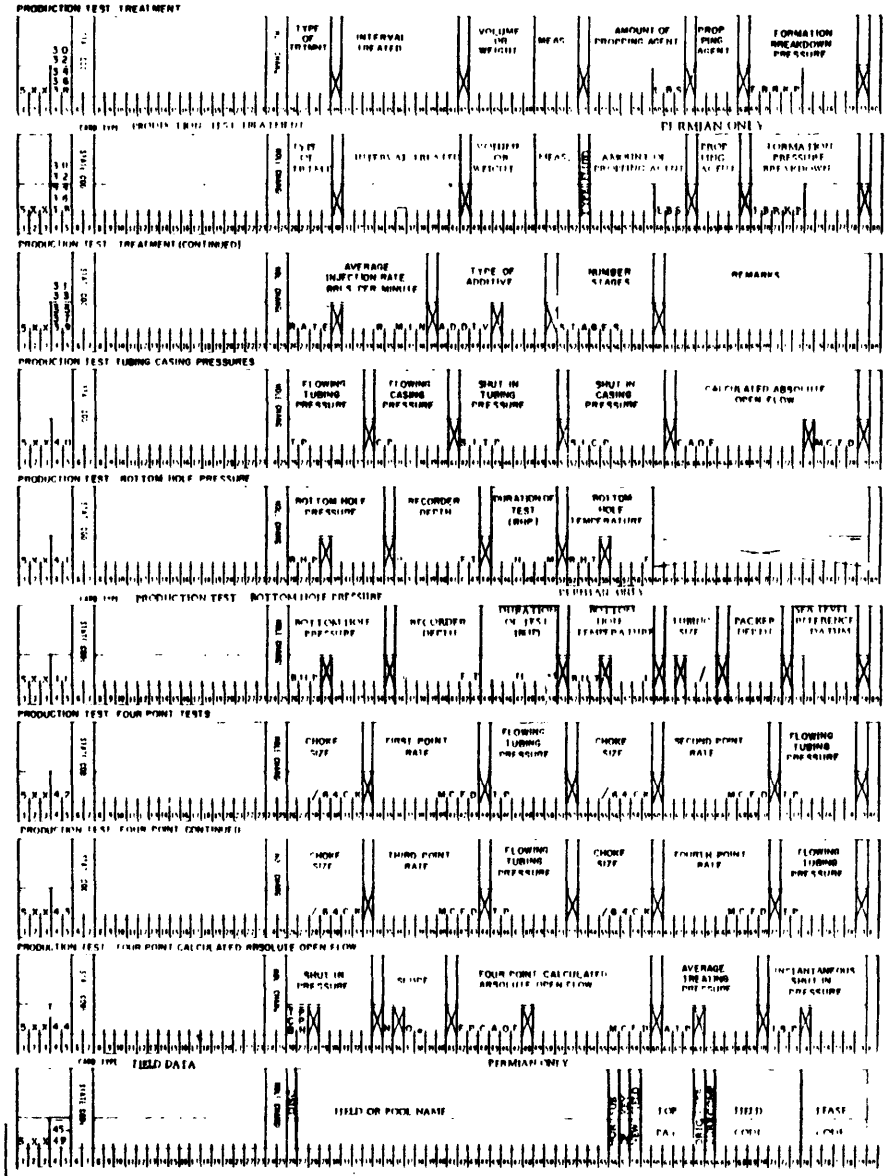


FORMATION TEST DATA (CONT'D)

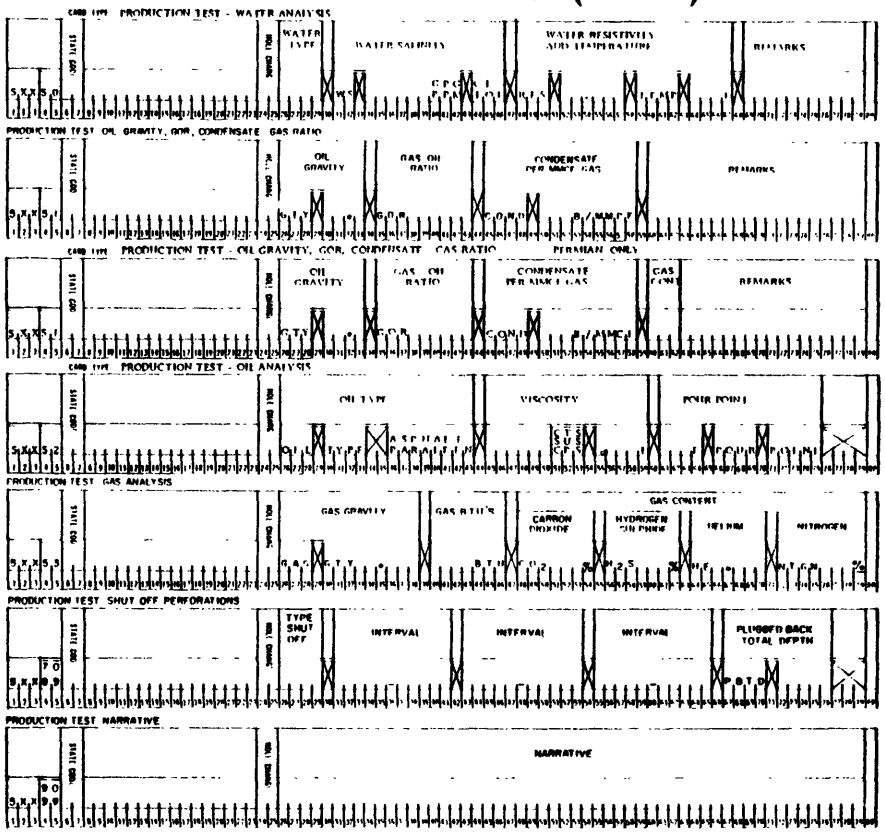


PRODUCTION TEST DATA

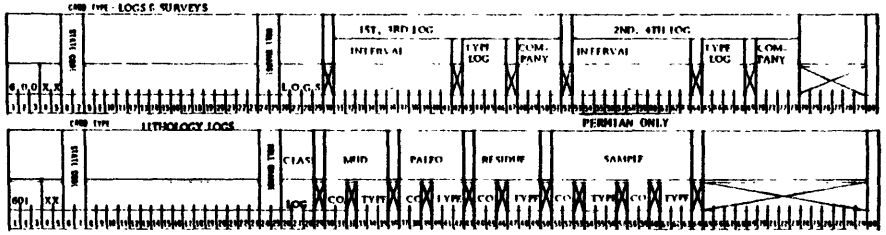




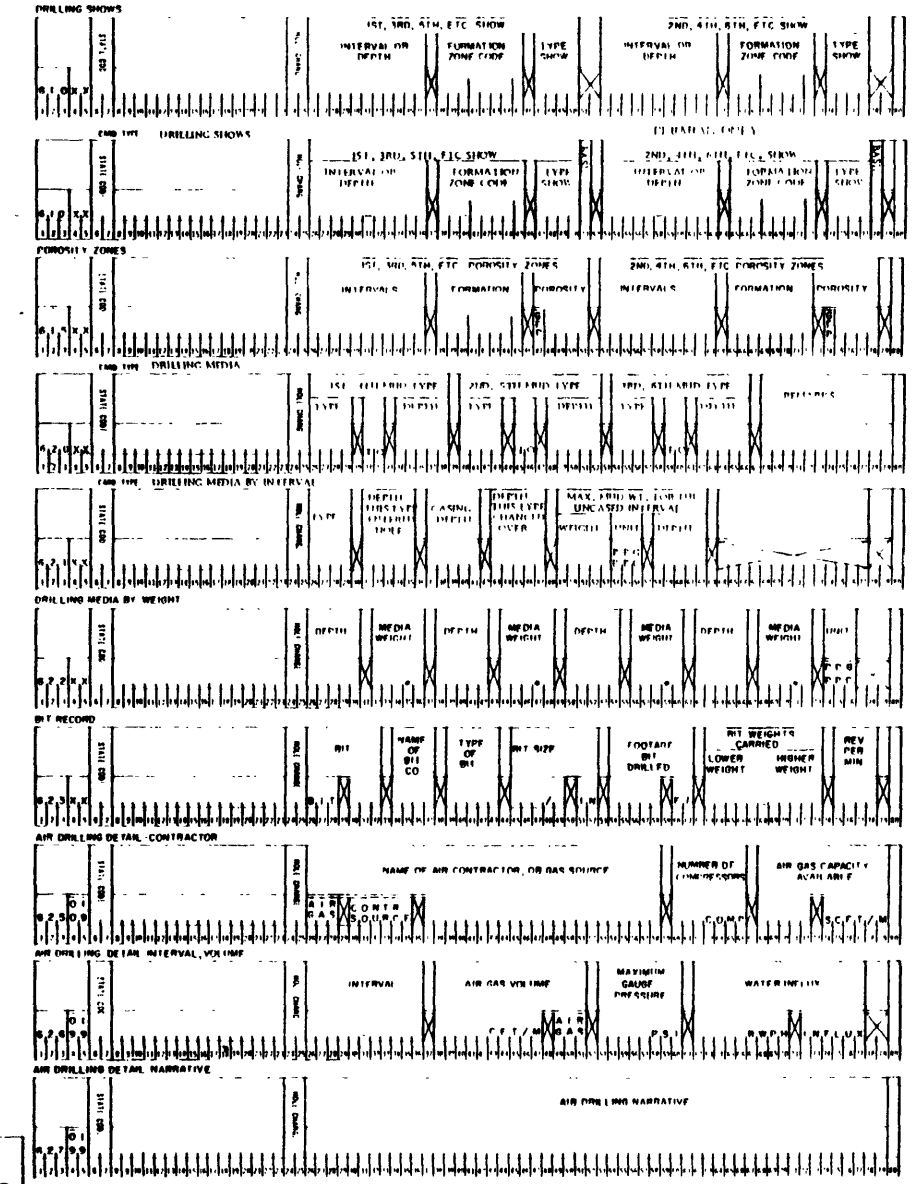
PRODUCTION TEST DATA (CONT'D)



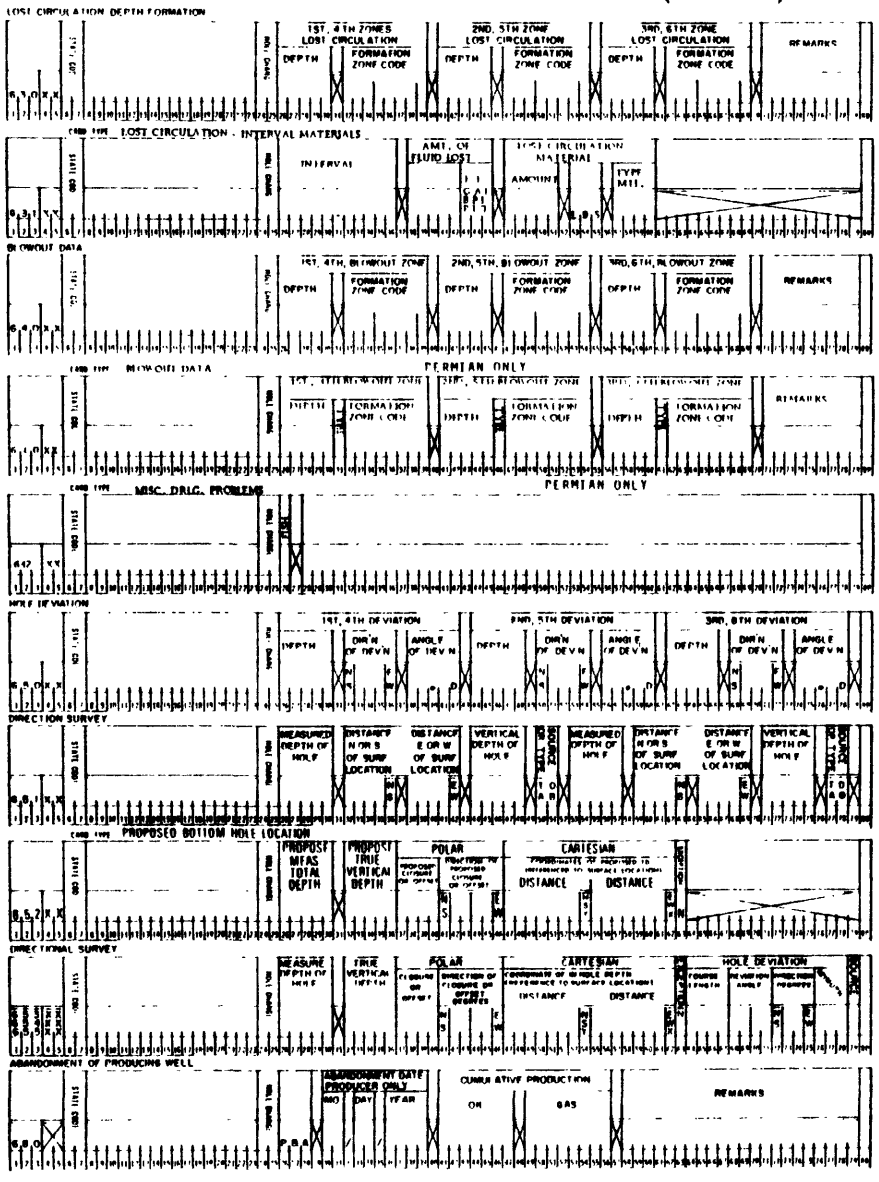
GENERAL AND MISCELLANEOUS DATA

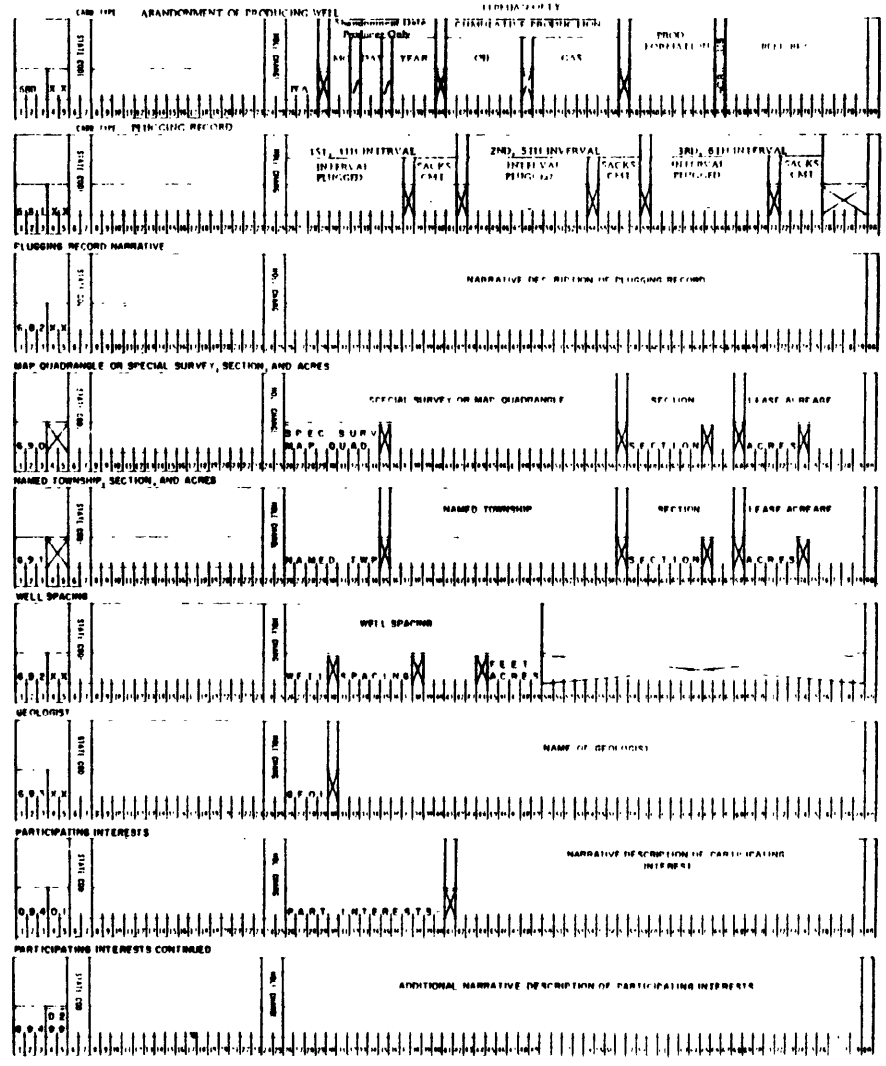


Petroleum Information.
CORPORATION



GENERAL AND MISCELLANEOUS DATA (CONT'D)





Petroleum Information.

FORM - OOGØØ1

OIL AND GAS DATA FORM

A IDENTIFICATION

A1 CONTINENT A2 COUNTRY

A3 STATE

A3A STATE CODE

A4 COUNTY

A4A COUNTY CODE

A5 FIELD

A5A FIELD CODE NO. (FROM FPC CODE BOOK)

A5B UNIQUE ID NUMBER

A6 POOL

A6A STATE OR FEDERAL IDENTIFICATION NO.

A7 SOURCE DOCUMENT (OTHER THAN STATE REPORTS OR OIL SCOUTS REVIEW)

A7A STATE REPORTS

A7B OIL SCOUTS REVIEW

A7C FPC EXHIBIT H DATA

B FIELD/POOL DATA

B1 REGULATORY DISTRICT OR AREA

B2 PRODUCING FORMATION NAME

B2A STRATIGRAPHIC CODE

GEOLOGIC AGE OF PRODUCING FORMATION (FROM DICTIONARY OF STRATIGRAPHIC NAMES)

B3

B3X

B3Y

B3Z

(Revised 4/78)

B4 DESIGNATION OF FIELD & POOL BY STATE REGULATORY AGENCY (CIRCLE APPROPRIATE CODES)

B4A OIL

B4B CONDENSATE

B4C GAS

B4D ~~ALLOCATED OR EXEMPT~~ Gas Cap Gas

B4E NON-ALLOCATED OR NON-EXEMPT

B4F GAS STORAGE

B4G HELIUM

B5 OFFSHORE

B6 LOCATION

B6A SECTION

B6B TOWNSHIP

B6C RANGE

B6D MERIDIAN

B7 FIELD CENTERPOINT

B7A LATITUDE

B7B LONGITUDE

B7C FIELD ELEVATION (AVERAGE FT.)

B8 TYPE OF RECORD

B8A FIELD RECORD -

B8B POOL RECORD -

C FIELD/POOL DATA CONTINUED

C1 NO. OF POOLS IN FIELD

C2 YEAR DISCOVERED

C3 YEAR ABANDONED

C4 FIELD DISCOVERY METHOD (CIRCLE APPROPRIATE CODE)

C4A	SEISMIC	C4G	PHOTOGEOLOGY
C4B	SUBSURFACE	C4H	RANDOM DRILLING
C4C	SEISMIC PLUS SUBSURFACE	C4J	OLD WELL REENTERED
C4D	SURFACE	C4K	GEOCHEMICAL
C4E	GROUND MAGNETICS	C4L	GRAVITY
C4F	AIRBORNE MAGNETOMETER	C4M	TREND
		C4Z	OTHER

C5 TRAP TYPE (GENERAL)

C5A STRUCTURAL

C5B STRATIGRAPHIC

C5C STRUCTURAL PLUS STRATIGRAPHIC

C5D HYDRODYNAMIC

C5E OTHER

C6 TRAP TYPE (SPECIFIC)

C6A	ANTICLINE	C6L	BURIED HILL
C6B	SALT DOME	C6M	REGIONAL FACIES CHANGE
C6C	FAULT	C6N	UNCONFORMITY
C6D	NOSE	C6P	LATERAL CHANGE IN POROSITY AND PERMEABILITY
C6E	SYNCLINE	C6Q	IGNEOUS INTRUSIVE
C6F	TERRACE	C6R	ASPHALT DEAL
C6G	FRACTURE	C6S	BIOHERM (REEF)
C6H	HOMOCLINE	C6T	BIOSTROME
C6J	DOME	C6U	SECONDARY CHEMICAL ALTERATION
C6K	DIAPIR FOLD	C6W	MONOCLINE
		C6X	LENSE
		C6Z	OTHER

D PRESENT STATUS OF POOL (MUST BE ANSWERED ON EVERY FORM)

D1 ABANDONED

D1A OIL

D1B GAS

D1C CONSOLIDATED OR DIVIDED POOLS <_____>

D2 TEMPORARILY ABANDONED

D2A OIL

D2B GAS

D3 PRODUCING

D3A OIL

D3B GAS

D4 SHUT-IN

D4A OIL

D4B GAS

D5 GAS STORAGE (DEVELOPED OR UNDEVELOPED)

D6 ENHANCED RECOVERY (Secondary Recovery ok)

D7 UNITIZED POOL

D7A YES

D7B NO

D8 DEEPEST WELL

FIELD

POOL

D8A DEPTH (FT.) <_____>

D8B FORMATION NAME <_____>

D8C GEOLOGIC AGE (FROM DICTIONARY) <_____>

D8D OPERATOR - LEASE - WELL NUMBER <_____>

D10 GEOLOGIC BASIN (NAME)

D11 GEOLOGIC BASIN CODE NUMBER

DISCOVERY WELL

E DISCOVERY WELL OF <FIELD> OR <POOL>

E1A OPERATOR NAME

E1A1 CODE (FROM CODE BOOK ONLY)

E1A2 WELL NO.

E1A3 LEASE NAME

E1B LEASE TYPE (MUST BE ANSWERED WHEN LEASE NAME IS AVAILABLE)

E1B1 FEDERAL

E1B2 STATE

E1B3 FEE

E1B4 UNIT

E1B5 INDIAN LAND

E1B6 OTHER

E1D ELEVATION (KB, DF, GRD, OTHER) FEET

E1E WATER DEPTH (FOR OFFSHORE WELLS ONLY)

E1H DEEPEST FORMATION PENETRATED

E1H1 FORMATION NAME

E1H2 GEOLOGIC AGE FROM DICTIONARY ONLY

E1H3 DEPTH

E1K PERFORATION (FEET)

E1K1 TOP

E1K2 BOTTOM

E1S DISCOVERY WELL SECTION

E1T DISCOVERY WELL TOWNSHIP

(Revised 4/78)

E1R DISCOVERY WELL RANGE

F NUMBER AND TYPES OF WELLS

~~F1 DUAL PRODUCING OIL AND GAS~~

F1A1 FLOWING

F1A2 GAS LIFT OR AIR LIFT

F1A3 PUMPING OR ARTIFICIAL LIFT

F1A4 OTHER

F1A5 TOTAL PRODUCING

F1A6 CAPABLE OF PRODUCING

F1A7 Dual Producing Oil + Gas

F1C

~~F1C1~~ SHUT-IN OR TEMPORARILY ABANDONED

F1D SERVICE

F1D1 INJECTION

F1D2 DISPOSAL

F2 PROVED ACREAGE (DEVELOPED ACREAGE)

F2A FIELD AREA (TOTAL APPROVED BY STATE)

F3 SPACING (ACRES PER WELL)

F4 WELL DENSITY (ACRES PER WELL)

F7 PRODUCING INTERVAL (POOL)

F7A AVERAGE THICKNESS (FT.)

F7A1 AVERAGE FEET PERFORATED

F7B DEPTH TO TOP (FT.)

F7C DEPTH RANGE

F7C1 SHALLOWEST

F7C2 DEEPEST

F7D CONTACT (OIL, WATER & GAS) SUBSEA FT.

F7D1 ORIGINAL WATER CONTACT (SUBSEA FT.)

F7D2 ORIGINAL GAS/OIL CONTACT (SUBSEA FT.)

F7D3 CURRENT WATER CONTACT (SUBSEA FT.)

F7D3A YEAR

F7D4 CURRENT GAS/OIL CONTACT (SUBSEA FT.)

F7D4A YEAR

G RESERVOIR DATA - GENERAL

G1 LITHOLOGY (SPECIFIC)

G1A SILTSTONE

G1B SHALE

G1D CHERT

G1E ANHYDRITE

G1F INTRUSIVE IGNEOUS (SERPENTINE) OR EXTRUSIVE IGNEOUS

G1K METAMORPHICS, DETRITAL, SANDSTONE, CONGLOMERATE, ARKOSE, GRANITE WASH, BEACH SANDSTONE, BAR SANDSTONE, NEARSHORE MARINE SANDSTONE, OR CHANNEL SANDSTONE

G1T LIMESTONE (CHAT), OOLITIC LIMESTONE, MICRITIC LIMESTONE, LIMESTONE REEF, OR MARLSTONE

G1U DOLOMITE OR DOLOMITE REEF

G1V CARBONATE

G1Z OTHER

G2 PRIMARY DRIVE TYPE (CIRCLE ONE OR MORE)

G2A DISSOLVED (SOLUTION) GAS OR DEPLETION

G2B GAS CAP GAS

G2C GAS EXPANSION OR VOLUMETRIC (DRY GAS POOLS ONLY)

G2D WATER DRIVE

G2E GRAVITY

G3 POROSITY (PERCENT)

G3A RANGE

G3A1 LOW

G3A2 HIGH

G3B AVERAGE

G3C TYPE

G3C1 INTERGRANULAR (PINPOINT)

G3C2 INTERCRYSTALLINE

G3C3 VUGGY

G3C4 FRACTURE

G4 PERMEABILITY (MILLIDARCIES)

G4A RANGE

G4A1 LOW

G4A2 HIGH

G4B AVERAGE

G5 ORIGINAL FORMATION VOLUME FACTOR

G5B CURRENT FORMATION VOLUME FACTOR

G5B1 YEAR

G6 RECOVERY FACTOR (PERCENT)

G6A PRIMARY

G6B SECONDARY

G7 WATER SATURATION (PERCENT)

G7A RANGE (PERCENT)

G7A1 LOW

G7A2 HIGH

G7B AVERAGE

G7B1 WATER CUT (PERCENT)

G7C OIL SATURATION (PERCENT)

G7C1 RANGE (PERCENT)

G7C1A LOW

G7C1B HIGH

G7C2 AVERAGE

G7D GAS SATURATION (PERCENT)

G7D1 RANGE (PERCENT)

G7D2 LOW (PERCENT)

G7D3 HIGH (PERCENT)

G7D4 AVERAGE (PERCENT)

G8 BULK VOLUME

G8A ACRE-FEET

G9 TEMPERATURE DEGREES (FAHRENHEIT)

G9C RESERVOIR OR BOTTOM HOLE

G9Z SATURATION PRESSURE

G9Z1 PSIA

G9Z2 AT (°F)

G10 SALINITY (PPM)

G11 VISCOSITY (CENTIPOISE)

G11A PSIA

G11B AT (°F)

H RESERVOIR DATA - CONTINUED

H1 GAS MEASUREMENT BASE

H1A PRESSURE BASE (PSIA)

~~H1A1~~ H1A TEMPERATURE BASE (°F)

~~H1A2~~ H1B ASSOCIATED GAS GRAVITY

~~H1A3~~ H1C NON-ASSOCIATED GAS GRAVITY

H2 SHUT-IN BOTTOM HOLE PRESSURE (PSIA)

H2A INITIAL OR ORIGINAL RESERVOIR PRESSURE

H2B__ CURRENT (REPLACE XX WITH APPROPRIATE YEAR)

H2C DATUM (SUBSEA FT.)

H4 PRESSURE AT ABANDONED CONDITIONS (PSIA)

H5 AVERAGE RATE OF PRESSURE DECLINE (PSI/BBL PRODUCED)

H6 GAS-CONDENSATE RATIO (BBL/MMCF)

H7 INSTANTANEOUS PRODUCING GAS-OIL RATIO (CF/BBL)

H7A INITIAL

H7B CURRENT

H7B1 YEAR

H8 Z FACTOR

H8A INITIAL

H8B ABANDONED CONDITIONS

H8C CURRENT

H8C1 YEAR

K PRODUCTION

K1 ANNUAL (REPLACE XX WITH APPROPRIATE YEAR)

K1B CRUDE OIL

K1C Non-Assoc. NATURAL GAS

K1D CONDENSATE

K1F WATER

K1G Total ASSOCIATED GAS

K1H HELIUM

K1J CARBON DIOXIDE

K1K HYDROGEN SULFIDE

K1T TOTAL GAS

K1M Dissolved Gas

K1N Gas Cap Gas

K2 CUMULATIVE

K2B CRUDE OIL

K2C NATURAL GAS

K2D CONDENSATE

K2F WATER

K2G ASSOCIATED GAS

K2H HELIUM

K2J CARBON DIOXIDE

K2K HYDROGEN SULFIDE

K2T TOTAL GAS

K2BYR YEAR

K2CYR YEAR

K2DYR YEAR

K2GYR YEAR

(Revised 4/78)

FORM - OOGØØ1

L AMOUNTS OF HYDROCARBONS REPORTED

L1 ORIGINALLY IN PLACE

L1A CRUDE OIL (BBL)

L1B CONDENSATE (BBL)

L1C NATURAL GAS (MCF)

L2 TOTAL ORIGINAL PHYSICALLY RECOVERABLE

L2A YEAR

L2B CRUDE OIL (BBL)

L2B1 (BBL/ACRE)

L2B2 (BBL/ACRE-FT.)

L2C CONDENSATE (BBL)

L2C1 (BBL/ACRE)

L2C2 (BBL/ACRE-FT.)

L2C3 (BBL/MCF)

L2D NATURAL GAS (MCF)

L2D1 (MCF/ACRE)

L2D2 (MCF/ACRE-FT.)

L2E ASSOCIATED GAS (MCF)

L2E1 (MCF/ACRE)

L2E2 (MCF/ACRE-FT.)

L4 ORIGINAL PHYSICALLY RECOVERABLE (SECONDARY)

L4A YEAR

L4B CRUDE OIL

L5 PRODUCING CAPACITY ANNUAL OR BBLS/DAY

L5A CRUDE OIL

L5A1 ANNUAL

L5A2 BBLS/DAY

L5B CONDENSATE

L5B1 ANNUAL

L5B2 BBLS/DAY

L5C NATURAL GAS

L5C1 NON-ASSOCIATED

L5C2 OTHER

L7 AAPG RESERVE CATEGORY

L7A OIL

L7B GAS

L8 API/AGA RESERVES EST. DEC. 31, 1974

L8A REMAINING PROVED CRUDE OIL RESERVES (FIELD BBLS)

L8B DAILY CRUDE OIL PRODUCTIVE CAPACITY 90 DAYS (FIELD BBLS)

M SECONDARY RECOVERY

M1 FIRST CYCLE OF INJECTION

M1A YEAR INITIATED

M1B TYPE

M1C YEAR ABANDONED

M2 SECOND CYCLE

M2A YEAR INITIATED

M2B TYPE

M2C YEAR ABANDONED

M3 THIRD CYCLE

M3A YEAR INITIATED

M3B TYPE

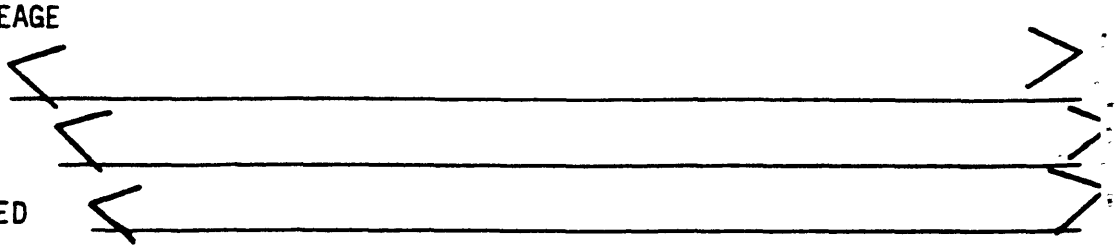
M3C YEAR ABANDONED

M6 WATER FLOOD ACREAGE

M6A ACTIVE

M6B ABANDONED

M6C UNDEVELOPED



(Revised 4/78)

A - 0003.01

CRUDE OIL ANALYSIS: TOTAL SAMPLE

N1A ANALYSIS (AGENCY)

N1B SAMPLE ID NUMBER (AGENCY)

N1C SPECIFIC GRAVITY

N1D API GRAVITY

- N1D1 RANGE
- N1D2 LOW
- N1D3 HIGH
- N1D4 AVERAGE

N1E SULFUR (WEIGHT PERCENT)

N1F NITROGEN (WEIGHT PERCENT)

N1G ASPHALT (WEIGHT PERCENT)

N1H ISOTOPE RATIO C^{13}/C^{12}

N1J ISOTOPE RATIO S^{32}/S^{34}

N1K POUR POINT (°F)

N1L CARBON RESIDUE (% OF CRUDE)

N1M RESIDUM

- N1M1 PERCENT OF CRUDE
- N1M2 SPECIFIC GRAVITY
- N1M3 VOLUME PERCENT

N1N VISCOSITY (SAYBOLT UNIVERSAL SECONDS)

- N1N1 100°F
- N1N2 77°F
- N1N3 130°F

N2N VISCOSITY (CENTIPOISE)

- N2N1 100°F
- N2N2 77°F
- N2N3 130°F
- N2N4 60°F

N1P APPROXIMATE SUMMARY (VOLUME PERCENT)

- N1P1 LIGHT GASOLINE
- N1P2 GASOLINE & NAPTHA
- N1P3 KEROSENE
- N1P4 GAS-OIL
- N1P5 NON-VISCOUS
- N1P6 LUBE MEDIUM
- N1P7 VISCOUS
- N1P8 RESIDUE
- N1P9 DISTILLATION LOSS
  - N1P9A OTHER

N1Q METALS PRESENT

N1R OTHER NON-METALS PRESENT

P CRUDE OIL ANALYSIS: FRACTIONS

P1 VOLUME PERCENT

P2 FRACTIONS 2-15, EACH

P2A SPECIFIC GRAVITY

P3 FRACTIONS 11-15, EACH

P3A VISCOSITY (SAYBOLT UNIVERSAL SECONDS, 100°F)

VISC11

P3B CLOUD POINT (°F)

FORM - OOGØØ1

Q WATER ANALYSIS

Q1 ANALYST (AGENCY)

Q2 SAMPLE NO. (AGENCY)

Q3 PH

Q4 GRAVITY

Q5 RESISTIVITY

Q4A SPECIFIC GRAVITY (68°F)

Q5A OHM - METERS

Q5B TEMP. (°F)

Q6 CHEMICAL CONSTITUENTS (PPM OR MG. PER LITER)

Q6A TOTAL SOLIDS (MG/L)
Q6A1 TOTAL SOLIDS (PPM)
Q6B Li+ (MG/L)
Q6B1 Li+ (PPM)
Q6C Na+ (MG/L)
Q6C1 Na+ (PPM)
Q6D K+ (MG/L)
Q6D1 K+ (PPM)
Q6E Na+ PLUS K+ (MG/L)
Q6E1 Na+ PLUS K+ (PPM)
Q6F Rb+ (MG/L)
Q6F1 Rb+ (PPM)
Q6G Cs+ (MG/L)
Q6G1 Cs+ (PPM)
Q6H Ca++ (MG/L)
Q6H1 Ca++ (PPM)
Q6J Mg++ (MG/L)
Q6J1 Mg++ (PPM)
Q6K Sr++ (MG/L)
Q6K1 Sr++ (PPM)
Q6L Ba++ (MG/L)
Q6L1 Ba++ (PPM)
Q6M Sr++ PLUS Ba++ (MG/L)
Q6M1 Sr++ PLUS Ba++ (PPM)
Q6N B+++ (MG/L)
Q6N1 B+++ (PPM)
Q6P Fe+++ (MG/L)
Q6P1 Fe+++ (PPM)
Q6Q Mn++ (MG/L)
Q6Q1 Mn++ (PPM)
Q6R Cl^- (MG/L)
Q6R1 Cl^- (PPM)
Q6S Br^- (MG/L)
Q6S1 Br^- (PPM)
Q6T $HCO3^-$ (MG/L)
Q6T1 $HCO3^-$ (PPM)

Q7A $CO3^{--}$ (MG/L)
Q7A1 $CO3^{--}$ (PPM)
Q7B $SO4^{--}$ (MG/L)
Q7B1 $SO4^{--}$ (PPM)
Q7C H_2S (MG/L)
Q7C1 H_2S (PPM)
Q7D NH4 (MG/L)
Q7D1 NH4 (PPM)
Q7E $PO4^{--}$ (MG/L)
Q7E1 $PO4^{--}$ (PPM)
Q7F Be++ (MG/L)
Q7F1 Be++ (PPM)
Q7G Ge++++ (MG/L)
Q7G1 Ge++++ (PPM)
Q7H Cu++ (MG/L)
Q7H1 Cu++ (PPM)
Q7J Cr+++ (MG/L)
Q7J1 Cr+++ (PPM)
Q7K Al+++ (MG/L)
Q7K1 Al+++ (PPM)
Q7L Pb++ (MG/L)
Q7L1 Pb++ (PPM)
Q7M Sn++++ (MG/L)
Q7M1 Sn++++ (PPM)
Q7N Ag+ (MG/L)
Q7N1 Ag+ (PPM)
Q7P Co++ (MG/L)
Q7P1 Co++ (PPM)
Q7Q Ni++ (MG/L)
Q7Q1 Ni++ (PPM)
Q7R Bi+++ (MG/L)
Q7R1 Bi+++ (PPM)
Q7S V+++++ (MG/L)
Q7S1 V+++++ (PPM)
Q7Y ORGANIC ACIDS (AS PROPIONIC)

Q7Z OTHER

(Revised 4/78)

FORM - OOG001

R NATURAL GAS ANALYSIS

R1 ANALYST (AGENCY)

R2 SAMPLE NO. (AGENCY)

R3 WELLHEAD PRESSURE (PSIG)

R4 HEATING VALUE (BTU/CU. FT.)

R5 SPECIFIC GRAVITY

R6 CONSTITUENTS (MOL PERCENT)

R6A METHANE

R6B ETHANE

R6C PROPANE

R6D n-BUTANE

R6E ISOBUTANE

R6F n-PENTANE

R6G ISOPENTANE

R6H CYCLOPENTANE

R6J HEXANES PLUS

R6K NITROGEN

R6L OXYGEN

R6M ARGON

R6N HELIUM

R6P HYDROGEN

R6Q HYDROGEN SULFIDE

R6R CARBON DIOXIDE

R6Z REMARKS

Z COMMENTS

(Revised 4/78)