GGDPAC

GOVERNMENT GEOSCIENCE DATABASE POLICY ADVISORY COMMITTEE

GEOSCIENCE DATA STORAGE WORKSHOP

29 AUGUST 1994

PROCEEDINGS

RECORD 1994/49

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AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

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AGSO RECORD 1994/49

DEPARTMENT OF PRIMARY INDUSTRIES AND ENERGY

Minister for Resources: Hon. David Beddall, MP
Secretary: Greg Taylor

AUSTRALIAN GEOLOGICAL SURVEY ORGANISATION

Executive Director: Harvey Jacka

ISSN: 1039-0073
ISBN: 0 642 22088 3

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Eugene Petrie - Petroleum Resources Branch, Bureau of Resource Sciences, Department of Primary Industries and Energy, Canberra

National Petroleum Data Storage and Access

Petroleum explorers in Australia are required by law to lodge various forms of basic and interpretive data with the government. These exploration results include such information as seismic survey reports, drilling reports, including well log reports, aeromagnetic and gravity maps, core, cuttings, fluid samples, geochemical data and results of various specialist studies. The availability of this data has an important influence over the exploration process as it provides a background that allows all participants in the industry equal access to information required to properly assess the petroleum potential of available exploration areas. The Australian Government through the Bureau of Resource Sciences is charged with the responsibility for the effective storage, care and distribution of this data.

Keywords - Petroleum data/Exploration data/Data access

Jeffrey Haworth - Western Australian Department of Minerals & Energy

State Holdings

The petroleum exploration industry is undergoing a major data revolution which creates major ramifications in data acquisition, storage and release for Government and industry. This revolution is exemplified by the sophistication of seismic and aeromagnetic survey data as well as the increased technology involved with borehole evaluation. Government agencies must address the issues raised by the sophisticated technology associated with petroleum exploration in regard to data submission, archiving and releasing the data back to industry.

Keywords - Petroleum data/Data storage/Data issues

Peter Vaughan - Woodside

Company Holdings - Woodside Offshore Petroleum

This paper covers some of the general concerns faced by Petroleum Exploration and Production Operators involving Petroleum Data Management. It includes an historical and current perspective of data management issues faced by Woodside Offshore Petroleum with a summary of data volumes and categories stored and submitted to Australian Archives. Suggested areas for improved efficiencies in the management and submission requirements are discussed and are presented not as intended solutions, but as a basis to promote wider discussion of the important issues faced by Industry and Government.

Session 2: Preservation and data access projects. Chair: Tony Noon

Sandy Radke - Bureau of Resource Sciences, Department of Primary Industries and Energy, Canberra

The Villawood Data Project: "The case of the disappearing records"

Last year industry and government concerns regarding the deterioration of public domain petroleum data stored on magnetic tape catalysed a budget appropriation of $1.5M to the BRS to address the preservation and management of the data currently stored at the Australian Archives facility in Villawood, NSW. In August 1993 the Villawood Data Project was initiated and BRS has since taken an active role in the preservation and management of the data.

The primary emphasis to date has been the transcription of data on deteriorated tapes to high density media and the establishment of a digital database to assist in the management of the data holdings at Archives. Within the initial funding period 25% of data has been entered on the database and 15% of data at risk has been preserved on new media. In addition to continuing the work undertaken so far, the next phase of this project will concentrate on document imaging of observer's logs, culling of data and the development of a terabyte storage facility for efficient data access.

Keywords - Petroleum data/Data management/Tape storage/Magnetic media/Tape deterioration/ Stiction/Data preservation

John M Fleming - Petroleum & Gas, Department of Minerals & Energy, Queensland

The Prince Project - A Queensland Initiative

The PRINCE Project is an initiative of the Queensland Government whereby seismic and other geological data held by the Department of Minerals and Energy can be stored, retrieved and manipulated to provide the maximum useability of this important aid to exploration. Opportunity will be given for explorers and others to participate in this project and to use it for their own data storage.

Keywords - Seismic data/value-adding/on-line data storage

Colin Ford - Encom Technology Pty Limited

Company Preservation and Data Access Projects

Much of the exploration data acquired during the '70s and '80s are stored on deteriorating or damaged 1/2" tapes. To preserve these data, they must be transcribed to a more stable, indexed medium using techniques designed to optimise recovery.

The level of effort required to maximise the recovery of data is high and can be expensive. In situations where reacquisition is straightforward and utilises improved techniques, the cost of data recovery may not be justified. In cases where reacquisition is difficult or impossible, reprocessing of data recovered from deteriorated tapes may be the only option available.

John R Hughes - Santos Limited, Adelaide

Santos' Approach to the Management and Preservation of its seismic Tape/data Holdings

Santos Ltd holds approx. 67,000 seismic tapes, the majority containing onshore seismic field data. Approx. 55,000 tapes are held in company operated premises in Adelaide with 12,000 tapes stored by commercial contractors in Brisbane and Sydney. Since early 1993 all newly acquired/reprocessed data have been copied to high density tape (Exabyte) at an early stage of the seismic processing sequence. In addition, Santos has embarked on a preservation project which will entail all remaining pre 1983 tapes being copied to Exabyte during 1994 and all 1983-1992 tapes to Exabyte (or alternative high density medium) during the next 4-5 years.

Session 3: Future Directions. Chair: Barry Drummond

David ML Berman - Australian Geological Survey Organisation, Department of Primary Industries and Energy Canberra

The Australian National Geoscience Information System - @ngis - Facilitating Access to Large Geoscientific Data Holdings

The new @ngis initiative has been designed to link diverse collections of Australian geoscience digital and physical data holdings. A model has been adopted which supports access to both centrally managed data, and data under distributed custodianship in public, private and educational agencies. Networks to be employed include public and private links over AARNet, and broadband capacity as necessary. AGSO is currently testing the key supporting technologies using the large geophysical, remote sensed imagery and databases of BRS and AGSO. These developments include a World Wide Web server, standards for metadata, a directory and query system, an online mass storage and archival system, and national geoscientific databases linked to spatial systems. The Program includes formal consultation with data providers and users to determine needs, and a consideration of policy to do with security, storage media, charging, and funding the digital capture of data on a prioritised basis.

Keywords - geoscience information, custodianship, networks, metadata, directories, databases, spatial data, data policy

Welcome & Introduction

David Berman
Chairman

Government Geoscience
Database Policy Advisory Committee

Introduction

To all participants from the Petroleum and Minerals Industries, support industries and the government sector within Australia and New Zealand, welcome to this one-day workshop. I trust that the time you invest in this meeting will be well spent, and that you are also able to use the opportunity to follow up on old and new business contacts, both at the workshop, and more generally while you are here at AGSO in Canberra.

GGDPAC

The Government Geoscience Database Policy Advisory Committee (GGDPAC) is a formal coordinating group for common geoscience data-related efforts and responsibilities in the public sector. It was set up by the Chief Government Geologists, who in turn report to the Australia & New Zealand Minerals and Energy Council (ANZMEC) - the peak States/Federal Ministerial Council. GGDPAC is active in several areas, notably information exchange, standards development, and promotion of data management concepts. GGDPAC is recognised by the Australia New Zealand Land Information Council (ANZLIC) as representing public sector geoscience interests on national policy and technical issues and is represented on relevant committees of Standards Australia.

A GGDPAC working group has been developing standards for the format and technical content of exploration reports over the last few years. GGDPAC was also instrumental in the commencement of the AMIRA GEO-DATA project this year, which will codify geoscience data type and attribute definitions for consistent use in information systems, such as databases and GIS. Finally, GGDPAC provided input to the 3rd National Workshop on Natural Resources Data Management: Data Standards and Directories, held in Canberra this year at the behest of ANZLIC.

Background

The idea for this workshop came about as a result of a number of developments. GGDPAC had been discussing the need for large data repositories in the early 1990s, following concerns from States, Territories and BMR over the adequacy of then current storage facilities, costs, and the deterioration of information assets. In 1992, GGDPAC supported an (unsuccessful) application by the then BMR for funding by the Energy R&D Corporation for a project to digitally manage tapes acquired under the Petroleum (Submerged Lands) Act, and held at Villawood. It also provided advice in 1992 to the ANZMEC Sub Committee on Offshore Petroleum Legislation, on the suitability of alternate recording media for the storage of large holdings of seismic data, through a review of industry practice and technical opinion.

GGDPAC decided there was a clear need for this workshop after the developments of 1993, which saw funding for the Villawood project, as part of the government's reaction to the review of BMR undertaken by Dr Max Richards. Much has been learnt over the past year, and given the development of parallel initiatives such as PRINCE in Queensland, and @ngis, it was felt that much could be gained from sharing experiences in such a forum.

Participants

The messages coming through to GGDPAC were that the workshop should involve key stakeholders who had major interests in the current and future uses of geoscience (particularly seismic) data. I believe that your attendance today substantially reflects those key stakeholder groups. As you can see, there is a good balance of industry, public and service industry representatives:

Petroleum companies

BHP Petroleum
Cultus Petroleum
Command Petroleum
Hadson Energy
Santos
Sagasco
WAPET
WMC Petroleum
Woodside

Minerals companies

Aberfoyle Resources
BHP Minerals
CRA Exploration (ACT)
WMC Exploration

Associations

APEA

Industry support companies

Callahan, Fox & Associates
Convex
Digicon
Earthware
Encom
Guardian
Indmin
NOPEC
QSL
Western Geophysical

Government agencies

Australian Archives
MESA
NSW DME
QLD DME
VIC DME
WA DME
AGSO
BRS
NZ Ministry of Commerce

Workshop Structure

Presentations in the first two sessions of today's program will initially focus on the nature of large data holdings in both government and individual companies and then look at some current data preservation and access projects.

During the discussion periods following these presentations, we encourage participants to identify any significant issues where their own perspectives may differ from the presenters' views.

After lunch, the program focus turns to future requirements. This provides an opportunity for all participants to specify any unmet or emerging user and management needs that data custodians should be looking to satisfy.

The three syndicates will allow participants to concentrate on identifying issues in three key areas:

- physical standards
- user access requirements
- data management.

Without attempting to limit the scope of the syndicate efforts, it is hoped that some of these issues can be considered within the time available:

Physical Standards for Storage Media

- Diversity of storage media-a competitive advantage ?
- Media stability and older legacy tapes
- Media handling and storage standards
- Media types - which standards to adopt?
- Archival or operational storage-impact on media selection
- Development of new media types - planned obsolescence ?

Data Access Needs of Users

- Balance of access versus preservation priorities
- Need to access original/processed/reprocessed data
- Data cataloguing requirements - what details ?
- Graphical search and display needs
- Improving access methods
- Access to include some online analytical capability

Data Management Issues

- Recognition of geoscience data as a strategic asset
- Balance between preservation and access in resourcing
- Agreement on a priority mix to balance industry areas of interest with other important criteria; ie future relevance, uniqueness, scientific merit
- Industry/government policies on data transfer and charging
- Policies for lending, storage and metadata
- Stakeholder involvement and technical input
- Policy development flexibility to match the rate of technology change
- Strategies to achieve adequate data description in repositories

Outcomes

In the final session, I hope that together we can develop an agreed set of workshop conclusions which I will be able to take to GGDPAC for follow-up action.

I would like to thank you all for your attendance. Please identify your needs. Please participate. I will now hand over to our chairman for the first session, Paul Williamson, head of the Petroleum Resources Branch, Bureau of Resource Sciences.

AN INTRODUCTION TO NATIONAL PETROLEUM DATA STORAGE AND ACCESS

Eugene Petrie

Petroleum Resources Branch, Bureau of Resource Sciences, Canberra, ACT, 2600

Abstract - Petroleum explorers in Australia are required by law to lodge various forms of basic and interpretive data with the government. These exploration results include such information as seismic survey reports, drilling reports, including well log reports, aeromagnetic and gravity maps, core, cuttings, fluid samples, geochemical data and results of various specialist studies. The availability of this data has an important influence over the exploration process as it provides a background that allows all participants in the industry equal access to information required to properly assess the petroleum potential of available exploration areas. The Australian Government through the Bureau of Resource Sciences is charged with the responsibility for the effective storage, care and distribution of this data.

Keywords - Petroleum data/Exploration data/Data access

Introduction

Australia's wealth depends partly on its petroleum and mineral endowment. The reality is that the exploration for and the development of our petroleum resources contributes significantly to our wealth by lessening our dependence on others, making us more self sufficient and directing the cost saved in imports to other areas of expenditure and growth.

Whilst petroleum exploration has been generally steady and effective since the mid-1950s, prior to 1957 exploration tended to be spasmodic in all States and Territories. From 1946 to 1956 Western Australia, South Australia and Queensland accounted for nearly all of the wells drilled for the search for oil. To further the exploration effort and pick up on the basic surveys conducted from 1948 by the Bureau of Mineral Resources, Geology and Geophysics, W.A.P.E.T. was formed and soon found oil in the Rough Range Bore No. 1 in November 1953. This event led to an increase in the scale of search throughout Australia and its Territories, including Papua New Guinea and on 12 December 1957 the Commonwealth Government's *Petroleum Search Subsidy Act 1957* (PSSA) received the Royal Assent. Under this Act, the Commonwealth undertook to meet half the cost of approved wells drilled for stratigraphic information. By the end of January 1958 applications had been received from 16 companies for assistance under the Act. This Commonwealth incentive which required the lodgement of data continued until June 1974.

In 1967 the legal framework for petroleum operations in offshore became governed by the Commonwealth legislation known as the *Petroleum (Submerged Lands) Act 1967* (PSLA). Under this Act company data is required to be lodged to both the Commonwealth and State Governments. The territorial sea and onshore operations remained under the control of State/Territory legislation.

The data lodged in accordance with the PSSA and PSLA legislation has been historically lodged as hard copy, physical samples and on magnetic tapes. The Bureau of Resource Sciences is the custodian and manager of this data which is released after a certain period.

Commonwealth Petroleum Legislation

Petroleum Search Subsidy Act 1959-1969

The administration of the Act was undertaken through the Secretary of the Department of National Development who was advised by the Director, Bureau of Mineral Resources, Geology and Geophysics (BMR). The Act required three copies of the final report to be submitted including any drill cores, sidewall cores, drill cuttings and fluid samples to the BMR. In addition, daily, weekly and half-monthly reports were also required to be submitted for drilling and geophysical operations.

The hard copy data including the physical data are currently stored at the Core and Cuttings Laboratory and Data Repository in Fyshwick, Canberra (see Appendix 1).

Petroleum (Submerged Lands) Act 1967

This Act covers all marine operations offshore beyond the three nautical mile territorial sea. The onshore and territorial sea operations are the responsibility of the individual State and Territory Governments and their respective petroleum Acts. The physical information and data submitted in accordance with the PSLA is stored in two locations - at the Core and Cuttings Laboratory and Data Repository (hard copy reports and cores, cuttings and fluid samples) and at Commonwealth Archives in Sydney (seismic tapes and associated data).

Purpose of Data and Reports

There are two main reasons why information and data are required to be supplied to the Commonwealth:

- To ensure approved work has been carried out according to PSSA and PSLA requirements and directions including industry standards.
- To make available results of exploration and production to further promote search for petroleum in the most economic and expeditious manner.

Nature of Reports

The required contents of reports are closely specified for drilling operations and surveys in the directions supporting the PSLA.

Geophysical data received under PSSA and PSLA include seismic, magnetic, gravity and site survey components. 'Basic' data include operations, positioning, processing and acquisition reports, shot point location and water depth maps, velocity data and seismic sections. Non-basic or 'interpretative' data comprise various reports and maps. Drilling data received under PSLA consist of well completion reports, logs, and other data generated during operations. Both prints and transparencies are stored for most logs,

maps and seismic sections. Also stored are reports and maps generated by companies during the course of an offshore permit term; examples of these reports include field assessments, basin mapping and stratigraphic analyses reports, and structure maps.

Data provided under legislation is also available to the public, subject to release provisions. Studies on "open file" cores and cuttings (for example, geochemistry, sedimentology, palaeontology or for other destructive analysis purposes) may be undertaken by individuals or companies subject to special instructions and reporting requirements. The reports submitted on cores and cuttings are released on "open file" six months after the material is sampled. As the cores and cuttings are finite, the release of destructive analysis reports as quickly as possible reduces the possibility of duplicating analysis on material limited in volume.

Categories of Information and Data

The PSLA defines three categories of data and information which may be released under the Act:

- Basic data is defined by subsection 118(2) of the Act as any data other than that, in the opinion of the Designated Authority or the Commonwealth Minister, is a conclusion drawn, in whole or in part, from, or an opinion based, in whole or in part, on any information that relates to the sea-bed or subsoil, or to petroleum, in a block but which does not qualify as basic data;

- Non-basic data (interpretive) is data that relates to the sea-bed or subsoil, or to petroleum, in a block but which does not qualify as basic data;

- Other data and information, not being basic or interpretive, which is supplied as part of an application for the grant of a title except for information that relates to the sea-bed or subsoil, or to petroleum, in a block or particulars of the technical or financial resources available to the applicant.

A definition of basic data is provided in the 'Administrative Guidelines' document which supports the PSLA. Under the PSSA (1957 to 1974), both basic and interpretive data were made publicly available six months after completion of the operation.

Timing of Submission of Data and Reports

The directions supporting the PSLA set out the required time at which data and reports are to be submitted to the Commonwealth and the Designated Authority. Generally the date of completion of an operation dictates the submittal date. For both wells and surveys, the time of submission of a final report is six months. For a well, the date of submission is deemed as no later than one month after drilling is completed or the date of submittal of data, whichever is the soonest. For surveys, the date for submission is deemed to be no later than one year after field work is completed or the date of submittal of the data, which is the soonest.

Approval must be obtained by the operator to submit late reports. Irrespective of any such approval for late submittal, the deemed dates are final for the purposes of releasing data to the public.

The directions also require that all data pertaining to geological or geophysical field surveys such as magnetic field tapes, copies of maps, observer's logs, cross sections be submitted within one month of completion of processing of data. The retention of seismic magnetic field tapes by the operator may be approved until the permit is relinquished, but in any case the tapes must be available under the two year rule for release of basic data and submitted to the Commonwealth upon the Designated Authority's request.

Release of Data

Both basic and interpretive data made public under the PSSA and PSLA have formed the framework for the availability of low cost data to industry. This public accessibility of exploration data forms an important part of the Government's "Offshore Strategy" announced in June 1990. As previously stated, one of the main purposes for reporting and submitting data is to make the data available publicly as quickly as possible but still recognising the title holder's need to first use the data.

The PSSA allowed for both basic and interpretive data available for publication six months after completion of an operation. The PSLA provides three categories of data and information which may be publicly released:

- Basic data, which may be released after two years, or one year in the case of production licences;

- Non-basic (interpretive data), defined as conclusions drawn on opinions based, in whole or in part, on basic data. Interpretive data may be released after five years, subject to certain safeguards; and

- Information as detailed in an application for a permit (excluding some technical and financial aspects which remain non-releasable) is usually available for release immediately after the award of a permit.

The safeguards in respect of interpretive data currently provide for the gazettal of the intention to release the data. Objections to the release of interpretive data can only be made on the grounds of disclosure of a trade secret, or of adverse effects on the business, commercial or financial affairs of the title holder.

Data Location

The bulk of physical data collected by the Commonwealth is stored in Canberra at the Core and Cuttings Laboratory and Data Repository, and at Villawood Archives in Sydney.

Geophysical Survey Records and Drilling Reports

Geophysical records and drilling reports lodged with the BRS are provided under the PSSA, and PSLA. Onshore and territorial seas data which are the responsibility of the State Governments have often been lodged after PSSA but these are on a complimentary ad hoc basis. To date, over 1000 drilling and 1050 geophysical PSLA reports are in the National Petroleum Database. PSSA reports (including Papua New Guinea data) consist of 659 drilling and 973 geophysical reports. Other reports and/or maps total 383 (Appendix 1).

Geophysical data received under PSSA and PSLA include seismic, magnetic, gravity and site survey components. 'Basic' data include operations, positioning, processing and acquisition reports, shot point location and water depth maps, velocity data and seismic sections. Non-basic (interpretive) geophysical data comprise various reports and maps. Drilling data received under PSLA consist of well completion reports, logs, and other data generated during operations. Both prints and transparencies are stored for most logs, maps and seismic sections. Also stored are reports and maps generated by companies during the course of an offshore permit term; examples of these reports include field assessments, basin mapping and stratigraphic analyses reports, and structure maps.

Both the PSSA and PSLA data that are on open file are available for perusal at the BRS Core and Cuttings Laboratory and Data Repository, Fyshwick, Canberra. Copies of the data can be obtained through BRS at the expense of the person/company concerned.

Cores, Cuttings and Fluid Samples

The cores and cuttings stored and recorded are derived from 659 PSSA petroleum wells, over 1000 offshore exploration and development wells, 1600 BRS stratigraphic drill holes and the remainder from industry donations, other government sources and universities. This provides the bulk of the collection. Samples collected during water bore drilling in the Great Artesian Basin, Otway Basin, Gippsland and other basins, are also stored for reference purposes. The collection also includes sidewall cores, fluid samples, residue samples, prepared specimens, palaeontological/palynological slides, reservoir plugs, vitrinite blocks and returned unused composite samples. The collection contains 1,000,000 washed and dried cuttings, and samples representing hundreds of kilometres of drilling. Depths of samples range from a few metres to more than 5.5 kilometres.

BRS's Core and Cuttings Laboratory and Data Repository provides samples on approval, for destructive analysis. The collection is composed of specified minimum amounts of each sample which constitute the BRS reference collection, which is a permanent reference, and is only available for non-destructive examination. Where sample amounts above the minimum are held, samples may be removed for destructive analyses in specialist laboratories outside the BRS. A borrower is required to provide a comprehensive written report on the analysis carried out, and return any worthwhile residues, and intact unused samples for reference, along with all prepared specimens, slides and vitrinite blocks which constitute the replacement for each sample borrowed. The conditions applicable to borrowers are outlined in Appendix 2. BRS has accumulated more than 1000 open file reports from industry and government sources that were provided after such destructive analyses of samples. These reports relate to petroleum wells drilled before 1988 in offshore and onshore basins in Australia and its territories, and Papua New Guinea.

Over recent years basic drilling data, including sample depths have been entered onto a database management system to replace the earlier manual records and files. The development of these digital data as part of BRS's Petroleum Exploration Data Index (PEDIN), has increased effectiveness in provision of reports and basic data. Furthermore, the cores and cuttings, and other data are now more accessible to search, and to report generation. The repository is further broadening its use of digital technology to extend to spreadsheet applications of input/output for borrowings, bibliography of reports and weights of samples.

Villawood Archives

Australian Archives has provided storage and physical control services for basic data composed of survey magnetic data tapes and supporting information which has been surrendered under the PSLA and under the PSSA at Villawood Repository in Sydney since 1974. These services began as an interim measure. The records in custody relate to offshore and onshore petroleum exploration and data from the 1950s to the present. Current petroleum holdings run to about 11.7 kilometres of shelf space consisting primarily of survey data (digital and analogue tapes) and supporting documentation (observer's logs, shot point maps, survey notes, drilling logs, seismic sections, monitor wells and velocity analysis data). The basic data is recorded in a range of media, eg. open reel tapes, cassette tapes, flexible disk cartridges (floppy disks), paper, microform and stable base transparencies. This basic data has been available for loan from Archives over a number of years subject to compliance to a set of procedures in order that control is maintained and material is readily available. A borrowing charge consisting of an item and handling charge has been applied by Archives over the last four years.

In the last three years it has become apparent worldwide that data stored on magnetic tape has a finite life, and that many of the tapes stored in Commonwealth Archives are suffering some deterioration. Certain specific brands of tape have been identified as having a problem with 'stiction'. There is a general concern that this problem will spread within a few years to also affect older data. Without proper management this data set, which forms a substantial national resource, could be lost.

In August 1993, the Commonwealth's Budget provided $1.5 million to address petroleum data issues at Villawood Archives. This was in response to the May 1993 Review of the Australian Geological Survey Organisation recommendation 3.5, commenting on a BRS responsibility relevant to database issues, and supporting the proper maintenance and management of the petroleum data stored at Villawood. It said: "The Government ensure that the holdings of industry geophysical data submitted under the Petroleum (Submerged Lands) Act (currently stored in the Australian Archives facility at Villawood, Sydney) be properly maintained and be made accessible through the use of modern information systems".

The Villawood Data Project was initiated in August 1993 to address the preservation and management of the data. To date about 20,000 field tapes have been copied to exatape. Of these about 12,000 tapes were of poor quality and suffering deterioration. The Villawood Data Project is the subject of another paper to be presented by Sandy Radke at this workshop.

PEDIN Database

The PEDIN digital database has been under development for 10 years and has now developed as the umbrella database for the National Petroleum Database. BRS and AGSO have ongoing commitment to maintaining this database for their own use and for the petroleum industry.

Currently PEDIN references over 7000 wells drilled throughout Australia and over 3500 geophysical surveys throughout Australia. Other modules available are:

- Australian Petroleum Accumulation series (text and data) for the Amadeus Basin, Bass Basin, Gippsland Basin, Adavale Basin, Bonaparte Basin, Otway Basin and Browse Basin. The Carnarvon, Canning and Perth Basin data is to be released soon.

- STRATDAT - Interpretive Biostratigraphy for Exploration is an interpretive biostratigraphic database which relates fossil zones and absolute time scales for selected onshore and offshore exploration wells. Currently available only to participating sponsors of the APIRA/AGSO Petroleum Systems Project.

- PORPERM Porosity and Permeability Database - 6278 core plug analyses from 551 Australian petroleum exploration wells. Includes depth, porosity, horizontal permeability, vertical permeability, lithology, grain size, comments.

- ORGCHEM - 36,500 geochemical analyses from 960 open file wells drilled prior to 1989. Onshore and offshore wells included.

- TITLES - lists relevant title numbers, title holders, areas of titles and expiry dates onshore and offshore Australia. Map is available in Integraph Design File, SIF and DXF Autocad format.

- Samples Version 1.0 - An inventory of down hole samples from over 3900 stratigraphic and petroleum exploration wells drilled in Australia since 1930. Includes the sample type and depth range.

- Reports Version 1.0 - A bibliographic reference database to destructive analysis reports for 1900 wells. Includes depth ranges and description of tests conducted.

- Petroleum Information Management System (PIMS) - An inventory database (part of the Villawood Data Project) of seismic and well log tapes and associated data held in Australian Archives, Villawood, New South Wales. Currently in development, PIMS is designed to assist in managing receipt, storage, loan and copy of digital material in Archives. The database is linked to the PEDIN Survey and Wells databases.

AGSO Digital Field and Processed Data

These data are the products of the AGSO's Continental Margin Program carried out by the Marine Petroleum and Sedimentary Resources Division and its predecessors. The program currently utilises the vessel *Rig Seismic* and collects framework seismic, other geophysical, geological, geochemical and bathymetric data to carry out basin analyses in frontier and explored areas of the Australian margin.

Extensive on shore seismic data collected by the BMR and AGSO are held by the MPSR Division as part of AGSO's basin studies projects. The data has been collected in analogue format since the 1950s up until 1976 (6955 line kilometres) and since 1980 has mainly collected deep profile data in onshore Australia.

The AGSO Library is Australia's largest geoscientific library which houses numerous books, folios, pamphlets and records. The library is also open to the general public.

Derived Digital Databases

These databases include summaries of geological and geophysical characteristics either as basic data or as results interpreted from the basic data. These include geochemical characteristics, porosity and permeability and other data.

Oil and Gas Resources of Australia 1993

This compilation is the third edition of a new series which replaces the previous Petroleum Newsletter, Australian Mineral Industry Annual Review - Petroleum chapter, Wells and Footage record and Identified Petroleum Resources information sheet. The contents include chapters on exploration, reserves and resources, development and production. It contains a new assessment of Australia's undiscovered petroleum resources and a new forecast of crude oil and condensate production to 2005.

As part of the background information to the assessment, detailed assessments are given of undiscovered resources within individual migration fairways in the Perth, Otway, Bass, Browse and Cooper Basins. The forecast of crude oil production is supported by separate forecasts of production from Australia's identified and undiscovered accumulations and of production from the Perth, Otway, Bass and Browse Basins.

Chronological listings of all offshore and onshore oil and gas discoveries, and listings of all petroleum platforms, pipelines and titles conclude the volume. A summary highlights oil and gas discoveries in 1993. The publication gives the background for much of the advice concerning petroleum resources that is given to the Australian Government and should be of interest to petroleum exploration companies, petroleum engineers and geologists, energy analysts, stockbrokers and share investors.

Data Issues and Future Initiatives

The following emerging concerns and issues are relevant and may need to be considered in the context of this workshop:

- Avoiding duplication of data and databases between government and industry.
- Sharing of information (offshore) - to avoid unnecessary destructive analysis of cores and cuttings.
- Access to basic and interpretive data awaiting release - ensuring non-released data is used for government advice purposes only.
- Ensuring required data is lodged with authorities and on currently acceptable media.
- Seeking title holders' views in identifying and separating basic and non-basic data for submittal.
- Subsection 118 of the PSLA which deals with release of information could be rewritten in plain English.

- Releasing basic and non-basic data immediately upon relinquishment, cancellation or expiry of a title.
- Governments could provide a clearer definition of basic and non-basic data.
- Operators could provide a clearer distinction between basic and non-basic data in their final reports.
- Copying digital and analogue data lodged under PSLA and held at Villawood.
- Preservation of deteriorating data.
- Standardising digital data submission formats and media.
- Regular review of digital data technology.

Acknowledgments

The author wishes to thank colleagues in BRS and DPIE for assistance with background material and review of text and completion of appendices particularly Paul Williamson, Ted Riesz, Hazel Small and Steve le Poidevin.

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APPENDIX 1

PHYSICAL PETROLEUM EXPLORATION DATA STORED BY THE COMMONWEALTH

Type	Area covered	Legislation	Number	Location
Drilling report	offshore	PSLA	1025	Canberra①
Geophysical report	offshore	PSLA	1030	"
Drilling report	onshore & offshore & PNG	PSSA	659	"
Magnetic report	onshore & offshore & PNG		90	"
Gravity report	onshore & offshore & PNG		100	"
Seismic report	onshore & offshore & PNG		783	"
General report	onshore	PSSA and complimentary	383	"
Cores & cuttings	offshore	PSLA	950 wells	"
Cores & cuttings	onshore & offshore & PNG	PSSA	700 wells	"
Cores & cuttings	onshore	BMR stratigraphic	1600 wells	"
Cores & cuttings	onshore	Donation/Water bores	1360	"
Destructive analysis report	onshore & offshore & PNG	PSSA & PSLA	1070	"

Other samples: donation from industry, universities, State Governments, sidewall cores, fluid samples, residue samples, prepared specimens, palaeontological/ palynological slides, reservoir plugs, vitrinite blocks and unused returns from destructive analysis.

Exploration tapes (digital)	onshore & offshore	PSSA & PSLA	200,000 (9500 shelf metres)	Villawood②
Exploration tapes (analogue)	onshore & offshore	PSSA & PSLA	300,000 (1200 shelf metres)	"
Supporting data	onshore & offshore	PSSA & PSLA	1000 shelf metres	"

① Bureau of Resource Sciences, PO Box Ell, Queen Victoria Terrace, Parkes, ACT 2600
② Australian Archives NSW Region, PO Box C328, Clarence Street, Sydney 2000

APPENDIX 2

BUREAU OF RESOURCE SCIENCES
CORE AND CUTTINGS LABORATORY AND DATA REPOSITORY

CONDITIONS APPLIED TO BORROWING CORES AND CUTTINGS SAMPLES

GENERAL:

1. Permission will be given only after a non-destructive examination and furnishing of a comprehensive list of the material to be removed. It will be subject to the amount of material available, and open file results obtained from previous destructive analyses.

A charge for the use of facilities and the provision of goods and services will be made at set rates which are determined by BRS.

CONDITIONS:

1. Three bound and titled copies of a report on the results and methods of all analyses will be submitted to the Director, Petroleum Resources Branch, of BRS within six months of the sampling date. One copy will be forwarded by BRS to the relevant State Department of Mines/Geological Survey.

2. The report(s) will be made open file data, for public inspection, six months after the sampling date.

3. All solid residues, unused samples, and prepared specimens (ie. thin sections, vitrinite plugs, core plugs, micro fossils etc.) remaining are to be returned to BRS on completion of the analyses. This material will also be made available for public inspection.

4. Samples from cuttings must be representative of the total sample (ie. selective sampling of chips from a particular lithology is not permitted).

I agree to the above conditions.

Signed: .....

Date:.....

AN OVERVIEW OF DEVELOPMENTS IN PETROLEUM DATA MANAGEMENT IN WESTERN AUSTRALIA

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Abstract - The petroleum exploration industry is undergoing a major data revolution which creates major ramifications in data acquisition, storage and release for Government and industry. This revolution is exemplified by the sophistication of seismic and aeromagnetic survey data as well as the increased technology involved with borehole evaluation. Government agencies must address the issues raised by the sophisticated technology associated with petroleum exploration in regard to data submission, archiving and releasing the data back to industry.

Keywords - Petroleum data/Data storage/Data issues

Introduction

Western Australia's petroleum exploration industry is continually expanding and in 1993, 52 wells totalling 104,994 metres were drilled for petroleum and 149,069 km of seismic was shot in the State① representing a large portion of Australia's petroleum activity.

Western Australia produced 4.994 million kilolitres of oil, 2.105 million kl condensate and 15.975 BCM gas from 31 fields in 1993① and provided $2.65 billion② representing nearly 30% of the total national petroleum production.

In 1989 the Department produced the WAPEX™ database providing the petroleum exploration industry with information to data supplied to the Department for petroleum exploration in the State. Since its inception WAPEX™ has undergone several updates to cater for the changing requirements imposed by new data submissions and client requests. The database presently contains information on:

- 2190 wells
- 1599 geophysical surveys
- 1151 permits (both current & historical)
- 1455 general reports on petroleum exploration
- 33 kilometres of core, 2 million metres of ditch cuttings and 200,000 palaeontological slides.

With over 700,000 data items relating to petroleum exploration registered in the system③ the database provides users with reports and information on:

- Well summary information, logs, formation tops, testing, digital data, cores & cuttings and palaeontological material;
- Geophysical survey summary information, line details, seismic sections, digital data, and horizon maps;
- Regional studies conducted for petroleum exploration; and
- Access to over 8000 reports, 60000 logs, 60000 sections and other physical data.

During the period 1980 to 1994, over 1.5 million metres of drilling was conducted in WA for petroleum exploration and production and Figures 1 and 2 show that 662,792 metres were drilled onshore and 838,299 metres drilled offshore, they give a further breakdown by type of well.

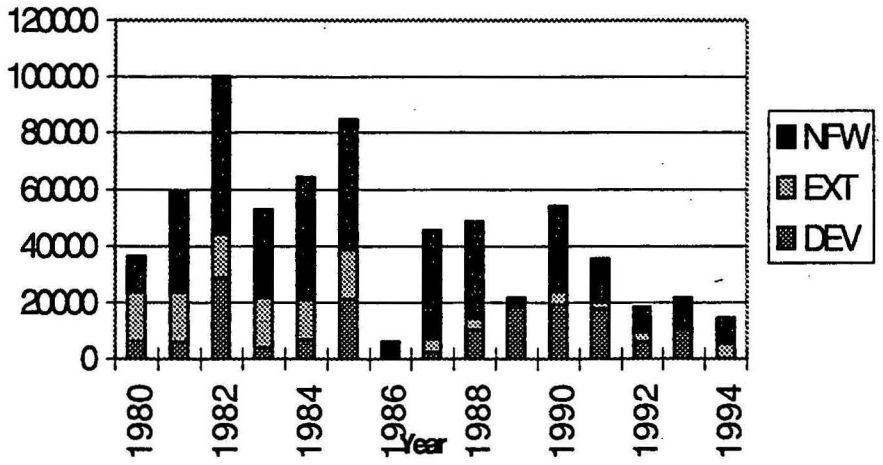

Figure 1: Metres drilled Onshore in WA 1980 - 1994

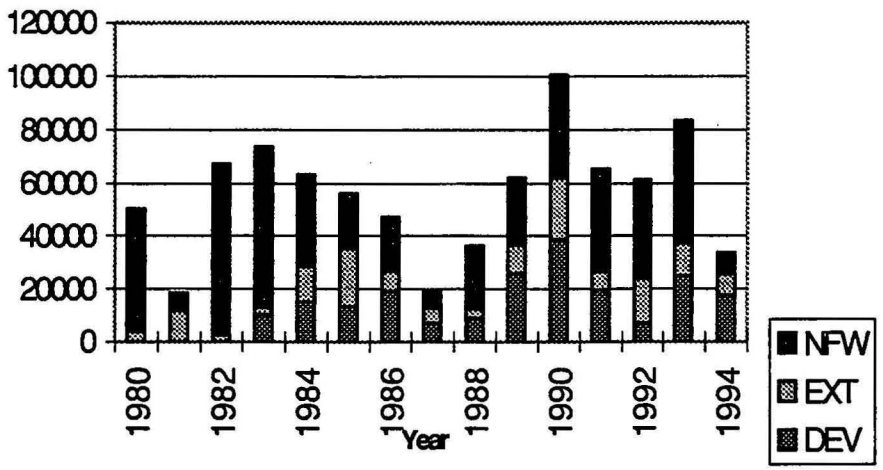

Figure 2: Metres drilled Offshore in WA 1980 - 1994

Wells drilled in WA over this period included vertical, deviated and horizontal wells and the technology used in both drilling and evaluating wells has become more sophisticated especially over the last 2-3 years with the common use of wireline logging "supertools", MWD tools and improved mudlogging and engineering technology. This increase in technology has substantially increased the amount of data per metre drilled provided to the Department both in hard copy and digital format.

Seismic surveys conducted in 1993 totalled 149,069 km of which 95,997 km was 3D seismic and 56,252 km was 2D①. Figure 3 shows the breakdown of these surveys for the State.

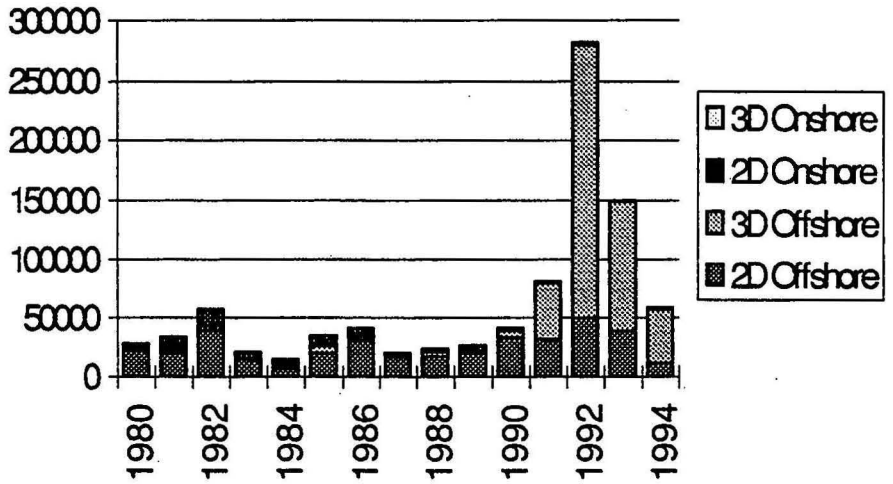

Figure 3: Kilometres shot for Seismic Surveys conducted in WA 1980 - 1994

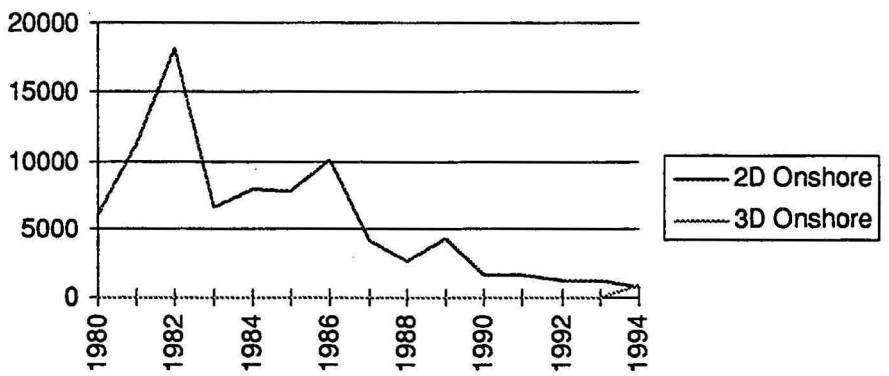

Figure 4: Kilometres shot 2D vs 3D Onshore WA 1980 - 1994

Figure 4 shows the kilometres shot onshore in WA of 2D versus 3D seismic, which shows in 1994, 3D seismic was conducted for the first time on land in the State.

Figure 5 shows the breakdown of seismic surveys shot offshore in WA during that period and the quantity of 3D seismic has been increasing since 1991 and, in 1992 one particular survey produced 140,195 km of data. The volume and type of data produced by these types of surveys have now become a major issue for the Department. Further technological advances include "pseudo" 3D processing of 2D data.

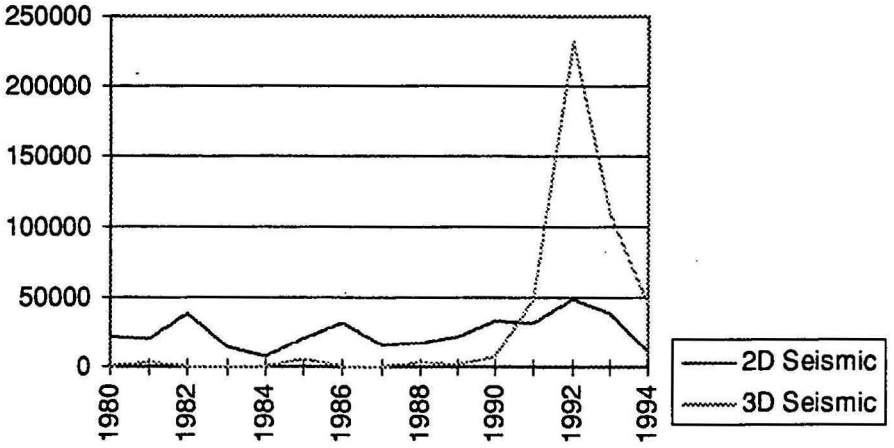

Figure 5: Kilometres shot 2D vs 3D Offshore WA 1980 - 1994

Aeromagnetic data has also been improved with data acquisition parameters, grid systems and image processing now combining to provide explorers high resolution data for interpretation. Since 1990 over 137,000 km③ has been flown for aeromagnetic data for petroleum exploration.

The amount of exploration activity is not only reflected in field activities such as drilling and seismic but also in the amount of data being requested from the Department. In June 1994, 60 reports, 62 hard copy well logs and 15,000 km of hard copy seismic was requested from the Department. The Department also received requests for 945 tapes to be borrowed from archives for reprocessing of seismic data.

Discussion

Data Management Implications:

The increased volume and complexity of the data now produced in petroleum exploration has raised several issues in administration, storage and release of this data.

1. Administration:

The WAPEX™ database stores a large index of data objects submitted to the Department as well as summary and technical data extracted from reports on activities. Due to the increasing volume of data being submitted, the increasing demands on information currently stored in the database and the requirement for additional data to be stored in the database, the Department is presently looking at restructuring the database to cater for these extra demands. Some of the areas under review are:

- *Electronic uploading of data supplied by Operators.*

For example seismic tape information which has been successfully incorporated into WAPEX™ and includes validation programs to ensure the data is correct. Industry now supplies the Department with ASCII lists of seismic tape data giving Tape number, Line number(s), Shotpoint ranges and data type (field, stack etc). The system loads this data and verifies all fields are present and fit set criteria, once validated the data is

automatically loaded into the database under the appropriate survey. Thus a task that took two weeks to manually enter the data now takes 20 minutes.

- *Incorporation of extra datasets to cater for more technical information from wells, surveys and fields*

Extra datasets are now required for both Departmental and industry use to quickly ascertain results of wells. Examples of these are engineering data, production data, log analysis data, palynological data, geochemistry data, etc.

- *Revision of Geophysical survey datasets to more appropriately deal with the new technology*

The manner in which 3D seismic and Aeromagnetic data is recorded, processed and submitted to the Department has certainly brought the requirement for restructuring the database. For instance the database has to cater for both line kilometres shot but also the square kilometres involved in the data acquisition 'block'. Data submissions are also different which requires new fields to accurately describe the type and source of data. For instance the processed tapes need to be described for processing (eg migrated) and whether it is filtered and scaled or other parameters involved in the processing. Data media should also be recorded to ascertain the viability for long term archiving or the need to transpose the data onto more suitable media.

- *Transforming the database from mainframe menu driven front ends to more user friendly GUI applications*

End users of the data find working in databases requiring SQL (Structured Query Language) for all enquires difficult and far prefer the QBE (Query By Example) form of enquiry for the simpler enquires. This requires new "front-end" applications to be attached to the database and put on PC platforms to run. GUI (Graphical User Interface) systems have become popular and are expected by users for IT applications. For petroleum data this not only includes the "Windows" style front-ends but also LIS (Land Information Systems) which is two dimensional and GIS (Geographic Information Systems) which is three dimensional, spatial display systems for query, data manipulation, interpretation and output/display purposes.

- *Running linked databases capable of viewing other datasets.*

This is the theory of a complete RDBMS (Relational Database Management System) with several databases storing "related" datasets being used for differing purposes by Departmental users but having 'common' objects that all users should access in the "related" applications to the database where the data was originally stored. An example of this is:

Geologists use well data for interpretation of basins and require the well name, location and various summary attributes to ascertain the relevance of the well to their study prior to loading specific attribute data for manipulation. The same summary attributes of the well are used by administration to ensure the well conforms to the permit work commitments and has been drilled safely. Royalties would view the well for revenue

purposes but again require the summary information common to the requirements of all these users.

When implemented successfully this will remove duplication and lessen the opportunity for errors to arise in the data.

2. Submission of Data:

What type of data should be submitted to the Department for archiving and release to industry to provide explorationists with the information they require to efficiently explore for petroleum. There have been many ideas put forward and no consensus from industry. Here are some possibilities that could further discussions on these issues.

- *Submission of multi-colour data in hard copy*

Hard copy data presently submitted for aeromagnetic and 3D surveys comprise colour coded images which, for the operator to provide in sepia transparencies is a costly and non-productive exercise. In the case of aeromagnetic data the images produced are currently not a requirement to submit, however it is invaluable data for future explorers, these images include 1st and 2nd Derivatives, Bouguer anomaly images and other image processing techniques. Consideration should be made to amend the Schedules of the Acts to cater for this change in technology.

Similarly enhanced well data being produced from FMS and CAST logs is colour coded such as fracture determination and stratigraphic dip logs and unreadable in black and white reproductions.

- *Submission of Digital data for seismic surveys:*

This is a major topic of debate not only within the Department, but also within industry. 3D seismic surveys produce large quantities of field and processed data, all of which may be required for evaluation and interpretation, such as the original field tapes, raw navigation tapes, velocity data and SEG-Y process tapes which can be used immediately in work stations. For offshore 3D reprocessing the main request made of the Department is for SEG-Y tapes rather than the original field data, however some interpreters also consider the velocity data and have requested this and the field tapes to reprocess the data. One company has requested the raw navigation data due to concern as to the processing of this data. Thus the Department presently accepts all digital data until consensus is reached within industry.

- *Digital versus hard copy:*

A recent APEA study identified the range in industry views in relation to 3D data. Larger exploration companies supported use of processed tapes rather than submission of hard copy sections. Smaller operators, however, considered that hard copy sections are of use.

One approach might be that only digital data need be submitted for offshore 3D seismic, both SEG-Y migrated and field data. Similarly for all seismic data the requirement for SEG-Y migrated data should be enforced. For all 2D seismic and any onshore 3D seismic where smaller exploration companies are more common, however, the requirement for

hard copy sections, horizon maps and location maps should remain. To ensure availability of data, processed SEG-Y migrated tapes should be submitted 3 months prior to the relevant date of release for all surveys to allow access by explorers when the data is available.

- *Submission of data as a result of borrowing tapes from Archives:*

Presently when companies borrow seismic tapes from Archives they are requested to supply, amongst other things, hard copy sections of lines reprocessed and a processing report. It is suggested that this requirement be replaced with a discretionary request that the borrower copy the field data on a new media to be returned with the original data. Further it should be requested that any SEG-Y migrated data produced from the borrowing should be submitted to the Department for archiving and release after a set period (eg two years from date of processing). This would replace the older, less reliable media with newer media and also provide industry with SEG-Y migrated data for surveys where none has been submitted.

- *Submission of Well data*

With the advent of the tools mentioned earlier, the LIS format has been found to be unable to store FMS data and other sophisticated logs. The SPWLA has endorsed the new DLIS format and now the Department receives DAT and Exabyte tapes with DLIS and ASCII formats.

Industry also now requires more from archived data such as edit composite tapes as well as field data. Recent requests also show digital data for which past procedures did not include verification of well log tapes has shown retrieved tapes often have missing data and are lacking essential information. Clear guidelines are now provided to ensure the appropriate information, eg curves, header data and repeat sections are provided and verification procedures are standard at the Department.

3. Archive Data Media

A major issue associated with the increase in reprocessing requests is the condition of the digital tapes in archive. Stiction has caused major losses of data and some companies resort to inappropriate heat treatment of tapes to extract the data making the treated tape useless for further processing. Alternative media such as DAT tapes, Exabyte tapes and optical systems such as terrabyte have been proposed to extend the useable life of the data and reduce the physical size of the archive.

Discussions with industry by this Department has shown some media currently used have problems, including data loss and media failure, such that it is probably not acceptable as a sole long-term archive medium. Further consultation with industry concerning the archive media for long term (10 year) storage is required. It is imperative that a system of rotational backup and rationalisation of redundant data be instituted for Government archived material. This must, however, be done by determining the seismic coverage of the area and the redundancy of the data. For example some areas in the Canning Basin onshore only has sparse 1970's data available, therefore it is imperative that this data must be preserved, on the other hand some late 1980's surveys conducted in the Northern Carnarvon Basin have been overshot by other seismic and in some cases 3D seismic

making the data redundant and therefore can be disposed of. This decision to destroy or preserve data needs to be a case by case joint State and Commonwealth decision in Commonwealth acreage as it is the States that deal with the daily requests for data from industry.

4. Release of Data to Industry by Government:

Industry now requires a higher level of sophistication in the data released by Government for petroleum exploration for instance:

- Hard copy data, whilst still used, is becoming less important for interpretation of seismic data or well log data. Explorationists now expect to retrieve SEG-Y migrated data for surveys to load into their work stations for interpretation and manipulation with other data rather than have to process field seismic data or digitise the sections. Similarly industry requires edited composite well log tapes for analysis rather than having to process the field tapes and produce edit composites prior to interpretation.

- Summary information in digital format is also often requested where industry requests downloads of certain open-file data from the database in ASCII or other formats for loading into their databases or use in their interpretations.

- Developments in data release show a trend for Government to produce the data submitted to it in a far more sophisticated manner than the original data provided and in the next few years, Governments will be scanning reports and maps to provide industry with digital products to load into PC's for manipulation and interpretation.

Conclusion:

The petroleum exploration and production industry is entering a revolution in data acquisition, storage and release which Governments must cater for in the requesting and release of data by:

- Reviewing submission requirements for petroleum exploration data, especially with respect to Geophysical surveys to ensure the data required for interpretation at release is sufficient to meet the requirements of industry.

- Upgrading storage facilities to ensure digital data is correctly stored and backed up and that hard copy data is stored to ensure it is released in the most appropriate manner for use by industry.

- Release of data is in such a format as to be of use to explorationists and to be sufficient data for interpretations to be conducted.

Digital presentation of data is now more sophisticated and hard copy data (except perhaps reports) will be redundant in the near future. This Department is addressing these issues now and laying the framework for systems and procedures to cater for, not only the current, but also the future requirements of the petroleum exploration industry.

References

① "Petroleum in Western Australia", February 1994, published by DOMEWA, p12.

② "An Overview of Minerals and Energy in Western Australia", November 1993, published by DOMEWA, pp 31-39.

③ Figures supplied from the WAPEX™ database as at 31 July 1994.

COMPANY HOLDINGS:
WOODSIDE OFFSHORE PETROLEUM

Peter Vaughan
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Abstract - This paper covers some of the general concerns faced by Petroleum Exploration and Production Operators involving Petroleum Data Management. It includes an historical and current perspective of data management issues faced by Woodside Offshore Petroleum with a summary of data volumes and categories stored and submitted to Australian Archives. Suggested areas for improved efficiencies in the management and submission requirements are discussed and are presented not as intended solutions, but as a basis to promote wider discussion of the important issues faced by Industry and Government.

Introduction

Petroleum data management has become increasingly important to Petroleum Exploration and Production Companies in recent years, due to the rapid development of digital processing technology, which has resulted in enormous increases in the amount of data acquired in the field and subsequently processed. The increasing use of 3-D seismic technology has not only changed the standard products produced but has vastly increased the amount of digital data to be managed. The use of interactive interpretation workstation technology has completely changed the tools an interpreter uses to evaluate the sub-surface information. These changes have occurred rapidly and Data Submission Legislation has lagged behind technological developments causing some inconsistencies and non-standard products to be generated for submission purposes. The problems of tape degradation are of major concern and the national petroleum data asset needs to be protected urgently and effectively. These above changes which the Australian Petroleum Industry and Government are facing can only be solved by Industry and Government co-operation and should be placed high on the agenda of both groups to ensure the increased effectiveness of Petroleum Data Management. Resolving the current concerns will not only benefit the current Petroleum Industry but also the future generations of Earth Scientists who will be using the data we acquire and work with today in the years ahead.

Historical Aspects

Woodside has operated exploration acreage on the North West Shelf of Australia since 1965 and has acquired 112,000 km of 2-D seismic data since 1969 and 222,000 km of 3-D seismic data since 1981. Approximately 124,000 field tapes have been recorded and 15,500 processed tapes have been produced representing 3,670 2-D seismic lines and 4,700 sq km of 3-D coverage. Woodside has submitted 32,000 field tapes to Australian Archives.

Current Holdings

Approximately 90,000 field tapes are currently stored by Woodside. 52% of these data are on IBM 3480 cartridges and the remaining 48% are on 9 track reel tapes.

Storage Facilities

Woodside stores most field data from the North West Shelf Project at Brambles Records Management in Perth. All non-NWS field data, all processed data and seismic sections are stored with Kestrel Information Management in Perth.

Woodside's Data Submission Status

Woodside submitted all pre-1980 field tapes and observer's logs from non-relinquished acreage to Australian Archives in 1986. Since then field data has been submitted as soon as possible after the data has become open file. Woodside is currently preparing the 1990 and 1991 3-D data for submission later this year.

The submission of processed data tapes is proving to be somewhat difficult for a variety of reasons. The retrospective submission requirements for digital processed data has resulted in a lot of "catching up" to do. Processed data tapes are held in a variety of formats and often many different versions of processed data are generated, some of which do not cover a whole line as special processing projects are often only performed on a limited shotpoint range. Special processing products involve the use of expensive and often proprietary processing software and are not required to be released as open file data. As only the initial processed products are to be released for open file distribution, this requires detailed and time consuming checking of processed data lists to ensure only the "basic" data is submitted.

Another problem faced by Woodside with submitting 1980's or earlier vintage data was shown in a recent migrated data tape copying exercise of older vintage Woodside data. The processed data tapes were difficult to copy and degradation of data apparent. This makes the copying exercise slow and expensive. Some processed data was found to be irrecoverable. This is going to be a problem faced by all operators and will mean that incomplete digital data submissions will result.

Woodside has not yet submitted any open file processed data; it is now in a position where requests from brokers and other oil companies come directly to Woodside for action. These requests take a considerable effort to fulfil especially where for example three different companies may be requesting the same data simultaneously. We intend to resolve this issue shortly by copying all open file data and submitting it to Australian Archives for them to administer. In the long term we intend to submit all processed data to the Australian Archives as soon as possible after completion of the initial processing and when the data is being tape copied for Joint Venture Participants. This avoids the need to copy vast amounts of data later. It is recommended that all companies submit their digital processed data as soon as the processing project is finalised and final films are prepared and submitted.

General Submission Concerns

There is concern about non-standard processing products being submitted under open file obligations. Exabyte final products are not SEG standard and all digital archive products should be IBM 3480 media or 9 track tape in an approved SEG format. Workstation format data is not acceptable. Survey datums vary throughout Australia. Shotpoint annotation varies from antenna to source to cdp position from area to area, survey to

survey and operator to operator. Consistency is called for on these issues and clearer guidelines are required to avoid confusion. Film and paper data submitted must be of the highest quality, both in data processing terms and also for reproduction. Some reproduced data is of such poor quality it is not possible to perform an accurate interpretation on what has been provided. Although the PSLA and PLA are Federal Legislation, they are administered somewhat differently by the various states. This again highlights the need for consistent interpretation and application of data submission requirements while also ensuring that only the highest quality products are submitted.

The archiving of "RAW" (no post-stack or migration processing) processed data is necessary if these data are to be used for subsequent processing or redisplaying. Individual seismic interpreters often apply their own preferred post-stack processing parameters to the data on their workstations and require "RAW" data as input for these processes to be effective. However, if only "RAW" data is archived it differs greatly to the final data submitted on film. I believe that a digital version of the final filtered and scaled migrated data which includes all post-stack processing applied, should also be submitted. This version should have the same processing sequence as the data submitted on film. Only migrated data should be submitted on film with stacks only submitted if the data has not been migrated.

The submission of field data for large 3-D surveys when due for open file release causes great additional expense and time delays for operators who may wish to reprocess the data at a later stage. A company that has submitted its original field data on time is disadvantaged when compared to a company that has not submitted its data. This problem needs addressing as the current situation is not adequate. Woodside is currently faced with a problem of this nature where it is reluctant to submit field data for one 3-D survey due to possible reprocessing requirements. One solution would be for the originating company to either be exempt from retrieval costs or at least obtain a retrieval discount. This would encourage all data to be submitted when due.

Disaster Recovery Procedures

Woodside has a disaster recovery procedure where all key data is duplicated in some form or another so if the original data is destroyed another version is obtainable. The two versions are not to be stored under the same roof and strict environmental storage conditions apply. This duplicate principle should be considered for operators and Government data management. It is believed that the Government should include lists of all data copied but not necessarily stored at Archives as original data may be unreadable and there may be good versions of copy data available which could be provided instead.

Data Submission/Retrieval Issues - Australian Archives

Woodside would like to commend the Australian Archives for their improved service in recent years. The tape preservation program is an essential requirement of preserving the valuable digital data assets of Australia. Continued progress in this area is necessary and funding must be continued to ensure the preservation program is completed as soon as possible and that quality data management principles are in place for the future, where regular random checks of data integrity are performed to monitor tape quality. There is some concern that funding limitations will limit further progress. The intended "user pays" system applied to the copying of field data from Archives may actually limit future funding

of the Government's copying program. If companies have made their own copies of field data on high density media as proposed by APEA's Seismic Operator's Committee these tapes can then be traded directly from company to company without using the Government's facility.

A "value" assessment of all data stored at Archives should be made as some old data is irreplaceable and other vintage data will have little or no value due to it being superseded by more modern data or maybe even overshot with high quality 3-D data.

A problem occurs where data is temporarily out of store and the Archives are not aware of its temporary location. This can cause confusion and delays where the same data is requested by more than one party. Further enhancements to the intended data base system may involve the development of an online access system to review data availability and tapes ordered directly instead of going through the state authorities and then to Archives.

There should be some thought given to establishing a Western Australian archive facility as the Villawood facility is now overcrowded. Data shipments travelling large distance by road expose Western Australian field data to unnecessary risk and potential permanent damage. Many Western Australian operators are based in Perth and a local archive facility would directly benefit these operators. Most of Australia's data processing contractors are now based in Perth adding further benefits for a WA based archive facility.

1993 Western Australian APEA Sub-Committee recommendations

In 1993 a sub-committee of the WA APEA branch was established to review various petroleum data management issues. The following summarises the sub-committee's activities and the recommendations proposed are as per the 1993 report which I believe are relevant to this forum.

A meeting of the WA APEA group was held on 5th August 1993 at the WA Dept. of Minerals and Energy to discuss petroleum data management issues with the aim of improving submission, storage and retrieval of petroleum data to assist operators and encourage exploration in Western Australia. At this meeting it was agreed that a sub-committee be formed to review the current petroleum data management requirements with the aim of presenting to APEA ideas for the updating of current Legislation (PSLA and PLA) and procedures for seismic and well data submission, storage and retrieval of Petroleum Data. The sub-committee met separately to discuss data management issues and reported back to the WA APEA group with plans to prepare a questionnaire to be distributed to all WA Petroleum Exploration permit and production licence operators. The questionnaire was prepared and sent out not only to WA permit holders as initially intended, but also to all APEA member companies. This has given the issues of concern a wider audience and therefore has significant national relevance and not just a West Australian concern. The report's recommendations and conclusions were as follows; "The responses received were generally consistent with the consensus being that a variety of improvements are urgently required in the legislation and petroleum data management areas.

1. Proposed Legislative Changes

Revised Legislation is required to cover the following issues:

1. All data (basic and interpretative) to be released immediately upon relinquishment, cancellation or expiry of Tenement.

2. The requirements for the submission of seismic data need updating to reduce/eliminate much of the currently requested hardcopy data. Hard copy velocity displays are not required and should be replaced with a digital version of time/velocity pairs. One standard scale (10cm/sec) for seismic sections is also preferred with only migrated versions being submitted unless only stacks are produced. Digital data sets are generally standard in format but not in medium, this issue needs standardisation and regular review. The submission time for 3-D data needs extending as the data processing is often not completed within the specified six months period, it is recommended to extend the period to 1 year after completion of acquisition.

3. Submission release times require changing so that Basic and Interpretative data are submitted at the same time. The definition of Basic and Interpretative data require clearer definition of requirements to obtain consistent standards.

2. Data Management Issues

1. There is wide concern that data storage and management of both digital and hardcopy data is far from adequate and improved storage, staffing and management practices are required. To achieve the necessary improvements a Western Australian based archive facility is required for the storage of digital seismic and well log data as well as the more general well completion and interpretation reports. The core store and archive should be integrated with data verification capabilities, modern indexing, nationwide data base facilities linked to the BRS, a library for data review and areas designated for core studies and review. Copying facilities for digital, plan printing and report copying should be included at the site. It is also recommended that the NSW Archives also upgrade their storage and data management facilities. The addition of a WA archive facility would remove a lot of the pressure from the NSW Archive.

2. Funding of the new facilities and improved data management systems and services required is seen as a Government responsibility and could well be resolved with joint State and Federal funding supported from current revenues from the oil industry.

3. Seismic contractors should be requested to devise a standard universal digital format for observer's logs to assist in reducing paper support documentation.

4. Recent developments in mass storage/retrieval technology and very high capacity cartridges look set to revolutionise digital storage/retrieval systems. The use of D2 tapes for seismic acquisition is to be tested in October and November 1993 in the Gulf of Mexico. If the acquisition tests are successful D2 tapes will probably replace 3480 cartridges for the future field tape medium.

It is recommended to establish a Committee to regularly review the development of digital storage and retrieval technology and new format concepts. There is a need to conduct a full cost benefit analysis of various approaches prior to any implementation of new systems, which should greatly improve efficiency and reduce storage costs significantly. Attached to this report are some brochures/ articles covering some of the new developments in Data Storage Technology which should be considered for possible options for mass storage and access to the vast amount of Australian digital Petroleum data.

An International workgroup has recently studied format issues involved in utilising the emerging high density magnetic computer media for exploration and production activities. The group is recommending the introduction of the Record Orientated Data Encapsulation (RODE) format which is based on a draft version of the American Petroleum Institute Recommended Practice 66. The RODE format enables old data of various formats to be encapsulated in a way that uses mechanisms permitting fast searching, indexing and partitioning to occur as well as allowing the recreation of the original data in its original record and filemark structure. Copies of data or sub-sets can be generated easily for specific requirements possibly on a variety of mediums. This format will provide great benefits to data archiving management and reduce long term costs.

5. The use of cuttings and cores for destructive analysis requires improved policing to prevent unnecessary or duplication of sample testing.

6. Digital data submission and retrieval is the generally preferred option for many data types. Currently there are many format variations and media used for digital data submissions which are not consistent across the nation. It is recommended to prepare a list of acceptable format and media for the various types of digital data. This of course will need regular review to keep pace with new developments in digital data technology. "

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THE VILLAWOOD DATA PROJECT

"The case of the disappearing records"

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Abstract - Last year industry and government concerns regarding the deterioration of public domain petroleum data stored on magnetic tape catalysed a budget appropriation of $1.5M to the BRS to address the preservation and management of the data currently stored at the Australian Archives facility in Villawood, NSW. In August 1993 the Villawood Data Project was initiated and BRS has since taken an active role in the preservation and management of the data.

The primary emphasis to date has been the transcription of data on deteriorated tapes to high density media and the establishment of a digital database to assist in the management of the data holdings at Archives. Within the initial funding period 25% of data has been entered on the database and 15% of data at risk has been preserved on new media. In addition to continuing the work undertaken so far, the next phase of this project will concentrate on document imaging of observer's logs, culling of data and the development of a terabyte storage facility for efficient data access.

Keywords - Petroleum data/Data management/Tape storage/Magnetic media/Tape deterioration/Stiction/Data preservation

INTRODUCTION

Each year the search for petroleum in Australian offshore waters generates terabytes of digital seismic data at a cost of millions of dollars to the petroleum industry. The data are both regional and detailed and used by explorationists to define the structure of the earth and identify prospective areas to drill for hydrocarbons. In Australia basic exploration data, after a period of time, become public domain property under the Petroleum (Submerged Lands) Act and are available for further analysis long after the initial processing of the information. This can save an explorer significant time and money by allowing them to use existing data and focus their exploration efforts.

In response to a recommendation of the recent Richards Review of the Australian Geological Survey Organisation (AGSO), an appropriation of $1.5 million was made in the 1993/94 budget to the Bureau of Resource Sciences (BRS) to address the management of petroleum data held at Australian Archives in Villawood. The money was to be used for the development of a digital data management system and for the preservation of the data on to more modern and compact media.

Public Petroleum Data

By requirement of two Commonwealth Acts, the *Petroleum Search Subsidy Act 1957* (PSSA) and the *Petroleum (Submerged Lands) Act 1967* (PSLA), governing petroleum

exploration and development, data are deposited with the State/Territory Designated Authority. Of these data, analogue and digital data and their associated support information are deposited with Australian Archives by a June 1971 decision of the Advisory Committee of the Australian Minerals Council and by arrangement between the then Bureau of Mineral Resources (BMR) and Australian Archives. As of 1989, the total petroleum data holdings in Villawood Archives was estimated at 560,000 magnetic tapes taking up 12,500 shelf metres of space (Wyatt, 1990).

The Department of Primary Industries and Energy, previously through the Petroleum Resource Assessment Branch of the Bureau of Mineral Resources and now through the Petroleum Resources Branch of the Bureau of Resource Sciences, carries the overall responsibility for managing the data and ensuring that it is available to the petroleum exploration industry.

To date, the day to day handling of incoming data and the loan of material to clients has rested, on behalf of DPIE, with the Australian Archives. For the Archives, the 12.5 shelf-km of digital and analogue data is an unusual collection. Firstly, it includes the only holdings of digital and analogue tapes at Villawood, and secondly it is the only Archives holdings that is available to non-government clients. Of growing concern to both the BRS and Archives has been the escalating cost of storing and handling such vast amounts of data. This has been exasperated by the emergence of 3D seismic technology which generates on the order of 4 times the amount of data as conventional seismic.

Magnetic Tape Deterioration

In recent years however, deterioration of the magnetic tapes has become a critical problem. The phenomena of "stiction", whereby the oxide coating of the tape peels off and sticks to adjacent strips of tape, is reported world-wide in a variety of industries dependent on this media. For media at such risk, the potential loss of data is great each time a tape is read, thus posing a serious threat to a valuable national information resource. To salvage the data, special techniques have been developed to temporarily revert the deterioration process and allow data to be copied to new media. These processes are time consuming and expensive but are worth the cost considering the value of the data and the cost of conducting a new seismic survey.

STRATEGIC ISSUES

Budget versus Time

The budget allocation to BRS was both an opportunity and a challenge. While the funds allocated provided an opportunity to address the issues, it was considered a "drop in the bucket" when viewed against the entire task. Indeed, at their March conference this year, APEA announced their view that the necessary additional funding was around $10M. On the other hand, appropriately spending the $1.5M in one financial year is not a trivial manoeuvre. Especially so at the onset of a project when a lead up is necessary to get to an operational stage. It was imperative that tight planning, scheduling and budget monitoring be undertaken.

Standards

Media used for transcription, data formats and equipment must all be chosen to reflect the best available industry standards at the time. There is never a clear-cut, universally accepted solution to many of these issues, however it was important to choose the most

accepted, least risk approaches.

Expertise
It was vital that BRS quickly ascertain what expertise it had internally and what it needed to recruit from other stakeholders in this area. While BRS had expertise with industry data and with relational databases, it needed support in seismic processing, archival practices and industry knowledge of the data at risk.

Transcription Technology
Tape deterioration is a world wide phenomenon however the expertise and technology required for salvaging seismic data, in particular, on stiction affected media was still a specialised process and available through a limited number of contractors. Virtually no standards were set up to evaluate methodologies and informed evaluation had to be based on the petroleum industry's experiences to date.

Relationship with Australian Archives
This new initiative imposed new roles for both the BRS and Archives with respect to managing the data. It was important that this impact was evaluated in terms of policies, resources and financial concerns.

Industry Expectations
As an important stakeholder in both data provision and use, the petroleum industry would have high expectations of better service and data.

PREPARATION

Strategic Planning
A strategic plan written by Williamson, et al (1993) outlined the overall project requirements and proposed implementations. A detailed strategic plan for the Digital Database Program was also compiled (Radke, 1993) and included a specification for the proposed Oracle database development consultancy.

Valuable input to the strategic plans was provided by AGSO, Australian Archives and representatives from the petroleum industry.

Consultative Committee
To advise the project, the Petroleum Data Consultative Group was established by BRS. It includes experts from BRS, the Australian Geological Survey Organisation, the Australian Archives, the Petroleum Division of DPIE and the Australian Petroleum Exploration Association. This committee provides both a vehicle for input and advice to the Project and a mechanism to disseminate the Project activities and progress to the wider petroleum community.

The Consultative Group has formally met twice during the project, otherwise communicating over distance. A Canberra sub-group, comprising representatives from BRS, AGSO, Australian Archives and the Petroleum Division of DPIE met as required in interim periods.

Set up of operational facilities
During the early stages of the project, all the work was carried out at BRS in Canberra,

however, an office space was later established within the Australian Archives at Villawood. A workspace in proximity to the actual tape data was made available by Archives and was fitted out by BRS as office space for up to 7 staff. Furniture, telephones, facsimile and computing equipment were set up by late December 1993 and the area was staffed in early January 1994.

Staffing
Full time staff recruited specifically for the project include two Technical Managers and two Technical Officers. In general one Technical Manager and one Technical Officer are employed for each of the Tape Copying and Database programs but all staff assist in various project activities. In addition, a data entry bureau was utilised to provide one or two data entry staff; currently one data entry person is engaged on the project.

Part time involvement was required by BRS officers in Canberra. Two senior officers were assigned as Project Managers for the Tape Copying and Digital Database programs respectively. Administrative, financial and advisory input was provided by the Senior Executive and other senior officers in the Petroleum Resources Branch. In addition, staff involved in the PEDIN Database project provided technical support.

Working with the Australian Archives
Consultation between BRS and the Australian Archives is an important aspect to the Project. Operational infrastructure, including accommodation and other services at the Villawood facility was required and obtained with assistance and cooperation from Archives, as was advice and comment on project activities. Of particular note, Archives offered one of their staff, who had long standing experience with the petroleum holdings at Villawood, for a 3 month secondment to the project in early 1994. This provided a valuable link between the two organisations and assisted the newly recruited staff in familiarising themselves with the tasks ahead of them.

PROJECT ELEMENTS

The fundamental components of the Villawood Data Project, as carried out to date, have been the Preservation and Copying program and the Digital Database Management program. Other elements, such as document imaging of support data, culling of data and incorporation of a terabyte storage and retrieval facility, are also being tackled in the next phase of the project.

Tape Copying and Transcription Program
The Tape Copying and Transcription Program is focused on the presentation of data stored on deteriorating magnetic tapes. Tape copying is contracted out and project staff are involved in defining and administering procedures and work flow.

The first order of business was to identify, assess and prioritize data for transcription. Important factors to identify data at risk are media brands and tape vintage. It is also important to take into account which data is of most value, has been superseded by newer and better data, and whether other copies of the data exist. This information is not readily available except by tapping in to the industry's experience of using the data. Through the Consultative Committee and APEA, a questionnaire was sent out to seismic operators to obtain information on their own holdings and their views on data that should be preserved.

Another important task was to set up a panel contract for the transcription work. With the Consultative Committee and with particular assistance from AGSO, work specifications were established which are aligned with industry standards for handling and using modern seismic data. The chosen transcription media is 8mm helical cartridge tape and the data must be de-multiplexed into SEG-Y format. The specifications also cover conditions for handling stiction-affected media, number of files per medium and quality control measures. As a result of advertising for tender submissions, four contractors were selected for the panel contract.

At the "coal face" staff at Villawood have been fully engaged in preparing data for copying and transcription, handling returned material and in maintaining records on the progress.

The Program is also responsible for quality control in both record keeping and in the tape copying process. To ensure the latter, contractors must also supply processed display plots of selected data from the tape copies.

Digital Database Management Program

The Digital Database Management Program, aimed at establishing a database system to manage the records and data held in Archives, last year produced the Petroleum Information Management System, otherwise known as PIMS. PIMS is an Oracle database system that is linked to BRS' existing petroleum database PEDIN and provides an item level inventory of the petroleum data holdings at Villawood. In addition to recording information on the data itself, PIMS also records data on the media, including the brand and date written to tape with the aim of identifying data at risk before it is too expensive, or too late to save it. PIMS also provides for the management of physical movement of the data through loans, copy issues, storage re-locations and disposal. Bar coding of tapes and other items also facilities data management.

Planning and development of PIMS commenced as soon as possible in the project. A strategic plan was completed in September and it was decided to contract the development work out in order to keep to schedule. As it was important to commence data input by late December, a tender was let for the development of PIMS in October to ensure that the initial data entry module would be completed in time. Other modules for data auditing, loaning and reporting, were staged for completion at the end of May 1994.

The database itself is comprised of seven Oracle tables: one data table, three lookup tables and three tables used for auditing and tracking the history of the data. SQL*Forms, SQL* Menu and SQR reporting software were used to develop the applications software. The production database resides on AGSO's AViiON Oracle server with Villawood acting as a remote site. Data entry is undertaken on PC's or vt220 terminals linked to a 64K ISDN Microlink service between Villawood and Canberra.

The data entry program was started in earnest in January 1994 and it is estimated that it will take two years to enter records for the entire collection. Data entry is carried out by technical officers and data entry staff under the supervision of a Technical Manager who has a background in seismic data acquisition and processing.

Document Imaging Program
In response to concern from the Consultative Group regarding the future preservation and access to observer's logs, a document imaging system was purchased late last financial year with the aim of scanning this material for storage in digital image format. Observer's logs currently held in Archives are in a variety of paper and microfilm formats. Only one copy is lodged making the collection vulnerable and accessible to only one user at a time. It also takes up considerable space. As the paper copies are the most at risk, emphasis will be placed this financial year in scanning these data into the system.

The purchased system stores the images in group 4 fax compression format and output can be paper copy, TIFF or PCX digital formats.

Data Evaluation and Culling Program
A significant amount of data held in Villawood needs to be evaluated for potential culling:

- support data not required under the PSLA or PSSA and which is not useful in future reprocessing or interpretation
- older data that has been superseded by newer data
- unreadable tapes
- data that has been copied to other medium
- duplicate copies of data

A working paper is being developed to more precisely qualify and quantify data for potential culling and to outline procedures for disposal. A draft of the paper will then be circulated through the Consultative Group for comment and approval before any action is taken.

Terabyte Storage and Retrieval System
Looking towards future access requirements, BRS acquired a terabyte storage system for data transcribed to 8mm cartridge media. The aim is to store a second "working" copy of the data in Canberra, while at the same time allowing efficient access to public domain information. As required, selected data can be retrieved and copied to 8mm media to send to clients. As communication and networking performance is realised in the future, these data could be sent down the much publicised "information highway".

The system has been integrated with existing computing facilities at BRS, National Resource Information Centre (NRIC) and is based on an hierarchical storage management system that utilises up to three possible storage devices depending on usage. The base storage unit is an Exabyte four-drive, 116 cartridge jukebox. When data is required for copying, the system will transparently migrate the data to the high performance disk drive thus providing faster transfer rates than the Exabyte technology. Depending on use drop off, the system will migrate the data back to either a magneto-optical or the Exabyte stack, freeing the hard disk for other work as required. Data in the Exabyte stack can also be manually migrated to off line storage as required.

CURRENT STATUS

At the end of the first year of funding 25% of petroleum data was entered on PIMS, approximately 15% of data at risk was preserved and work has commenced on the document imaging of support data, data culling and the establishment of a terabyte

storage system.

From September to December of 1993 the Tape Copying and Database Programs underwent a "set up" or pre-production phase. In early 1994, the project was staffed and productive activities commenced. At the end of the financial year, planning and acquisition of the document imaging and terabyte systems was initiated and by August 1994 all Project elements were in progress. As the funding for the second year is considerably less than the first, the Tape Copying Program has been suspended with the aim that adequate funding can be obtained next financial year.

To date, 35 seismic surveys comprising 22,241 9-track tapes have been transcribed to 8mm cartridge. Data entry on PIMS has registered 162,792 tapes from 264 PSLA surveys.

FUTURE ISSUES

Data Culling
The Data Evaluation and Culling Program has only just commenced and many issues are yet to be resolved. Although some categories of support data may be clearly designated for culling, most other seismic data will have to evaluated on a case by case basis.

Data not submitted
As a result of work carried out to date, it is estimated that nearly half of the data that should be submitted has not been lodged with the Commonwealth. In addition to highlighting the overall quantity, the statistics emphasise a particular gap in the mid 1980's data. Resolving this dilemma is not straightforward. It is certainly dangerous to ignore the problem as the risk of losing the data forever is high, however BRS does not have the resources to call in the data all at once. It will be important to develop strategies to both identify where the data is currently held and to establish priorities to systematically request data to be lodged.

Long Term Management of the Data
Longer term management is already being considered by BRS, the Australian Archives and the Consultative Committee. Issues ranging from staffing, technology and cost recovery and charging must all be considered.

Analogue Data
The collection of analogue data is costly to store and generally inaccessible due to the technology that is required to read it. BRS needs to evaluate the cost benefit of transcribing all or part of the collection into digital form. This also has implications in terms of data culling.

Resources and Funding
The initial funding period for the Project ended in June 1994 however some of the initial funding ($0.3M) was carried into this financial year to extend the project. Unfortunately, insufficient funds are available in the 1994/1995 financial year to continue the Tape Copying and Transcription Program. Strategies are now being formulated to seek to fund the project on a longer term basis and with sufficient resources to continue the data preservation activities.

CONCLUSION

As the Villawood Project enters its second year, significant progress has been made toward the preservation and management issues of public domain petroleum data. Approximately 15% of the data identified at risk has been transcribed to high density media and procedures and methods have been established to continue this work. A digital database management system has been developed which has already had impact on the management of data at Villawood. Document imaging and mass storage technologies have been adopted to further address the preservation and access to these data while consideration is also being given to the culling of unnecessary information storage.

Strategies are now being formulated to seek to fund the project on a longer term basis. Cooperation and support from industry and government agencies has been instrumental in the achievements so far and will continue to shape future directions. If BRS is successful in maintaining an effective ongoing program significant benefits will be realised in the cost of data storage and management, as well as an improved information service to the public.

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THE PRINCE PROJECT - A QUEENSLAND INITIATIVE

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Abstract - The PRINCE Project is an initiative of the Queensland Government whereby seismic and other geological data held by the Department of Minerals and Energy can be stored, retrieved and manipulated to provide the maximum useability of this important aid to exploration. Opportunity will be given for explorers and others to participate in this project and to use it for their own data storage.

Keywords - Seismic data/value-adding/on-line data storage

Introduction:

It has been said that for every thousand bits of data, there is one bit of information; that for every thousand bits of information there is one bit of knowledge; and for every thousand bits of knowledge there is one bit of wisdom. Even with that huge reduction, there is an awful lot of potential wisdom about these days.

Like so many others in the world today, the Queensland Government is facing a serious problem with geophysical data. So much data is stored in low density format magnetic tape and is both difficult to access and degrading in quality as time passes. This data has been collected over the years as a direct result of legislative requirements under which data from seismic operations, gravity and aeromagnetic survey must be submitted to the Department of Minerals and Energy within 6 months of completion of the work. Until now, there has been no attempt to secure this data by transcription or other means, so it follows inexorably that this data is becoming less secure with every passing day.

The loss of data is always regrettable, but never more so than when the data is really important. This description surely fits geophysical data, hard-won and both time-consuming and costly to reproduce. So one of the prime objectives of PRINCE is to store this data in a form which is stable and secure.

But there is little point in storing data if you can't use it. It is an undeniable fact that increased production of natural resources like petroleum comes from increased exploration.

And it is equally true that increased exploration comes with increased confidence by explorers which in turn comes from their perception of prospectivity and knowledge of the risks and opportunities. The seismic and other data can provide that knowledge, so by making this data readily accessible the Government can provide a direct stimulus to exploration activity in the State, and in consequence an increase in employment, an increase in discoveries, an increase in the wealth of the State and of its citizens. And as one of those citizens, I reckon that's OK by me.

The Problem:
As already stated, the prime problem is that there is a deteriorating data asset which cannot be readily accessed or used to assist explorers. But the problem is a little deeper than that. Even if the data was stored in a form where its future security could be guaranteed, and even if we could guarantee accessibility, there remains the problem that, in many cases, the data needs some down-stream processing before it can be an effective exploration tool. The idea of "value-adding" to the stored data is central to the PRINCE concept as is the idea of making this information as readily available as possible - effectively "on line". To do that, we need some pretty powerful computing engines and some pretty nifty data handling.

The Solution:
The solution is not fully developed yet, for it is only of recent days that we have consulted with the major stake-holders to get their views and, as I speak, we are receiving offers from consultants to draw up a business plan for the project. So it is early days. But this much is known: the PRINCE project will be a joint venture between the Queensland Government, Queensland Supercomputing Laboratories and Digital Exploration Limited. The Queensland Government will provide project leadership and initial funding for the project, Queensland Supercomputing Laboratories the technical expertise and the use of the considerable computer power at their disposal, and Digital Exploration Limited the software support which will be needed to transcribe magnetic and other data into a common format, and will also provide the expertise necessary to provide value-added data.

Much of the hardware necessary for the project already exists in the form of the Convex super-computers at QCAT, the Queensland Centre for Advanced Technologies, where the operations of PRINCE will be based, and in which the Queensland Government already has a substantial investment.

The one major piece of equipment which will be needed is a robotic tape handler. This will enable the large quantities of data to be rapidly accessed and give the project a very large data handling capacity. Indeed, it is estimated that PRINCE will be capable of handling more than 100 times the data volume of the total Queensland reflection seismic data set. With this data handling capacity, it is clearly envisaged that PRINCE will be able to offer exploration companies and other Government authorities a powerful and competitive alternative to the maintenance of secure in-house data storage facilities.

In terms of staffing, there will be a business manager, appointed to oversee the promotion of the project and its use, there will be a geophysicist, whose major task will be to assess current data and to prioritise it for processing and the whole project will be overseen by a Project Manager from the Department of Minerals and Energy, me!

At first, the project will allow better access to raw data, and, as consultant and other bodies become involved, value added data will appear on the menu. The ultimate aim is to have the PRINCE facility connected "on-line" to the Department's Mining Tenures Data Base and thus make possible the direct connection to PRINCE from the Head Office of the Department or any of its regional offices. Thus, from a relatively obscure set of tapes at Zillmere, a Brisbane outer suburb to a rapidly accessible information resource available throughout the State, PRINCE will undoubtedly transform the petroleum exploration business in Queensland.

Of course, nothing comes for nothing, and there will be a cost in running and maintaining PRINCE. While it is inevitable that the project will need support in its formative years, it is planned that the project become self-funding well before five years are up. Part of that funding will come from supply of raw data, part from the value-adding process and, hopefully, part will come from others using the system. And these others need not necessarily be petroleum explorers. While the initial focus will be on petroleum geophysical data, we should not be constrained by this. What we will be offering is a system that can store and retrieve very large quantities of data and will have the ability to manipulate and transform that data as needed. Such a system will have application in every area of geoscience where digital information is used. It will find particular application in such areas as down-hole geophysics, aeromagnetics, satellite imagery, geochemistry and so on.

Many people have been asking about the technical details of the project and, I am delighted to say, I am practically incapable of answering any of them. My technical expertise does not lie in the realms of super-computing and I am not afraid to say so. In any case, the project is at an early stage in its development. The "i"s and "t"s are only being written much less dotted and crossed respectively. So the honest answer to many such questions must be a respectful "pass". But I suppose the technical principles are reasonably defined. A robotic tape handler is pivotal to the project, so any storage medium we use must be compatible with such devices.

The storage formats will need to be such that they are either directly useable by the project's customers, or that they can be readily converted into useable form. The idea of the storage and retrieval system is that, as far as possible, it should be transparent to the user, and that the user gets what the user wants and in the form the user wants. That is the aim, and I am sure that, in this day and age, it is an achievable aim.

And if the technical details are as yet a little vague, then so too are the commercial details. As I stated previously, the PRINCE project is a joint venture and involves three foundation parties. Discussions on such weighty matters as how costs are shared and how profits are distributed may take a day or three to resolve, but like the technical questions, there are solutions and they will be found. It should also be noted that, in the longer term, we will seek to add to the range of value-added services by introducing new specialist participants.

Conclusion:

The PRINCE project is an exciting one. It holds promise of not only storing data, but of using it, and using it for the benefit of Queensland and, indeed, Australia. There will no doubt be many problems to overcome along the way, but those involved are sure that these problems will be solvable and that the project can become a real resource in its own right. As a measure of the confidence of the team in the long-term viability of the project and its possible extensions, just look at the term PRINCE itself. It started life meaning Petroleum Resource INformation CEntre, but as the extended possibilities emerged it became "Pacific Resource INformation CEntre". And maybe I'm being a bit too enthusiastic, but I note with some pleasure that the acronym would remain intact if the thing really takes off.

After all P stands for "Planetary" too!

DATA RECOVERY FROM DETERIORATED OR DAMAGED 1/2" TAPES

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Abstract - Much of the exploration data acquired during the '70s and '80s are stored on deteriorating or damaged 1/2" tapes. To preserve these data, they must be transcribed to a more stable, indexed medium using techniques designed to optimise recovery.

The level of effort required to maximise the recovery of data is high and can be expensive. In situations where re-acquisition is straightforward and utilises improved techniques, the cost of data recovery may not be justified. In cases where re-acquisition is difficult or impossible, reprocessing of data recovered from deteriorated tapes may be the only option available.

INTRODUCTION

As a specialist tape transcription and data recovery company, Encom Technology handles tapes of all ages, all brands and all conditions.

A significant percentage of the tapes provided by our clients have been affected by stiction and, in many cases, previous attempts to read and/or clean the tapes had caused considerable damage to them.

Despite this damage, high levels of recovery can be achieved by using techniques designed to take advantage of the characteristics of the data.

FACTORS INFLUENCING DATA DEGRADATION

The problem of degradation of exploration data stored on 1/2" tape reels is well known. Most explorationists are aware of the fact that 1/2" tape data can suffer deterioration, but few realise the amount of destruction that has already occurred or what the causes are.

In our experience, the factors which affect data integrity on 1/2" reels are the following (in decreasing order of importance):

1. The brand of tape
2. The canisters in which the tapes have been stored
3. Storage conditions (humidity, temperature, dust etc.)

These factors all contribute to the degree with which tapes are affected by the problems of stiction and binder degradation.

It might be expected that age would be a significant contributor to tape deterioration. In our experience, however, this is not so and the age of tapes bears little correlation to the ease with which data can be recovered from them.

We have recently processed 3,200 tapes recorded during 1978 with 100% recovery. And

yet we have also recently processed a 200 tape survey within 4 weeks of it having been recorded and already the tapes in this survey are suffering from stiction to the extent that errors were encountered in reading several of them.

However, tapes recorded from 1981 to 1984 tend to be more badly affected by stiction and to exhibit consequent damage to a greater degree than tapes recorded either before 1981 or post 1984.

The real problem of deteriorating data can be summed up in the sentence:

People damage tapes - nature doesn't.

Whilst stiction and binder degradation set up the conditions for tape damage, it is only when attempts are made to read, clean or exercise tapes that loss of data actually occurs.

By careful and attentive processing, almost 100% of data can be recovered from stiction affected or binder degraded tapes. However, once the oxide/binder layer has been removed from the tape, no amount of effort can recover data from the damaged portion.

Figures 1,2 and 3 show examples of pre-existing damage on tapes which have recently been sent to us for data recovery. We can only speculate as to what caused these types of damage.

Figure 1 is an example from an offshore WA survey recorded in 1982 and shows parallel striations which occur in a nearly continuous fashion for many metres along the tape.

The second and third examples are from an NT survey recorded in 1981.

Figure 2 is a typical example of binder failure, where oxide may be completely removed in strips 30 cm or more in length. In some instances the removed oxide may be found adhering to the back of the preceding revolution of tape, indicating that the weakened binder failed when the tape was being run (probably at high speed) on a drive or cleaning device.

Figure 3 shows damage that probably occurred when reading or cleaning a highly stiction affected tape, with the cleaning blade(s) contributing to the repeated sharp breaks in oxide removal.

FACTORS INFLUENCING DATA RECOVERY

The principal influence on data recovery is a commercial one and can be summed up with three statements:

The more a company is willing to spend to protect its data, the greater the recovery that can be achieved.

The greater the value a company places on its data, the more money it is willing to spend to protect it.

The more responsibility both the contractor and the client assume for the

data, the greater the recovery that will be achieved.

Almost 100% of data on tapes suffering from stiction or binder deterioration can be recovered. This recovery requires perseverance, skill and time, and therefore the experience of the company recovering the data and its commitment to obtaining the best recovery possible is of paramount importance.

Even in cases where significant damage has occurred, the majority of data can be recovered.

To achieve high levels of data recovery from deteriorated or damaged tapes, a large amount of time and effort must be expended. Since time spent equates to money spent, the cost of recovery must be balanced against the value of the data, the amount the client is willing to spend, the cost the contractor is willing to absorb and the responsibility to data recovery shown by both the client and the contractor.

Where a large amount of damage has already occurred and a long period of time has passed since the original acquisition of the data, it may be that newly acquired data, using the latest acquisition techniques, may have rendered the older data obsolete. In such cases, the cost of recovery may be simply too high.

In other situations, re-acquisition, if at all possible, may be very expensive or difficult, and data recovery is therefore a viable option.

In bidding for a recovery job, it is in a contractor's commercial interest to minimise the cost and time of performing the job. It is also in the client's commercial interest to minimise this cost and to select the lowest tendered price, even though ultimate data recovery may be less than that which could be achieved by opting for a higher tendered price.

When one looks at the damage in Figures 1, 2 and 3, it is difficult to believe that the company causing the damage was unaware that it was occurring. The conclusion therefore would be that cost minimisation on the part of either the contractor or the client (or both) at the time the damage was created, influenced the way in which the job was performed.

INFLUENCES OF DATA ON ULTIMATE RECOVERY

Data vary in their ability to be recovered when damage has occurred.

The ease with which data can be recovered is largely dependent on the ease with which resynchronization can occur within a file or dataset.

If data contains sentinels or signatures which can be detected, then resynchronization is relatively straightforward.

If, on the other hand, there are no identifying characteristics in the data which allow it to be resynchronized, then recovery of useful data is made much more difficult.
Text files are, in general, easier to resynchronise than binary files.

Fortunately, seismic field data are normally recorded in one of the SEG formats (SEGA, SEGB, SEGC or SEGD). The designers of these formats, in their wisdom, provided a large number of sentinels within the data which allow a program reading the data to determine whether a synchronisation problem has occurred and, in many cases, to resynchronise the data automatically.

Since much deteriorated seismic data is recorded at 1600 bpi in one of these field formats, the storage of each seismic shotpoint may take up to 150 feet of tape, as individual block lengths may exceed 3 megabytes. Thus, even when tapes are damaged, data loss may be relatively small if the techniques available for recovering the data allow for resynchronization.

The comparative ease with which data can be recovered from damaged tapes recorded in a variety of common exploration formats is as follows:

Straightforward	UKOOA, SEG-Y
Somewhat difficult	SEGA, SEGB, SEGC, SEGD
Difficult	LIS

A SEISMIC DATA RECOVERY EXAMPLE

As an example of the ultimate recovery which can be achieved from deteriorating tapes, we will consider two tapes from a group of nearly 300 tapes recently sent to one of our processing centres for data recovery.

The tapes were recorded in permit WA-192-P in 1982. All tapes were severely stiction affected and, in many cases, the oxide/binder layer of large sections of tape had been completely peeled away by previous read attempts.

In many cases, with these tapes, read attempts resulted in the tape getting stuck after several files. This is a common symptom of tapes that are affected by stiction. In all cases the tapes were treated to harden the binder and, in the 80% of cases where tapes stuck, multiple reads were performed to extract groups of shotpoints.

Figure 4 shows the results obtained from two consecutive tapes from line 193A after the first read attempt on each tape.

The first several files (shotpoints) were read without error but as stiction effects increased, reading of the files became more erratic until finally the tapes stuck to the head of the drive reading them.

Figure 5 shows the results after two read attempts. After the drive heads and tape path had been cleaned, the second attempts were performed from the place each tape had previously stuck to the head. Successful reading occurred for several files until the tape stuck again.

This process was performed several times until the end of each tape was reached and then several extra passes were made to fill in the gaps where data recovery on the previous passes was erratic.

Figure 6 shows the results achieved by selecting the best shots from each pass, prior to demultiplexing them and then writing to the output cartridge.

This type of reconstruction work is time consuming and costly but the results speak for themselves.

DATA RECOVERY/ARCHIVING AND VALUE ADDED PROCESSING

It is important to distinguish between the data recovery process and value added processing.

It is possible to recover data from deteriorated or damaged tapes and to archive them on higher density media without reformatting the data or performing other types of processing.

In our experience during the last two years, the preservation of data has been the primary concern of the majority of our clients.

A secondary but still important consideration has been the compacting of the data onto smaller, high density media. The massive savings in storage and physical management of archives that can be achieved through compaction of data to high density media is dramatically illustrated by this example.

In cases where the preparation of data for reprocessing is a priority, then reformatting to a more easily accessed format is often a requirement. The most common value added process of this type which is requested is the demultiplexing of seismic field data and its output in SEG-Y format onto high density Exabyte 8mm cartridges.

Even when data are to be format-converted for ease of access, we believe that the archives of the original data should be retained wherever possible. This is especially important when data recovery requires resynchronising of damaged data.

Reformatting is not necessarily a two-way process. During the reformatting of data (especially damaged data), the reformatting software makes decisions which may be irreversible. The degree to which data is retained in the reformatted dataset is dependent on the validity of the processes performed by the reformatting software. Even in cases where 100% clean data is being processed, incorrect assumptions by the reformatting software can cause data to be lost.

By retaining original data, reformatting can always be re-performed using more sophisticated procedures and synchronising techniques, if required. If the original data is not retained, there is no possibility of correcting errors or enhancing recovery at a later stage.

8MM TECHNOLOGY AND HIGH CAPACITY DATA STORAGE

The most commonly used storage medium for high capacity storage of exploration data is the 8mm or Exabyte, helical scan cartridge. Exabyte cartridges can store either 2.5 gigabytes or 5.0 gigabytes of data depending on the mode of recording.

The 5.0 gigabyte (or 8500) mode of recording is far superior to the lower density (8200) mode. Exabyte 8500 drives can transfer data at up to 28 megabytes/minute and the maximum time to access any point on a 5 gigabyte tape is 90 seconds.

With the release of the Mammoth Exabyte drive in early 1995, storage capacity will be increased to 20 gigabytes and transfer speed will be increased to more than 180 megabytes per minute.

Exabyte cartridges provide a good compromise between archival quality, cost, convenience and speed of access.

In our experience, the cartridges are highly reliable. We have been using Exabyte technology since its inception 7 years ago and during that time have read and written thousands of cartridges.

We have heard complaints about incompatibilities between Exabyte drives, lack of performance and unreliability, but in all cases where we have investigated these problems, we have tracked them down to one or more of the following:

1. Use of inferior media (e.g. 8mm video tapes)
2. Lack of proper cleaning of drives
3. Drives which are grossly out of alignment
4. Poor handling (leaving cartridges out of cases)
5. Very old revisions of microcode (especially on older 8200 drives)
6. Application software problems.

Where high grade media such as Exatape or Sony data grade tape are used and cleaning and maintenance follows the manufacturer's specifications, compatibility problems should not occur.

Performance is closely related to the degree of understanding that a software developer has of the device and the techniques that should be used to optimise its performance.

As a case in point, when we first converted our software which reads our 8500 format Exabyte archive cartridges to run on a Sun workstation, we found that the time taken to skip files was extremely slow.

From the motion of the Exabyte unit, it was obvious that even though our software had issued a command to skip multiple files on the cartridge, the Exabyte unit appeared to be skipping one file at a time. In doing this, it was ramping up to speed at the start of a file and ramping down at the end. For a cartridge with a large number of files (e.g. a SEG-Y cartridge containing processed seismic lines), what should have taken 30 seconds was taking over 10 minutes.

It turned out that the problem was in the kernel of the Sun operating system and the way the Exabyte unit was defined. By making a one byte patch to the operating system, the problem was resolved.

As far as we know, this patch is not normally applied to exploration workstations and therefore any software which accesses Exabyte cartridges using the standard device driver

will suffer from the same problem that we experienced.

Timing is also important in accessing Exabyte cartridges. If a program does not send or receive data from an Exabyte drive within certain well defined time windows, then the Exabyte drive will go through a repositioning cycle or, if delays are lengthy, it may retract the heads away from the tape.

Software which does not take into account the particular requirements of the Exabyte unit can cause major delays for which the Exabyte is unjustly blamed.

SUMMARY

In presenting this paper I have touched on several of the practical aspects of data recovery from deteriorated 1/2" tapes.

This is a major problem for the Exploration Industry and one which can only be resolved by the intelligent transcription of these data to a more stable and compact medium.

Apart from those cases where major physical damage has completely removed the data, recovery should be high even from tapes which show major effects of stiction or binder deterioration.

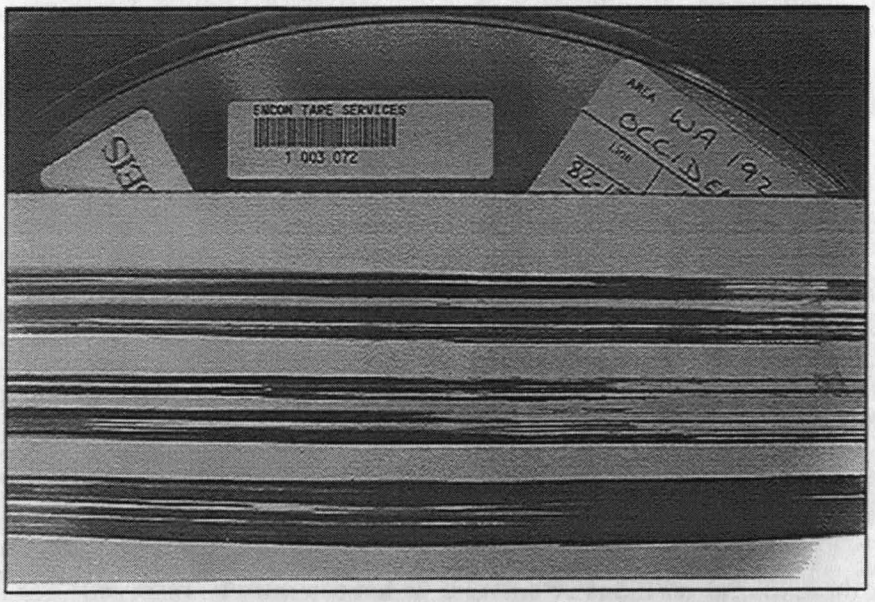
To optimise recovery, time and patience are required and a judgement has to be made as to how much effort and money should be spent in the recovery process.

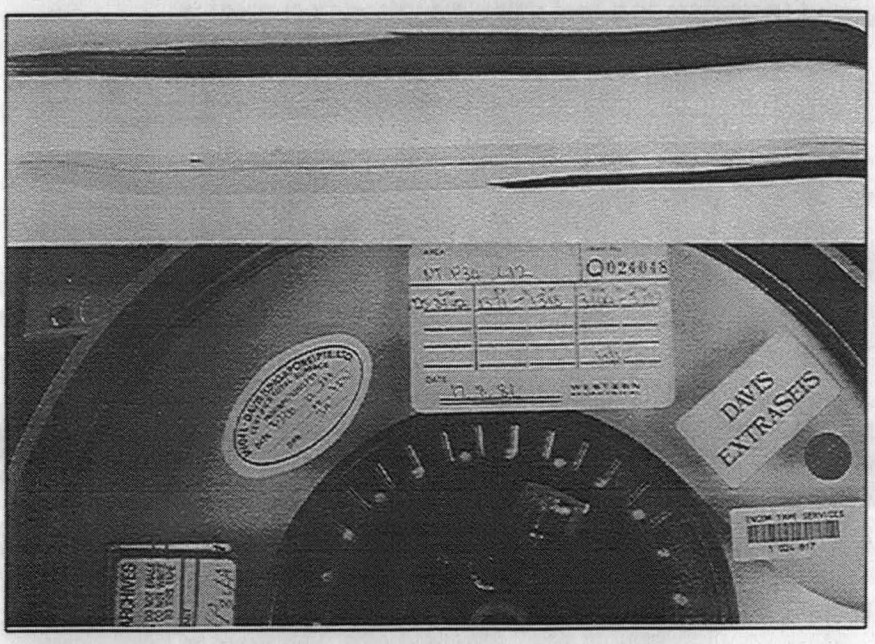
Contractors can use their best endeavours to recover data; however, it is ultimately the responsibility of industry and government to decide how much the data is worth.

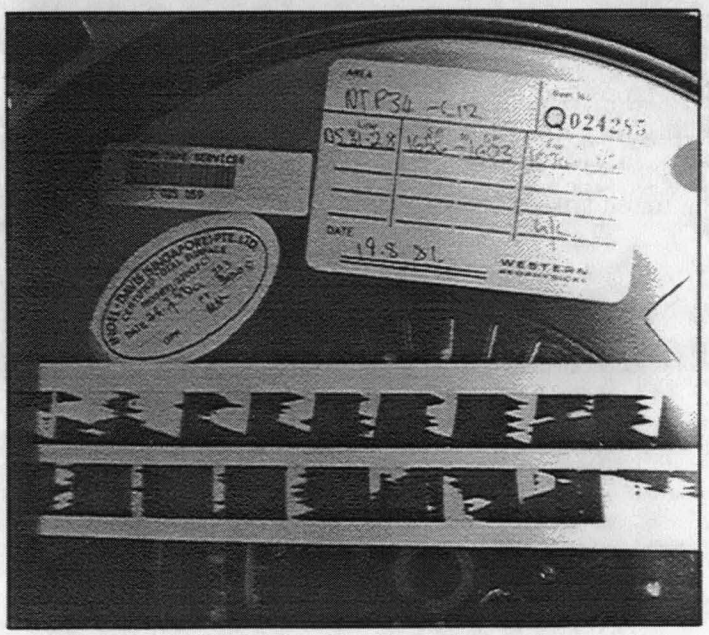
Currently the most common form of high capacity storage onto which 1/2" tape data is transcribed is the 8mm or Exabyte cartridge. This medium provides an excellent compromise between cost, reliability, archival characteristics and availability.

Higher capacity and faster 8mm drives are just around the corner but with advances in data storage technology it is quite possible that another medium will take over as the medium of choice for high capacity archival storage.

Because of the inherent problems with 1/2" tapes and the continuing degradation of tape data, the transfer of data to a more stable, higher capacity medium should be an exploration imperative. Once this transfer has been performed, then the conversion to a newer technology at a later stage will be a much smaller task than the one we are faced with today







Figures 1,2,3 - Examples of tape damage

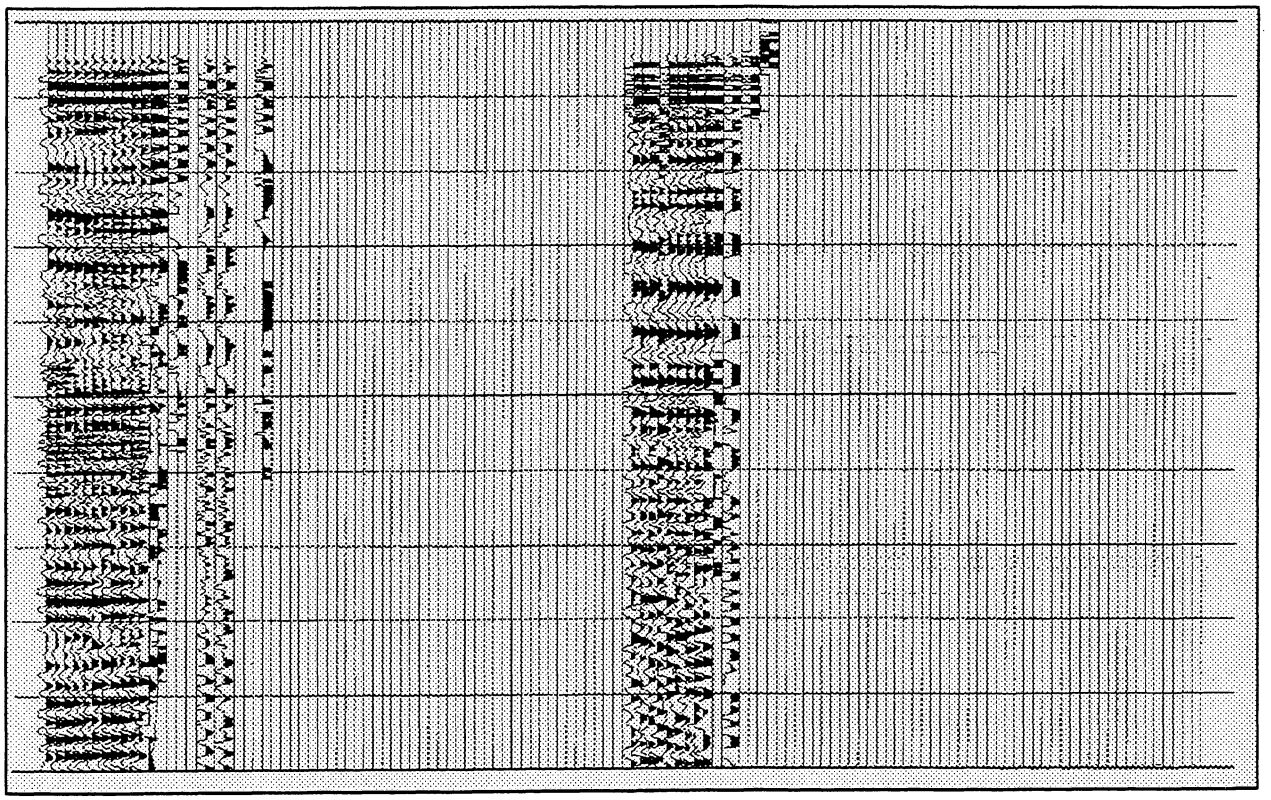


Figure 4 - First attempt at reading two tapes

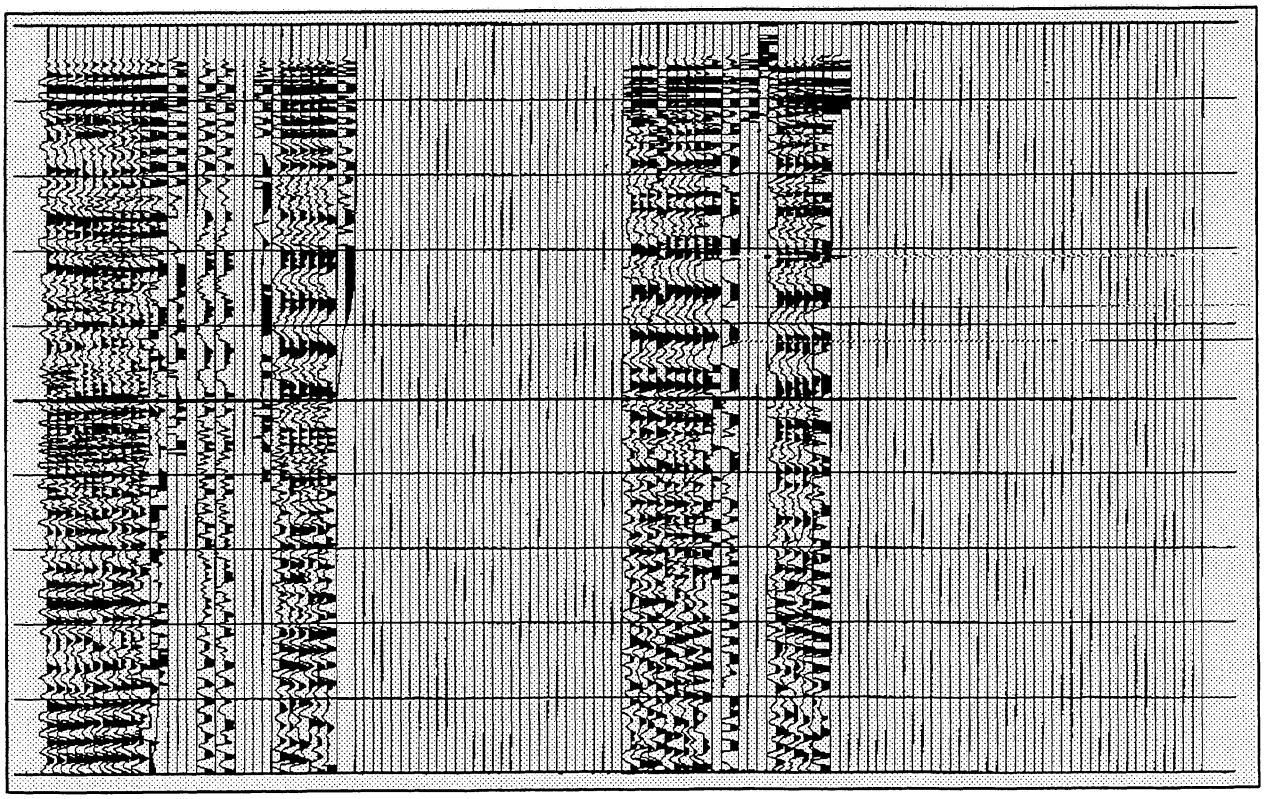


Figure 5 - After two read attempts

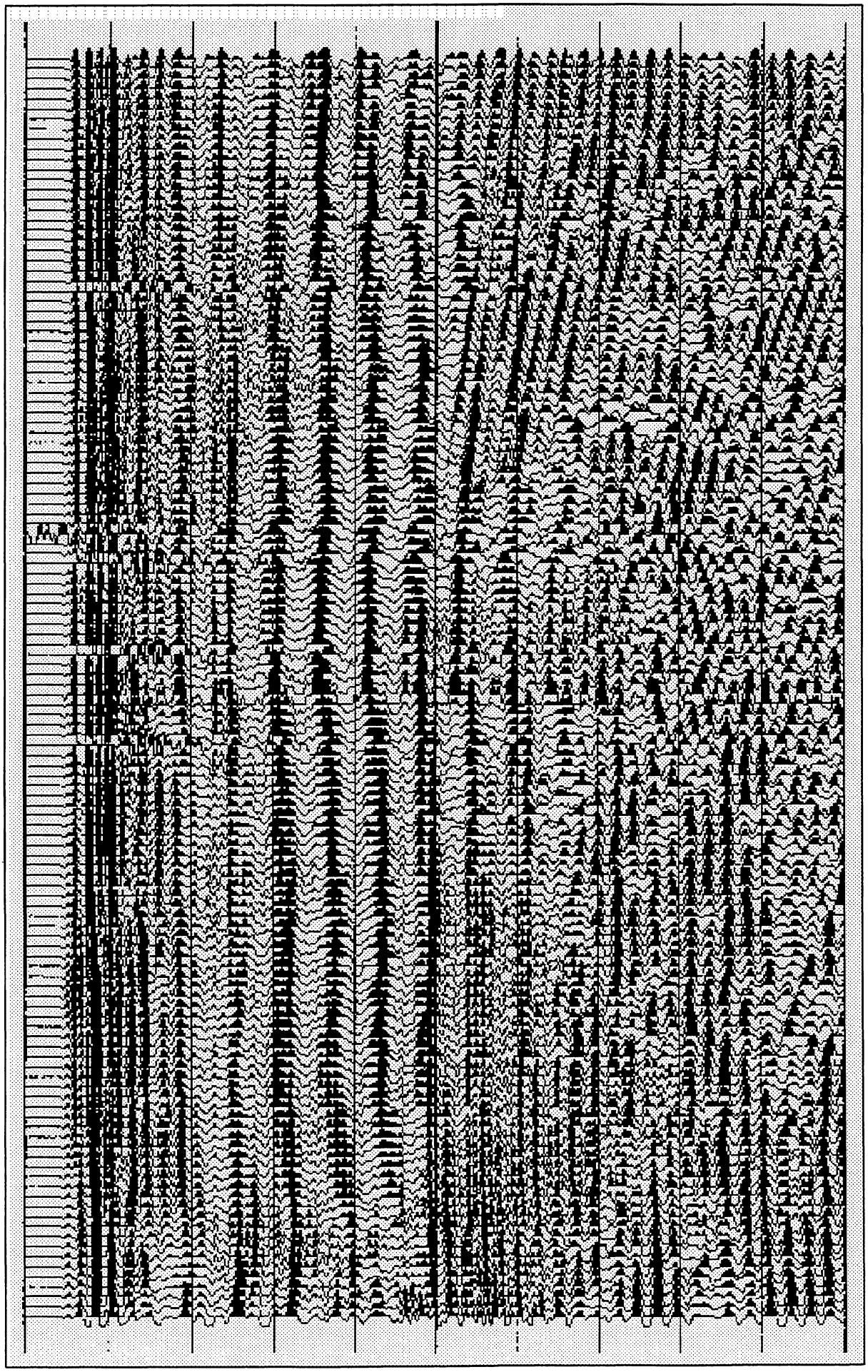


Figure 6 - After 5 read attempts and compositing of best recovered shots

SANTOS' APPROACH TO THE MANAGEMENT AND PRESERVATION OF ITS SEISMIC TAPE/DATA HOLDINGS

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Abstract - Santos Ltd holds approx. 67,000 seismic tapes, the majority containing onshore seismic field data. Approx. 55,000 tapes are held in company operated premises in Adelaide with 12,000 tapes stored by commercial contractors in Brisbane and Sydney. Since early 1993 all newly acquired/reprocessed data have been copied to high density tape (Exabyte) at an early stage of the seismic processing sequence. In addition, Santos has embarked on a preservation project which will entail all remaining pre 1983 tapes being copied to Exabyte during 1994 and all 1983-1992 tapes to Exabyte (or alternative high density medium) during the next 4-5 years.

Introduction

Since early 1993, when Santos Ltd suffered its first and, to date, only loss of seismic field data due to magnetic tape deterioration, it has embarked on a major project to ensure that its seismic-tape/data holdings are readily useable in future years. Due to the relatively large holdings maintained by Santos, it is envisaged that this will be a 4-5 year program which will lead into a more sophisticated approach to tape management.

Existing Seismic Tape Holdings

Santos holds approx. 67,000 seismic tapes of which approx. 8,500 contain offshore data. 55,000 tapes are held in two company operated premises in Adelaide, with 12,000 tapes stored by commercial contractors in Brisbane (9,000 tapes) and Sydney (3,000 tapes). This latter category has arisen as a result of recent operatorship transfers and may not necessarily be retained in this manner in the future.

The tapes stored in Adelaide consist of a master set amounting to 32,000 tapes (29,000 field tapes, 3,000 processed tapes) stored at one location and a partial back-up set, consisting of uncorrelated single sweep data for onshore seismic operated since 1983, in another location. Santos often needs to access this back-up set due to the phase problems sometimes encountered with incorrectly correlated vibroseis data, especially log sweep data that were minimum phase correlated by some crews during the 1980s.

Two sets of observer's logs are generally retained for all lines, a master set retained in-house and a back-up set off-site.

Fig. 1 summarises the number of tapes by year. This demonstrates the rapid increase in activity in 1980 and the sharp drop experienced in 1986. The reduction in tape holdings in 1993 represents the impact of outputting summed/correlated data to Exabyte rather than 9 track tape.

Initiatives to Minimise Future Problems

Santos recognised that not only should it embark on a tape preservation program, it should also initiate procedures with all newly acquired or reprocessed data that would minimise data management problems in the future.

Since early 1993 all newly acquired or reprocessed data have been copied to Exabyte at an early stage of the seismic processing sequence. It is recognised that this may be a temporary solution while the seismic industry "gets its act together" on high density output media, but we believe that this procedure will provide a more manageable system for the future.

In addition, Santos' philosophy of carrying out major reprocessing programs in conjunction with new acquisition, has significantly minimised the overall problem. In the onshore environment we have reprocessed more than we have acquired in recent years.

As the supporting data is equally as important as the tapes, Santos has embarked on a series of major upgrades to its data bases during 1994. The seismic tracking data base is designed to link the upgraded co-ordinates, tapes and processing status data bases with the interpretation workstation environment to achieve maximum visibility of all data types. An upgrade of the upholes data base is also in progress. Additional fields incorporated into these data bases include location of permanent markers, water depths and tape brand.

Preservation Project

As a result of being unable to access all the seismic data on one 1982 line during early 1993, it was recognised that there was an urgent need to ensure that all remaining non-reprocessed data can be readily accessed in the future.

Funds were incorporated into 1994 Joint Venture Budgets to cover the copying of all pre-1983 seismic data. It was anticipated that 1983/84 tapes would be addressed in 1995, 1985/6 tapes in 1996 through to 1991/92 tapes in 1999 such that, by that time all seismic data would have been copied onto Exabyte or alternative high density medium. As previously mentioned, all data acquired from 1993 onwards will have been transferred to high density medium at the time of processing.

Tenders have been invited on the basis of just over 5,000 pre 1983 tapes and this project commences during September. In addition, the decision has recently been taken to bring forward the overall program such that the remaining 1983/84 tapes are also copied during the rest of 1994.

Issues for Discussion

Santos plans to destroy the original tapes once the output tapes have been satisfactorily quality controlled. The quality control procedure will involve reading the copied tapes at a second site and displaying one trace from every record, formatted into a constant offset trace gather, plus a full record display of every fiftieth record.

It should be noted that, at this stage, even the original tapes on those lines that have been reprocessed from copied tapes have not yet been destroyed.

Another issue that Santos has not yet addressed is the appropriate format for storage of observer's logs and recording geometry information. Preference would be given to image files on the seismic magnetic tapes.

The maintenance of all other supporting data is also considered to be of major importance. To this end Santos has embarked on a major upgrade of its co-ordinates and upholes data base. The industry will need to consider the case for uniformity in the storage and preservation of such information.

Conclusion

Santos is in the early stages of a major upgrade to its seismic tape/data management system which includes a significant tape preservation project and an overhaul of its various data bases. Although the costs are not insignificant, we believe the returns in improved data management and eventual cost effectiveness will be well worth the effort.

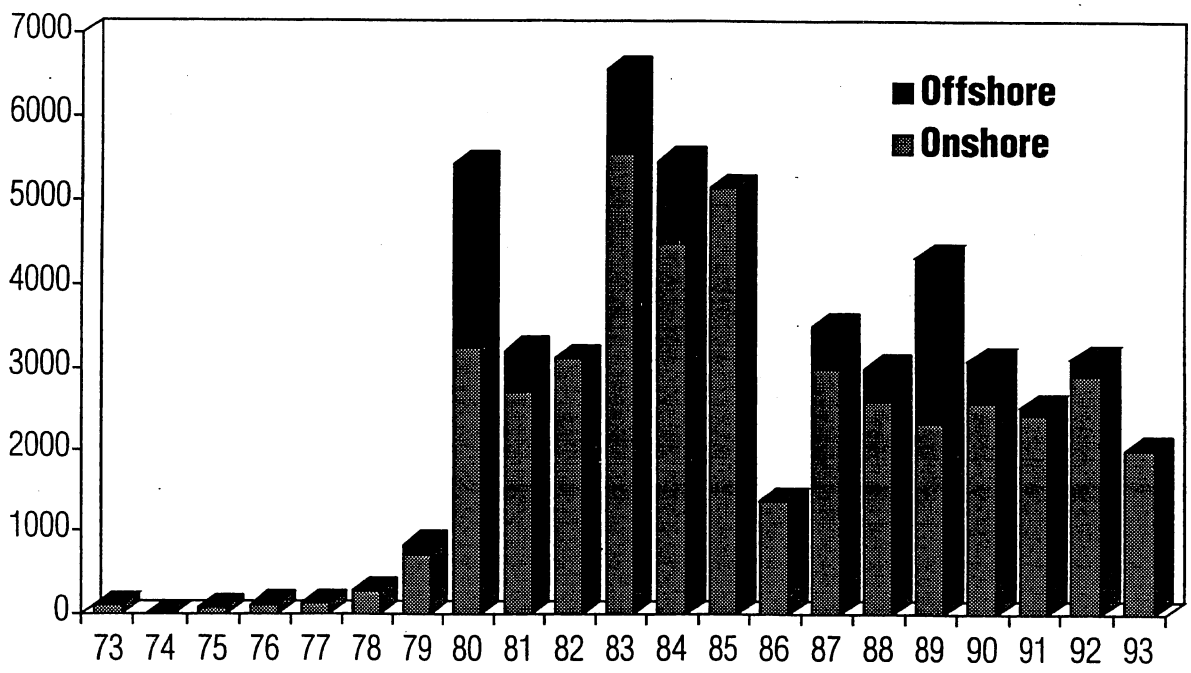

Figure 1 - Summary of Tapes by Year

THE AUSTRALIAN NATIONAL GEOSCIENCE INFORMATION SYSTEM
- @ngis -
ITS ROLE IN FACILITATING ACCESS TO LARGE GEOSCIENTIFIC DATA HOLDINGS

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Abstract - The new @ngis initiative has been designed to link diverse collections of Australian geoscience digital and physical data holdings. A model has been adopted which supports access to both centrally managed data, and data under distributed custodianship in public, private and educational agencies. Networks to be employed include public and private links over AARNet, and broadband-capacity as necessary. AGSO is currently testing the key supporting technologies using the large geophysical, remote sensed imagery and databases of BRS and AGSO. These developments include a World Wide Web server, standards for metadata, a directory and query system, an online mass storage and archival system, and national geoscientific databases linked to spatial systems. The Program includes formal consultation with data providers and users to determine needs, and a consideration of policy to do with security, storage media, charging, and funding the digital capture of data on a prioritised basis.

Keywords - geoscience information, custodianship, networks, metadata, directories, databases, spatial data, data policy

Introduction

The Review of the Australian Geological Survey Organisation initiated in August 1992 was aimed at improving the short and long term performance of Australia's geoscience effort. The Review, chaired by Dr Max Richards, issued its report in May 1993.

As one of its major recommendations, the Review specifically identified the need for a major program for a nationwide network of interconnected physical and electronic geoscientific data holdings. The Review also recommended that cost of access to geoscience data holdings should be set at a level to encourage use of the information. National policy governing charging for data transfer has since been developed by the Australia New Zealand Land Information Council, and jurisdictional bodies such as the Commonwealth Spatial Data Committee (Berman, 1994).

Geoscientific data includes the holdings of geoscience libraries and museums, geological sample collections including core cuttings, palaeontological and palynological specimens, paper logs, charts and maps, fluid samples, company reports, photos and imagery, electronic databases and other paper and computerised records.

While AGSO and many geoscience-related agencies already provide access to selected geoscience data holdings for some clients, the thrust of recommendations from the Review was that access to these diverse holdings should be developed, coordinated and significantly extended on a national basis.

FIGURE 1

Richards Review Recommendations and Government Response

Recommendation 3.4

AGSO develop the 'National Geoscientific Information System' as a major program, with itself as the hub of a system of interconnected physical and electronic geoscientific data holdings in other Commonwealth and State agencies, CSIRO, universities and industry and with the aim, through the use of contemporary technology, of maximising accessibility for all government, business, research and community users. Cost of access should be set at a level to encourage use of information.

"The Government supports the establishment of a 'National Geoscientific Information System' and has set AGSO management a target date of 1 July 1997 for its establishment.

- the Commonwealth will provide an additional $0.5 m per year from 1994-95 to develop the National Geoscience Information System.
- AGSO management has been directed to ensure that the National Geoscience Information System links into other Commonwealth information systems such as, the ERIN and NRIC information systems.
- AGSO management has been directed to ensure that maximum use is made of existing data exchange agreements already established by the Commonwealth.
- once established, cost of access is to be on a full cost recovery basis."

Recommendation 3.5

The Government ensure that the holdings of industry geophysical data submitted under the Petroleum (Submerged Lands) Act (currently stored in the Australian Archives facility at Villawood, Sydney) be properly maintained and be made accessible through the use of modern information systems.

"The Government accepts the need to resolve maintenance issues and improve access to industry geophysical data stored at the Australian Archives.

BRS management has been directed to resolve the data maintenance and access problems at the Australian Archives facility at Villawood, Sydney

- the Commonwealth will provide an additional $1.5 m in 1993-94 for this purpose.
- the Commonwealth considers this BRS data set can make a contribution to the National Geoscience Information System and has asked AGSO and BRS to establish the necessary linkages."

Recommendation 3.6

AGSO adopt a program structure as follows:

- *National Geoscience Mapping Accord with two programs*
  - *Mineral and Petroleum Provinces*
  - *Regolith and Environment*
- *Continental Margins Program*
- *National Geoscientific Information System*
- *National Geoscientific Observatories*

"The Government endorses the strategic priorities indicated by the program structure suggested. However, the Government believes that in accordance with good management practice, decisions on how best to implement the broad priorities should be left to Departmental management."

In its response to the Review (Figure 1), the government endorsed the NGIS Program concept, and set funding for a 3 year developmental program, commencing in 1994/95. AGSO is responsible for managing the new NGIS Program, and will be developing **@ngis** - the Australian National Geoscience Information System - as a primary delivery mechanism.

The government also funded the Bureau of Resource Sciences to put in place procedures for the ongoing maintenance and accessibility of the vast archives of geophysical data collected under the P(SL)Act, and currently stored at Villawood. These datasets are also to be considered as part of the national geoscience data stores that can be located through @ngis.

Strategic Approach

The following strategic actions have been identified as keys to achieving the NGIS Program objectives, in meeting generic client needs. AGSO will:

- Create a computer networked information system, based on a common spatial interface and query service;
- Catalogue information about AGSO's and others' geoscience data holdings;
- Set up corporate-wide data archival and retrieval systems underpinning the information system;
- Facilitate the adoption of national geoscientific data standards;
- Digitally capture physical data holdings such as library information and map sheets, according to client priorities;
- Concentrate on proof-of-concept within AGSO before expanding to meet identified external client needs and priorities.

The @ngis Concept

System Linkages

A national computer-based network is required to provide wide access to a range of geoscience data holdings covering Australia and its territories. Within AGSO, there is a need to support the continuing development of the infrastructure to support external access, as well as internal access by other AGSO Programs, both as data custodians and clients.

The government also directed that AGSO is to develop appropriate links with other Commonwealth information systems, such as the ERIN and NRIC information systems. The Environmental Resources Information Network (ERIN) is already operating in a manner that could serve as a model, albeit in the environmental domain (taxonomic, biogeographical, bibliographic, vegetation, etc data).

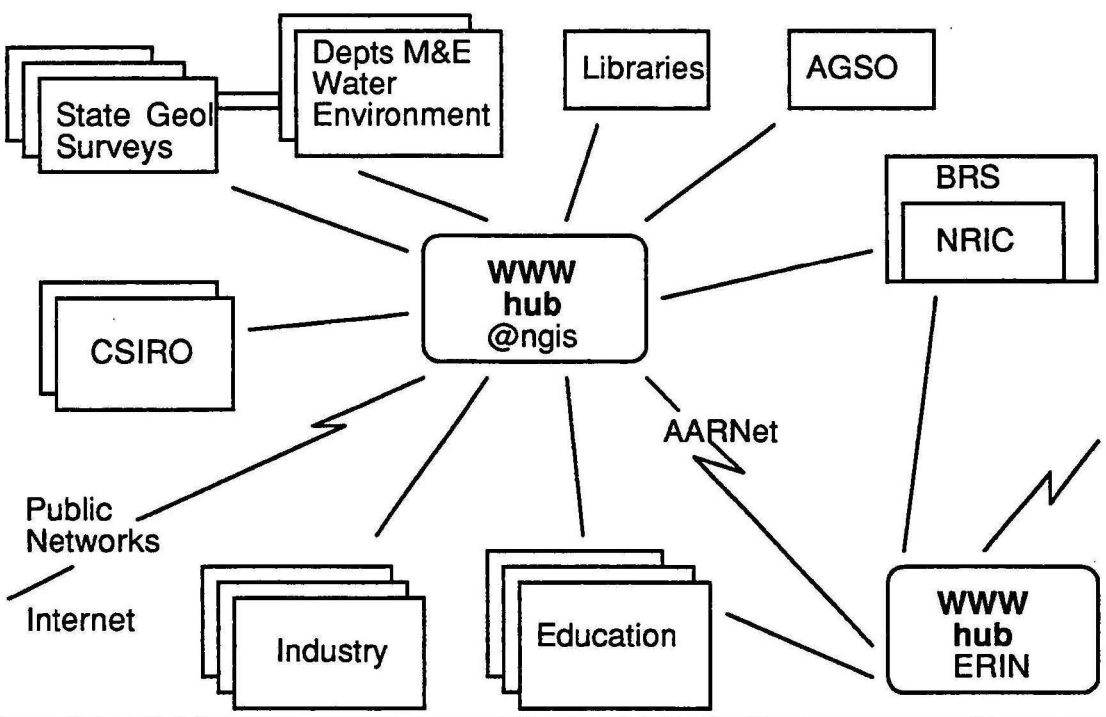
A "web" of domains of such information holdings can be envisaged. In the Commonwealth, other lead agencies and custodians have various responsibilities for information management - eg Bureau of Meteorology, CSIRO (land, soil, water, coastal), AUSLIG (topography, satellite imagery), Defence (bathymetry). Similarly, the webs can extend out into comparable State,

industry, academic and commercial holdings - such as bibliographic (AESIS - the Australian Earth Science Information System), and relevant administrative information (exploration tenements, licences, land use).

NRIC, as the National Resource Information Centre, needs to draw upon information bases that are well developed, managed and made accessible, by agencies such as these. NRIC's National Directory of Australian Resources (NDAR) is a key means of client groups and NRIC locating the information sets needed to undertake integrative studies - increasingly through the Geographic Information Systems approach.
The State and Territory Geological Surveys are also custodians of large holdings of geoscientific information, through various legal responsibilities, or through conducting and funding geoscience research and data collection in their own right.

The Surveys have an administrative focus in their information systems management, wherein access to tenement, reserves and company reporting details is crucial to their business. A number of geoscience databases and information systems are at various stages of development in the States and AGSO. Current and potential users of these systems would benefit from creating linkages between systems and their data. These linkages are represented in Figure 2.

FIGURE 2 **@ngis Information Hub and Web Concepts**



Other users and custodians of geoscience information are found in the wider research and education sectors, including CSIRO, Cooperative Research Centres, libraries, museums, tertiary and secondary education bodies, and industry.

Clients and Consultative Processes

A collaborative approach to the planning and development of @ngis has been adopted, which will be based on an survey of potential clients and their needs, commencing next month.

Involvement of these groups, who may function as both data providers and clients, can be achieved in various ways. At this stage it is expected that users who wish to access geoscience data holdings on Australia will be looking for satisfaction in four key areas:

- identifying the existence of relevant holdings,
- accessing identified holdings,
- extracting data for subsequent use,
- analysis tools.

GGDPAC, as a formal communication mechanism of those involved with government geoscience information systems, is already uniquely set up to provide valuable guidance on @ngis, and has endorsed the approach being taken. As well, GGDPAC is deeply involved in the data standards issue, which is of fundamental importance in making information accessible (Berman *et al*, 1994).

System Design

In line with the above strategies, the @ngis design is based on five key interlinked components:

- User spatial access mechanisms (map/hypertext/GIS/RDBMS linkages)
- User query/analysis system via a directory
- National geoscientific metadata catalogue
- National wide area network (Telecoms, AARNet)
- Electronic data repositories & physical collections

Figure 3 shows the functional requirements and relationships between the major components.

National Data Repositories

GGDPAC had been discussing the need for large data repositories in the early 1990s, following concerns from States, Territories and BMR over the adequacy of storage facilities, costs, and the deterioration of information assets. In 1992, GGDPAC supported an application by the then BMR for funding by the Energy R&D Corporation for a project to digitally manage tapes acquired under the Petroleum (Submerged Lands) Act, held at the Australian Archives, at Villawood.

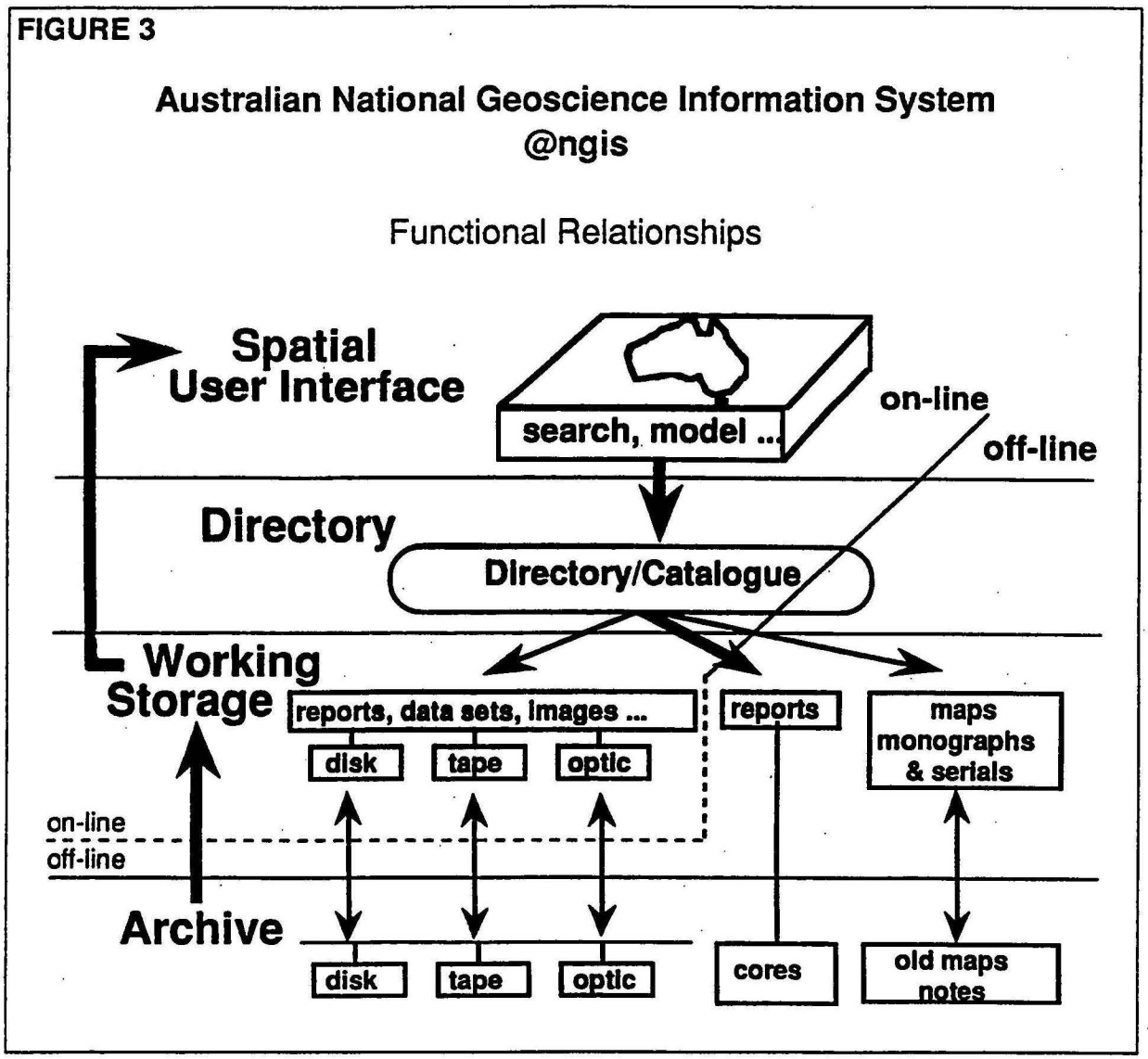
Draft Commonwealth guidelines on data custodianship had been circulated, and a strategic scoping paper on the need for a national data repository had been prepared by the GGDPAC secretariat early in 1993. However, the government's decision mid year to fund the computer cataloguing and preservation of the geophysical archives of Commonwealth data at Villawood had pre-empted wider circulation of the proposals.

AGSO is now assisting BRS in the Villawood project as part of its wider responsibilities for geoscience data access, as directed by the government in its response to the Richards Review, and in its vision of the NGIS Program. An ISDN link has been installed between Villawood in Sydney and AGSO's computer network. A database has been set up by BRS on the AGSO Oracle server, to assist in cataloguing the half a million tapes at Villawood. AGSO has contributed its Oracle database administration environment and procedures, which currently support the national geoscience databases. This environment operates under formal change

control and user security procedures (Kucka, 1992) on a Data General AViiON Unix server, with redundant (RAID level 5) disk storage, and is currently being upgraded to the latest version 7 of Oracle.

A panel of contractors is converting the data to exabyte tape. Industry has cooperated in suggesting priorities for capturing survey lines, and in supplying originals of tapes showing problems. A separate report on this project has been presented at this workshop.

FIGURE 3



AGSO's Tape Holdings

AGSO also has large tape holdings, which are a mix of 9-track, exabyte and IBM 3480 formats (Table 1). They include some 30,000 field seismic tapes holding SEG Y formatted data which are stored at the Australian Archives facility at Mitchell in the ACT. Stored at AGSO, there are another 7000 marine seismic survey tapes (SEG Y), 2000 land seismic survey tapes (in SEG B/D formats), as well as some 5000 tapes with airborne magnetic data in the AGSO/BMR format. In addition, AGSO has about 2000 tapes containing geophysical data collected by the Australian Seismological Centre, and plans to convert these to exabyte. In the late 1980s, the BMR acquired a complete LANDSAT MSS dataset to support its fieldwork planning, and remote sensed imaging capabilities. These holdings have also been converted to

exabyte over the past 3 years, despite a large problem with tape quality (stiction). Further information on AGSO holdings, measured in gigabytes, is given in Table 2 in the context of the mass storage system.

TABLE 1 **Major AGSO Tape Holdings**

	Location	Numbers	Media
Field Seismic SEG Y	Australian Archives	30,000	9 track
Marine seismic SEG Y	AGSO	7,000	9 track/ 3480
Land seismic SEG B/D	AGSO	2,000	9 track
Airborne geophysics	AGSO	5,000	9 track
Seismological	AGSO (ASC)	2,000	9 track
LANDSAT	AGSO	150	exabyte

The prospects for having to manage increasing volumes of geophysical data are high, as the States and the Commonwealth have announced programs to substantially increase funds for conducting new airborne geophysics surveys, and seismic surveys onshore, and on the continental margins. As well, new generations of high bandwidth satellite imagery and remotely sensed geophysical signatures coming onstream this decade will increase data management problems by an order of magnitude or two.

National Network

As the objective of the NGIS Program is to facilitate access to geoscience information and products, @ngis should be seen as a great opportunity for the entire Australian geoscience community. AGSO envisages @ngis as an electronic gateway to digital geoscience data held by participating groups. @ngis would be accessible from any point in the national Telecom network, and the "information super highway". AGSO has identified the Internet and its rich software environment supporting World Wide Web nodes as key technologies for the delivery of @ngis. AARNet is rapidly developing as a major national facility for the delivery of systems such as @ngis, and a prototype WWW server is currently under construction.

Under the model now envisaged, there is no need or desire to centralise the linked data collections. Rather, @ngis should provide the means for clients to draw together relevant data from different organisations, or to access indexes and catalogues showing where data or supporting materials are held.

Spatial Access System

The spatial data gateway to @ngis through an electronic map front-end will give access to information, digital objects and knowledge associated with an area or topic. This is currently under development, using Mosaic software from the Internet, and will be explorable in a hypertext manner, laterally, and also by drilling down to underlying data layers supporting concepts or models.

A software system could be based on a directory such as developed by NRIC, to dynamically query and integrate data models in use, for a composite view, over systems. It is expected that industry, in particular, will be very interested in complete information sources which do not stop at artificial boundaries, in much the same way that AESIS currently does for geoscience bibliographic information. Further, under the model envisaged, access would be at the discretion of the particular custodian, and in fact might involve electronic transfer of national and international clients to a locally supported Information System, or specialist modelling package.

Data Capture Program

Although AGSO sees its own information base as being a prime initial candidate for @ngis, there is a clear understanding that funds might also be applied to the digital capture and linking of information (maps, reports, GIS etc) that is generally recognised to be of national importance and held by other agencies. In order to establish such priorities for the NGIS Program, AGSO will be consulting widely with clients to address their concerns and sound out their views on priority data areas.

Mass Storage System

To support its contribution to the @ngis concept, this year AGSO has acquired a 1 terabyte capacity Mass Storage System (MSS). Only a small proportion of AGSO's digital data are currently accessible online. Most holdings are on tapes (exabyte, 9-track, 3480 cartridge) and managed, to varying degrees, in locations ranging from desk drawers, basements, warehouses and computer rooms, to fireproof safes. The results of a 1993 survey of major AGSO datasets are shown in Table 2, in terms of gigabytes held and anticipated by the year 2000.

TABLE 2 Current & Future AGSO Data Holdings (GB)

	Online	Offline	1993	2000?
Imagery, GIS layers	50	238	288	370
Geophysical	20	80	100	230
Cartographic	20	39	59	94
Petroleum	0	5000	5000	5405
Seismology	3	560	563	1005
Other (..., library)	0	0	0	10
Total	93	5917	6010	7114

Petroleum seismic (onshore and marine) and raw data from the Australian Seismological Centre will most likely reside in far offline archives (such as Australian Archives, or at AGSO). Marine programs find the processed data of more use, while the ASC only requires access to fairly recent data. By the year 2000, these holdings are predicted to have grown from 6,010 to 7,114 gigabytes. It has been observed, however, that data manipulation

requires about 10 times more "elbow-room" than the final product. The MSS acquired by AGSO therefore had to serve also as a scratchpad, as well as an archive, under a diverse range of loads and demand conditions. In the first phase of loading the MSS, remote sensing, GIS and airborne geophysical datasets are being targeted.

AGSO's functional requirements for the MSS were dictated by a modest budget, a desire to leverage the existing multiple servers, operating systems, hard disk and Ethernet infrastructure, and to function transparently for users. We were also attracted by support for the proposed IEEE standard for an MSS reference model. The network access protocol NFS was required, as was the ability to support hierarchical storage management over distributed disks, tapes and optical media. It was imperative that archived files should appear in directory listings, as if present on a local disk. Users should only notice a performance "hit" when a file is restored from tape archive after no use for more than 3 months. Otherwise, local disk demand caching is automatically in operation. The system is not designed to service high bandwidth I/O demands of supercomputers.

Most important was the capacity of the system for disaster recovery. Over gigabytes of data, bad disk blocks can be anticipated weekly. Our requirements for minimal downtime (hours, rather than weeks or months with some systems) in the event of minor or total disasters, also severely limited the available choices. The system selected is able to scan in the barcodes of the last *n* backup tapes placed in a (replacement) tape robot, and replicate information in the background. Continuous file migration ensures that routine file backup occurs within an hour of an update, with no down time.

At this time, AGSO is in the process of "burning in" the Metior system, marketed by Dawn Technologies. It consists mainly of C software running on a Unix server, with supplementary three 1160 GB capacity exabyte drives, and two 60 GB capacity optical disks, ie 0.5 TB.

The design of the system is thus capable of managing local datasets, but also in accordance with the @ngis concept, the MSS can also "know" about the remote location of unlimited collections of digital and physical data holdings, in association with relevant metadata maintained by custodians. It therefore will cater for bulk archiving of data on behalf of organisations which no longer wish to manage their holdings, can provide the equivalent of a global file directory listing for all participating custodians, and also enables new physical storage media to be passively substituted as technology evolves, or as media become unstable.

Metadata System

Critical for the success of a MSS is the control of metadata - or information about the data contained therein. AGSO will contract the building of a metadata management system this year, and institute data management policies which dictate how the system will be used. An initial problem is the cataloguing of existing data. To accomplish this, AGSO has adopted draft metadata standards. These have been developed with reference to proposals from the Australasian Spatial Data Exchange Centre, which itself has been heavily involved in developing the Australian Spatial Data Transfer Standard from the USA model, on behalf of ANZLIC.

Phase 1 standards will be used when loading existing datasets (Figure 3). They are a minimal set of fields, and may be added to.

FIGURE 3 Draft AGSO Mandatory Metadata, Phase 1 Datasets

Identification Section
- Data set identity
- Theme keyword
- Representation model
- Data set description
- Intended use
- Data set extent (lat/long, map sheet name/no., 250K representation)

Projection Information
- Projection name
- Horizontal datum or ellipsoid
- Vertical datum
- Projection units
- Standard parallel
- Longitude of central meridian or zone number
- Latitude of projection's origin

Data Custodian information
- Contact type
- Contact organisation
- Contact person & title
- Alternate contact
- Contact mailing address
- Contact telephone
- Contact instructions

Status Information
- Completion dates
- Copyright status
- Custodial liability

Metadata to Phase 2 standard (Figure 4) will be required for all new projects.

FIGURE 4 Draft AGSO Mandatory Metadata, Phase 2 Datasets

To include all the elements of **Phase 1** plus the following:

Table Definitions - Portion of Data Dictionary/Schema
- Table identity
- Table definition
- Table definition source

Table Attributes - Portion of Data Dictionary/Schema
- Attribute identity
- Attribute definition
- Attribute definition source
- Attribute table identity
- Attribute domain value definition
- Attribute format type
- Attribute format length

Source Information
- Source name(s)
- Secondary bibliographic reference
- Source scale
- Creator(s) of source
- Date(s) of source materials

Processing Steps
- Procedure
- Procedure tolerances

Data Quality
- Positional accuracy
- Positional accuracy method
- Attribute accuracy
- Attribute accuracy method
- Data model integrity
- Completeness

Metadata Reference Section
- Metadata revision date
- Metadata contact

Fig.4 (cont)

Conclusion

The NGIS Program has been set up to address an imbalance in the development of national geoscience programs. There has been a tendency to focus resources on data acquisition, data processing, and compartmentalised product development. Data integration, data management and overall access to data has been a difficult organisational and technical problem.

Since the Richards Review, AGSO has recognised that it is in the geoscientific information business. AGSO has acknowledged that it has an obligation to help conserve and mine existing data and information resources, for new knowledge.

The @ngis initiative is a natural evolution of AGSO's ongoing development of national geoscience databases. The challenge is great, considering the vast stores of nationally inaccessible geoscience data in existence. Careful identification and consultation with clients will enable priorities to be set which will deliver the access, and data capture, that the resource levels permit.

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Session 4: Plenary - Conclusions
CHAIR: David Berman (GGDPAC)

Reports by syndicate rapporteurs

GROUP 1 - PHYSICAL STANDARDS FOR STORAGE MEDIA
Report by Ed Pinceratto (BHP)

Diversity of storage media - a competitive advantage

It was considered that diversity was more a hindrance than an advantage. It was also concluded that there are several ways to choose storage media. With acquisition, we must take what is available. For land acquisition, nine-track tape is still the standard media; for marine acquisition, IBM 3480 is now standard. For storage of processed data, exabyte has been the standard.

The conclusion on this issue is that there are some very rapid changes happening at the moment. A report on an exercise by four companies, carried out between December 93 and February 94, reviewed IBM 3482 and D2 technology, and compared quality, durability, economy of space.

The syndicate's conclusion was that at the moment there are such rapid changes happening that it is not possible to make a recommendation on choice of storage media for, say 6-12 months.

Media stability and older legacy tapes

It is agreed that exabyte seems to be a good archive solution for tape users; however, for the long term archive, maybe more durable tapes should be considered, perhaps optical?

Media handling

The main perceived problem with media handling is access and how data is being handed over to government for storage. We see a need to review the standards of supporting data and how basic data is labelled; currently data may be labelled inadequately or incorrectly, making later access difficult.

Media types

As above. Helical scan was discussed, but the syndicate's conclusion was that as changes are happening fast, it is not possible to make a recommendation.

Archival or operational storage... media selection

Again, Exabyte seems to be the main medium for data exchange, but for permanent archives a more durable medium is required. There was discussion regarding density, and it was agreed that preferably only one density should be used for exabyte.

Development of media types

CD-ROM and Optical were discussed. Consensus was that CD-ROM is not practical and Optical is too expensive. Thus cartridge IBM, Exabyte or the new D2 are alternatives.

Integration of seismic data and logs onto one storage medium.

Desirable but not practical. The formats SEG-D and SEG-Y do not cover this. It would be desirable to have good definition of standards by government so that the operating companies can submit log data in digital form.

SUBSEQUENT DISCUSSION

John Hughes (SANTOS) observed that all tapes are still magnetic and asked what shelf life these tapes should have. Ed Pinceratto replied that D2 technology is considered to have a shelf life of 14 years and Exabyte comes with a shelf life guarantee of 30 years. The expected life of IBM 3480 is at least the same as D2. There is an advantage in buying data grade tapes.

There was some questioning of the real value of exercising tapes. Frequent usage might hasten degradation. The question of hub pressure was discussed, and it was noted that this is so small on Exabyte as to be less of a problem.

John Hughes (SANTOS) stated that IBM 3480 has only been around since 1985 and asked if anyone had information regarding deterioration in the tropics. Ian Grierson (Encom Technology) noted some stiction problems had been experienced with specific brand tapes.

Malcolm Fleming (Kestrel) asked if others had had problems with tapes prior to any recordings being made on them. Ed Pinceratto replied that it was an issue and should be covered in the data acquisition contract.

GROUP 2 - DATA ACCESS NEEDS OF USERS
Report by Martin Bawden (NOPEC)

Balance of access versus preservation priorities

It was decided that the priorities should be specified by industry and government, but it was recognised that there was a difference between the priorities onshore and those offshore. Generally companies requesting data are the ones preserving. We have to preserve all data that is needed. It is recognised that the only way of identifying that data is no longer needed, is when it can be proved that it has been superseded.

Accessing original/processed/reprocessed data

It was considered that originals should always be kept, as should original processed data, but there was discussion regarding reprocessed data. It was agreed that reprocessed data could be submitted but under certain conditions, to be agreed between the person submitting the data and the designated authority.

There was discussion as to whether processed data was interpretive or not. Reprocessed data could be accessed under certain conditions when the block is relinquished, ie when government agencies want access, pure research etc.

Data cataloguing requirements - what details?

In addition to normal data specific information (re shotpoint identity, who shot it, etc) it was suggested that information be held as to when it was last loaned, when it was last copied, by whom, to keep track of who has had access. There must be good tracking information so the information can be easily pointed, also so that people accessing the data can make the right decisions. It is important to identify the right information so you can plan. It is important that catalogues are consistent across government agencies and companies so that effective transfer of information can occur.

Graphical search and access needs

The most important thing is the ability to find the information easily. Everyone is looking to @ngis to access electronic data easily.

Improving access methods

A list of completed surveys from the Villawood project will be sent out by Sandy Radke. The primary concern at the moment should be preserving and cataloguing of data. In the future, we are looking to electronic down-loading via @ngis of open file data, or to be able to electronically order the data.

Access to include online analytical capability.

We should provide tools so that people can actually use the data. In summary, the main requirement is for a consistent, accessible catalogue of reliable information of secure data.

SUBSEQUENT DISCUSSION

Ed Pinceratto (BHP Petroleum), on the issue of interpretative data - is there a case for it to be more clearly defined? Paul Williamson (BRS) replied that processed data is considered to be basic data under current legislation, and should be submitted. Reprocessed data is a grey area.

John Hughes (SANTOS) stated that it was not probable that, as it costs a lot of money to acquire data, companies would keep data just to compact them down. Documents can be kept for 100 years for the same cost as copying them. If it is in danger of degrading on tape it should be copied. There was considerable discussion on data copying costs.

Jeffrey Haworth (Dept Minerals & Energy, WA) asked who defines what data is needed. Martin Bawden replied that it will only be removed when it is proved to have been superseded.

Alan Willocks (Dept Energy & Minerals, Vic) stated that it was probably in industry's own interests to define what it thinks it wants to get back from government, because industry is the user of that data in the long run.

Doug Roberts (Sagasco Resources) asked how long it might be before Internet can be called up for a listing of lines and their availability. Sandy Radke (BRS) indicated that it would probably be this year.

Don Reid (Exploration Division, WMC) noted how much it costs to store bulky data. John Hughes (SANTOS) said their figures show the basic cost of 35c a year and, say $30 a tape, would give almost 100 years of storage time compared with copying costs

GROUP 3 - DATA MANAGEMENT ISSUES
Report by Malcolm Fleming (Kestrel)

It was felt that, most importantly, there was an urgent need for more collaboration, between disparate groups with tight resources and because of the compartmentalised way Australia handles its data. There is enthusiasm to address these issues. It was felt that this increased collaboration need not increase costs significantly.

It was suggested that GGDPAC should set up a working group, in collaboration with ANZMEC. It was recognised that Internet was a useful tool for facilitation.

The need to define what is basic and what is non-basic was recognised, so that data which is not required can actually be disposed of. Discussion took place regarding the submission of data in digital form and whether it should be mandatory. The decision was that it was not essential at this time.

There was also recognition of the aim to maximise effective digital capture of data. There was concern for the 'little guys' losing out, but even as a long term objective this option was not agreed to. But there was recognition of the management overhead required to check digital data.

There was a reluctance to state that 100% of information could be submitted in digital format. It was recognised that there were a number of data bases in existence which addressed the same needs at various levels, and that ideally there should be only one. It was suggested that @ngis could provide that overall view. POSC and other issues were discussed briefly.

Subsequent Discussion

Paul Williamson (Bureau of Resource Sciences) reported that the Villawood project sub-committee has agreed to make the management system of Villawood available to other government agencies, which may result in a consistent database, and would help with better collaboration.

In response to a question from John Hughes (SANTOS) regarding the future of the Villawood consultative group, Paul Williamson stated that the next step is to raise funds. Sandy Radke (BRS) proposed that the states and territories should become involved with this consultative group.

Graeme Hart (CONVEX) reported that there is a significant range of databases being developed by various states, and suggested that Internet links might provide cheaper access.

David Berman (AGSO) stated that there were negative comments being made regarding several different databases, however exposure to best practice and competition is good in a marketplace. @ngis might provide a good overview into this marketplace.

The question arose as to whether there was a need to update the required list of interpretive data. The meeting considered there was no requirement.

There was discussion regarding monitor records and whether or not they should be thrown

away, based on existing guidelines, but no conclusions emerged.

There was concern from the floor because as time goes by the distinction between what is basic and what is non-basic becomes hazy. Perhaps improved collaboration between industry and government, and hopefully legislation, would help. Paul Williamson stated that the present legislation was put in place in 1969, but what might be required is legislation which allows you to adapt and continue to operate through rapid changes in technology.

John Hughes (SANTOS) indicated that perhaps there should be a definition of basic data, (ie the field data) that recognised that if the data is lost, all research would have to be done again.

Sandy Radke informed the meeting about an initiative on Internet to consider an International Petroleum News Group. Geoff Wood will send messages by email to interested parties.

CONCLUDING REMARKS

Workshop Overview by David Berman (GGDPAC)

Firstly thank you for all the contributions. Just reflecting over the day, I would like on behalf of everyone here to offer our thanks to Geoff Wood and AGSO for putting together an excellently balanced program, and bringing an excellent group of people together. We didn't expect this good a response to the workshop; I am delighted that this happened. If we are going to take things forward, we really need a mandate of some validity. I think GGDPAC has received excellent input that it can build on as a result of your participation.

The morning sessions gave an excellent background on the legislative basis as to why governments and businesses are worrying about data management, and we have had perspectives on what the States are doing, what their problems are, and typical holdings. I refer you to the papers that have been supplied independently, for perspectives from people who couldn't come to the meeting. We have heard from industry; Woodside and Santos in particular, and some concerns they have and how they see the data storage issue from an operational point of view-having to keep the data for use later on, and compliance with Government requirements.

It was very interesting to bring together players in the growing information systems arena, if you could call it that broadly. We had the Villawood initiative, Prince initiative, and WAPEX described, and the attempt at the national level to put an overarching umbrella on top of all that via @ngis. Obviously it is very early days in all this, and it is encouraging to see that people are positive about developments and not bringing political grudges and preconceptions. Everyone is talking in the national interests here, which is excellent.

There are obviously a number of streams which came out in the discussion. First of all there is definitely a solid technical side to all this; no getting away from that. The trouble is that the game keeps changing so fast. The big issue here to me is one of just plain everyday communication. There are people such as Encom and Kestral who know what the answer is, who have tested storage media and had experience with it. It is a real question of getting that message across to people through professional bodies or through mass media systems such as the Internet, so that reputable information can be passed across, so people can make a decision about whether it is appropriate to use this or that emerging technology.

Some strong co-ordination issues came out. People were happy to see that at least the Federal Government has started to take seriously the issues in some of these data management problems. There has been a focus for too long on the up-front data collection side. You can get away with it for a certain amount of time, but you have to pay the bill at the other end. We are looking solidly at that now. It is going to get worse for a while, but it is good to see that a start has been made. While people haven't been talking actual hard dollars, you should realise here that the amount of money that has been put up from the Federal side is probably an order or magnitude less than is required to make an actual decent dint into the problems of Villawood, etc. The feeling of meetings such as this where people assess what is going on, talk about it back home and convey conclusions back through the political budget process is very important, and it does have a bearing on how things turn out down the track.

I saw the standards issues as coming up quite strongly as well. People want to be told what it is definitely that government needs. Obviously the legislative approach is not a workable

vehicle; the time frame is too long, things change too fast. Other mechanisms for doing this have been suggested. The reason GGDPAC actually called this meeting was because it is charged with coordinating information on what is going on, and to nudge the standards issues along. We needed to know what support there is for these activities. You can go back to Government to say "Look, hold on that big data collection program, we need an enormous investment in standards development or data management practices". They say "with what authority are you saying that?" It is only through meetings such as this that you can gather that authority.

There is also great concern to see that we don't duplicate efforts in our management systems for tape holdings across the countries. Perhaps there is a small note for the Villawood people to take away for their coordination issues, to address States' concerns as well.

A very interesting point came up about new models for lessening the need for everyone to store many copies of the same data. You have legislative requirements, you have a company's own need to hold a copy of data for it's own access, and companies are also often employing service companies to hold a copy of data. One suggestion was that a little bit of sensible coordination, through some industry/government partnerships, could make use of these service companies and lessen the government archive load. There would perhaps be some licensing arrangements, and checking of standards adhered to. Some interesting models need exploring.

Another strong message that came out was that there was good support from each of the groups with the general concept of an information locater of the @ngis variety. @ngis is very young in concept, but some of the thoughts that we have had on the subject, which are really only starting to be aired publicly now, seem to be winning some support. So we will be developing these further and speaking about details with interested groups.

This workshop has tended to focus very much on seismic related data. If someone was walking in here from some other side of the geosciences, they might be a bit overwhelmed by the comments on seismic data related issues. There are other sorts of datasets in the geosciences, and there are other datasets and disciplines outside the geosciences as well. Perhaps because of the size of the seismic industry we are a bit inwards looking on our problems. Steven Ellis would like me to emphasise that in fact some of these problems are not unique to this industry. If you are a Department of Social Security or a Medibank, you are playing with bundles and bundles of data as well and the same issues about storage media and location systems crop up. Its the role of groups like your professional associations, and Government groups such as GGDPAC, to try to look over the fence at what is going on in other spheres, and to pass on that learning and information.

I am always taken back to a clipping that I took out of the Financial Review when I first joined this Organisation some 4 years ago, which is a little lesson from the American situation. Some Government commission had looked into the vast holdings of health data. It came out of the Agent Orange Inquiry when they started to try and track back servicemen records, and records of where people had been, and what people had been exposed to. They found that much of the information they had collected 20+ years ago, they could not read any more, or if they could read it they did not know what it meant; they had lost the metadata. I took it to heart back then and resolved in myself to try to leverage the systems of Government to make sure we weren't laden with those same crosses down the track ourselves. I think we have the ability and willingness to avoid those sorts of problems.

Where do we go from here? We are putting together a formal record of the workshop, I have asked those who have spoken to make sure that copies of overheads, along with their papers, reach the secretariat. We have a scribe busily taking down notes, which will require a little bit of work. We aim to get all that in shape and out in a month. If that is achieved that gives people time to get back on top if it before they lose the thread of what was discussed here. We will try to do it quicker if we can.

Finally, new things are happening all the time. For example, there is a new datum coming out soon and AUSLIG is trying to let people know how it is going to affect things. Do try to keep in contact. We will put you on the mailing list and try to get up an appropriate Internet news group people can have access to. Hopefully you will contribute to it to keep the information flow going, so that meetings such as this may not be a three or four year occurrence. They can be a daily occurrence, in the same way as when I turn on my PC in the morning I find out what is happening in Canada or England, etc through the various newsnets I am on. It is a really good system.

We will leave the workshop there, a very successful workshop. Thank you very much to all the speakers and generally to everyone involved.

MINISTRY OF COMMERCE - NEW ZEALAND
Te Manaru Tauhokohoko

The Resource information Unit is part of the Energy and Resources Division of the Ministry of Commerce. We are responsible for the management, long term storage, archive and dissemination of data relating to New Zealand's mineral and energy resources. The information is collected by the Ministry of Commerce under the Statutes it administers.

General collections are

a) An extensive resource database of exploration and production reports relating to coal, mineral and petroleum. This includes seismic lines and drilling logs.

b) A copying library based on (a) established as a consequence of client demand. All seismic and logs on film.

c) Seismic Tape Library totalling 31,000. Dates from 1967. A project to transcribe the 21 track tapes to 9 track DMX is almost completed (1587 remain). The focus is now on copying the entire collection on to DAT (Digital Audio Tape). This includes a second copy which will be stored off-site as a disaster measure.

d) Observers Logs and Paper data related to (c)

e) Well Log Tape Library. Totals 1033

f) Small collection of tapes generated from coal/mineral exploration which have been enhanced and are backed up on the National Coal Database.

g) Core sample libraries for Petroleum, Coal and Minerals.

Mainly based in Wellington, we also have core library sites in Paeroa (near Auckland), Chistchurch and Dunedin.

We work in a close relationship with the Crown Research Institute of Geological and Nuclear Sciences.

Lynette R. Ellis
Acting Manager

RESOURCE INFORMATION
ENERGY & RESOURCES DIVISION

Geophysical Tape storage

Currently the Geophysics Section of the Geological Survey holds nearly 550 magnetic tapes. All tapes are in 1/2 inch nine track format The density of all tapes is either 1600 b.p.i. or 6250 b.p.i. Any tapes originally recorded at 800 b.p.i. have been rewritten at 1600 b.p.i.

All data have been archived onto Exabyte tapes and duplicate copies have been made by a contractor and are stored in a controlled environment and exercised regularly. During the process of duplicating and archiving the tapes all tapes were verified. A small number of problems occurred which were mostly due to stiction problems After heat treatment of the tapes these problem amounted to less than 1 percent of all tapes.

The majority of the data held are airborne geophysical surveys although there is a small number of borehole logs and a small number of gravity surveys.

The data are both government and company acquired surveys. Since 1989 the regulations of the Mining Act in NSW have required that all airborne data flown over Exploration Licenses be submitted to the Department. Therefore some of the data held by the Department will always be confidential. Although companies have been only required to submit data since 1989 many companies have submitted all of the digital data they hold in NSW and the Department holds a proportion of the data flown before 1989.

The regulations of the Mining Act require that airborne data be submitted in ASEG-GDF format (ASEG-GDF is the standard for exchange of airborne data developed by the Australian Society of Exploration Geophysicists). Most of the data submitted after 1989 are in this format but the data before this are in many and varied formats. Details of the format on the tapes is held in header files on the tapes though there are exceptions to this.

A record is kept of all tapes and details of the data contained on the tapes is included. This record has recently been put into a GIS and linked to the survey boundaries.

Issues to be faced is which is the preferred medium for submission of data since 9 track tape drives are becoming less common and are extremely expensive. The majority of the airborne data is exchanged on Exabyte tapes although some companies use DAT format.

The issue of whether ASEG-GDF is an appropriate standard for the new storage media is another question to be resolved. This is probably best dealt with by the ASEG Standards Committee.

Data held on magnetic tapes by Coal and Petroleum Geology Branch - NSW

SEISMIC TAPES

TYPE	OFFSHORE	ONSHORE PSSA	ONSHORE STATE	TOTAL
Australian Archives				
Digital				
1/2"	753	953	830	2563
1"	181		7	188
IBM 3480 cartridges	232			232
Total	1166	953	837	2983
Analogue				
4" SIE & AMPEX		19083		19083
7" TECHNO		12362		12362
Other	110			110
Total	110	31445		31555
Geophysical Magnetics				
1/2" Digital			365	365

Although these tapes are stored in environmentally controlled conditions, tapes are being found to be in poor condition. The Department has found that it is necessary to transcribe these tapes onto a more stable medium. Discussions have been initiated with BRS as to suitable mediums and formats. It is proposed to start transcribing tapes in the near future.

BOREHOLE GEOPHYSICAL TAPES

The Department has been transcribing digital recordings of borehole geophysics onto CD-ROM for permanent storage. Currently approximately 60 tapes have been transferred to 2 CD-ROMs. This is the Department's current holding.

Subject: **Northern Territory Tape Holdings**

Email msg: Date: Mon, 22 Aug 94 09:58:18 CST
From: mulder@dme.nt.gov.au (Lex Mulder 61-89-895377)
To: gwood@dme.nt.gov.au
Subject: geoscience data storage workshop 29 Aug. 94
Content-Length: 3030
Status: RO
X-Lines: 52

Geoff,

Thank you for your fax of 4 August regarding the workshop. Unfortunately the NT Geological Survey is unable to send someone along as a representative. We would like, of course, to be kept informed on the outcome of the workshop. I have included a brief report on tape matters in the NTGS. I hope you will have informative and successful discussions. Regards, Lex Mulder.

NT Tape Archiving Project

The NTGS has an ongoing program of airborne magnetic and radiometric data acquisition. The airborne geophysical survey activities of the Northern Territory Geological Survey (NTGS) started in 1981, and have now continued uninterrupted since 1984. The number of surveys carried out has this year reached 22, covering a total of 122 mapsheets or parts thereof. The data is considered vital to the regional mapping programs of the NTGS and AGSO, and is providing continuing support for mining and exploration activities in the Northern Territory. Consequently, the safekeeping of these data is of the utmost importance.

The Department also archives copies of all seismic and well-log data acquired on land in the NT. In addition to this there is a small amount of non-seismic company data in archive.

After careful study of current archiving procedures in government and industry, it was decided to transfer all data from 1/2 inch, 9-track tape to EXABYTE. After pre-qualification, the tender was awarded to Guardian Data Seismic.

The project was set up in two parts:
-Transcription of current data in archive, and
-Transcription of further incoming data, data management, and data copying for clients.

The second part of the project has not been activated yet, as very little data is at present being submitted to the Department.

Of the 18 NTGS surveys that require transfer to EXABYTE, 12 have been completed:

Barrow Creek, Huckitta, Huckitta-East, Petermann, Petermann-East, Ayers Rock, Kulgera, Kulgera-West, The Granites, Tanami, Litchfield-North and -South.

This involved the transcription of 195 1/2 inch tapes onto 6 EXABYTE tapes, reflecting the six areas in which the surveys could be grouped sensibly. The data were then organised per mapsheet, as text is read: from west to east and from north to south. The next step was to record first all located, corrected data for each mapsheet, then located, raw data, and finally calibration and test-line data.

Of the seismic data in archive, 2775 tapes from the McArthur Basin have been transcribed onto 23 EXABYTE tapes. This is roughly 1/3rd of the archive. Since all currently transcribed data are from the McArthur Basin, acquired by Pacific Oil & Gas, the data were organised first chronologically. The next level then was according to area, which resulted in lines in alphabetical and numerical order, and each line with the numerical order of shotpoints. The ultimate purpose was to achieve a coherent archiving of data with the least possible disturbance of the original data organisation, using as few a number of EXABYTE tapes as possible.
end of msg

TASMANIA DEVELOPMENT AND RESOURCES

Enquires K G Bird
Phone: (002) 33 8351
Our File KGB62.94:KAC
25 August, 1994

Mr G Wood
Australian Geological Survey Organisation
P O Box 378
Canberra ACT 2601

Following are brief notes outlining the data storage situation within Mineral Resources Tasmania which you may wish to include in any discussion in the workshop.

* Current Data / Tape Holdings
  Magnetic tapes: - about 100 held.
  - mainly aeromagnetic data.
  - small amount of seismic data.
  - experiencing some media deterioration.

  Paper and film data: - large volume of data.
  - many different sizes.
  - some deterioration.
  - access difficult.

* Preservation of Data
  Aeromagnetic data: - awaiting ASEG-GDF2.
  - using Exabyte tape for new storage.
  - examining other storage options.
  Other data: - no plans at present.

* Future Directions
  Easily reproducible media required.
  Document scanning.
  Long term high volume storage required.

If you have any enquires please contact Dr Robert Richardson Ph 002 338324 or myself Ph 002 338351.

It would be appreciated if would send me a copy of the Proceedings of the workshop.

Yours faithfully

K G Bird
MANAGER

DATA MANAGEMENT SECTION

MINES AND ENERGY, SOUTH AUSTRALIA

TAPE TRANSCRIPTION SUMMARY

Mines and Energy, SA (MESA) through its administration of the Petroleum Act (1940) and the Petroleum (Submerged Lands) Act 1982 is responsible for the management, storage and archiving of some 12,000 digital magnetic tapes recorded during onshore seismic operations within South Australia and adjacent inshore waters. Further an indefinite number of seismic tapes are still held by companies operating existing Petroleum Exploration Licences and some 30,000 tapes are held by SANTOS, the current operator for the SA sector of the Cooper: Basin.

The tapes held, not surprisingly have a wide variety of formats, packing densities, length and brand but the major concerns confronting our storage managers involve the sheer volume of data plus the deterioration of the tape media - an industry wide problem.

To address these problems, MESA as well as SANTOS have invited tenderers to bid on the transcription, demultiplexing and recovery of these seismic field data tapes and output onto EXABYTE tape in SEG Y format. The design of these two tenders is very much aligned with the BRS contracts which have recency been let for the recovery of offshore seismic data, held at Australian Archives.

The aims and objective of the MESA program then is to establish a management system that will not only recover deteriorating data but provide digital seismic data in a for that is:-

- more accessible to the exploration industry
- reduced in physical volume
- reformatted to an industry standard
- managed by a data base system allowing, fast and efficient access to desired data
- indexed with an inventory of contained data, problem files etc.

The transcription program will continue on a survey by survey basis with priorities established by geological province. It is envisaged the program will start in late 1994 and continue for 3-4 years depending on budget availability.

GGDPAC

Geoscience Data Storage Workshop

29 August 1994

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