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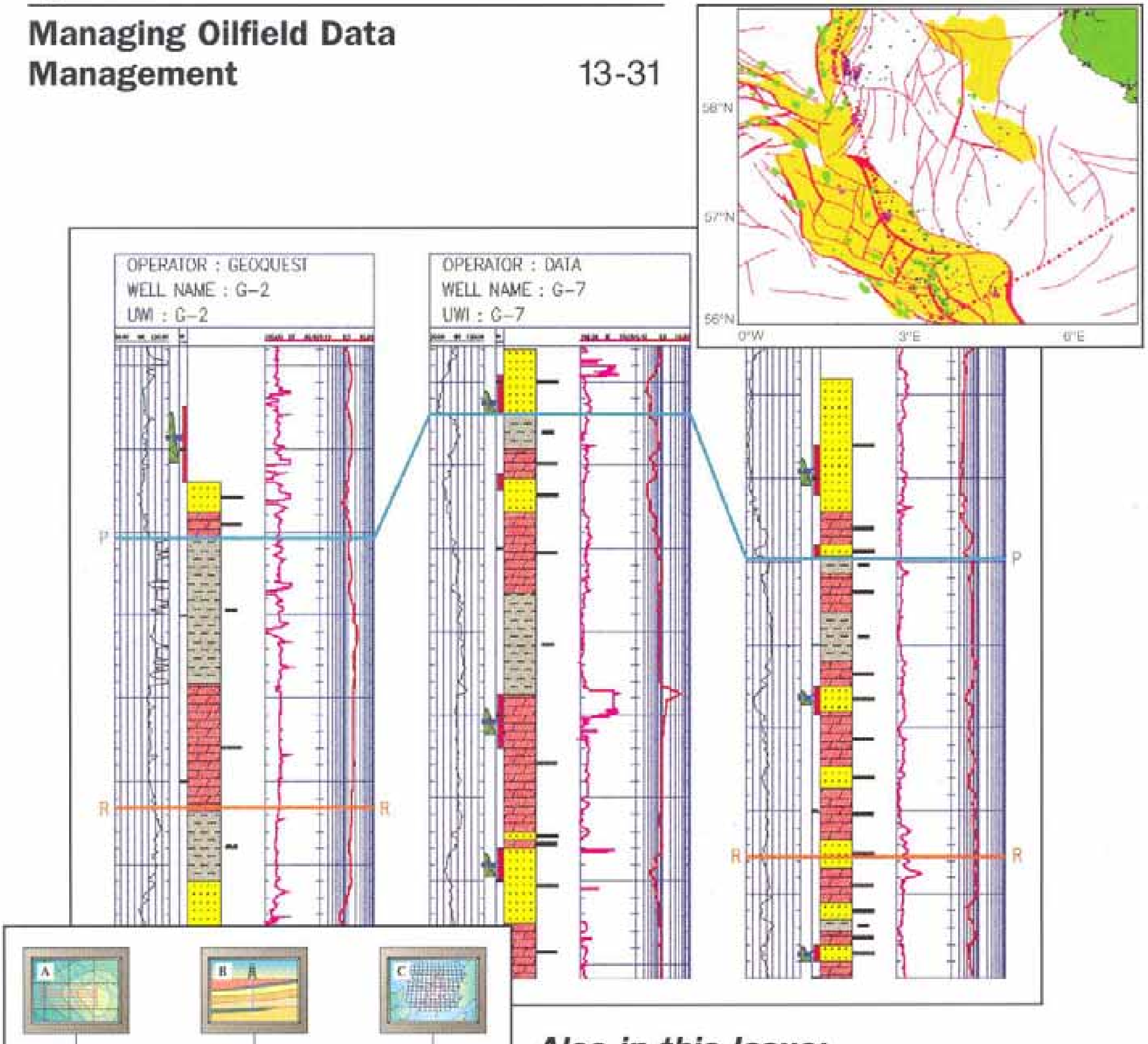
Special Feature:



Also in this Issue:

Contents

Preview Feature

Special Features

Regular Features

Preview Deadlines - 1996

Revised deadlines apply for the rest of this year:

August	**August 19**
October	**September 30**
December	**November 25**

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Editor's Desk

As I write this editorial the April issue of Preview is in the queue for printing and processes are being compressed somewhat as we work towards getting the publishing dates back on schedule. We are aiming to achieve that by the December issue.

Associate Editors have been an important source of supply of material for our magazine. Steve Mudge (RGC), Rob Kirk (BHP), Leonie Jones (University of Wollongong) and Derecke Palmer (University of NSW) have all contributed to the interest and variety of Preview. Two in particular, Steve Mudge and Rob Kirk, who produce the 'Excitations' and 'Seismic Windows' columns respectively deserve our special thanks for continuing contributions over the last few years. A word of thanks also for their employers, RGC and BHP, for the support which has made it possible. But it's time now to call for input from new sources to ensure that the columns continue to inform and interest the membership for years to come. All of the Associate Editors are keen to receive material from a range of contributors so don't hesitate to contact them if you have something to say. I also continue to welcome letters to the editor.

The ranks of Associate Editors have grown with Peter Whiting adding to the petroleum effort from Brisbane. And we are working towards further broadening the editorial base by recruiting volunteer sub-editors from all branches and foreign correspondents from selected international sites. Andre Lebel (Perth), Mark Russell (Sydney) and Terry Harvey (South America) have already volunteered their services which are accepted with much appreciation. There is a wealth of talent out there still to be tapped and we will be seeking to do that, both in Australia and in foreign places near and far. So, if any of you have new and interesting news or exploration experiences to offer, and would like to see you name in print, don't hesitate to volunteer.

Planning for the 12th ASEG Conference and Exhibition at Darling Harbour in Sydney continues, with great efforts to create another milestone in our Society's history. You can read about the latest developments on Page 12. Don't forget the starting date, Monday 24th February '97, and begin planning for another exciting event.

Mike Shalley, Editor

President's Piece

Travelling North

The Federal Executive has joined the great migration and is moving north. I use the present tense because the move is no single event and, at the time of writing, is in a process that is nearer the end than the beginning. New Preview editor, Mike Shalley, began working with Geoff Pettifer in February. Lindsay Thomas is looking after the 1995 tax returns and assisting the new treasurer.

Let me take this opportunity to thank Kathy, Hugh, Geoff, Lindsay and all the members of the Melbourne Committees for their contributions in the last four years. The Society has continued to prosper and grow and the new executive will rely on their support and advice. It should be kept in mind that the new executive does not come to office in the same manner as a new government. We do not come with a political manifesto promising to change the world, only to find that the outgoing committee has papered over the cracks in a desperate effort to stay in power. In fact, we may well find that they understated the effort they put in so as not to scare us off. We do have a mandate however, and that is to ensure that the Society remains viable and relevant.

As volunteers we recognised that it was our turn and I was surprised how little ambushing was required to find the committee members. Most of them have already served on earlier Federal Executives or similar bodies, such as conference committees, and one of our members, Koya Suto, has taken on back to back commitments, having moved from Melbourne to Brisbane at about the same time as the Executive. The Society is very fortunate to have "found" Mike Shalley (who was not doing much else at the time) as editor of Preview. The previous editor, Geoff Pettifer, has raised the standard to an extraordinary level through a lot of creativity and sweat and has left big shoes to fill. Good luck Mike. Brisbane Committee members will be introduced to you through the pages of Preview.

It is the intention of the Brisbane Committee to leave the Secretariat in Melbourne. Janine Cross has been working for the ASEG for some four years and it would be foolish to leave that experience behind. Anyone who has seen the publication storeroom (and I have) would be daunted by the thought of moving it. The separation between the Executive and the Secretariat will involve some extra communication costs, but that should be considered against efficiency losses involved with any move. In the long term a permanent Secretariat should enable a smooth transition of the Federal Executive from city to city. We aim to make it work.

The outgoing committee has made a recommendation to combine Preview and Exploration Geophysics. The future of our Society's publications, their costs and quality is of the highest priority for the new committee. It is our intention to reduce the Preview editor's workload so that he can concentrate on editing and we are reviewing our options. The plan is to effect any changes by the first issue of 1997.

In the last few days I have received a fair volume of correspondence on the issue of registration of geoscentists. Kathy Hill has already written on this matter and I encourage members to put their thoughts to pen and write to the editor. This is not an issue that will simply go away.

Henk van Paridon
ASEG President

Calendar Clips

September 24-27 1996
The 11th Offshore South East Asia Conference & Exhibition.

Sept 30 - Oct 3 1996
6th International Conference on Ground Penetration Radar.

Sept 30 - Oct 3 1996
ANZAAS '96 - Defending Our Planet.

November 10-15 1996
SEG Annual Meeting. (See advert p.38)

November 27-29 1996
Nickel 96, Mineral to Market

December 18-20 1996
33rd Annual Convention & Meeting on Geophysical Instrumentation

February 23-27 1997
12th ASEG Conference & Exhibition.

(Details and more events on Page 46)

Executive Brief

The newly elected ASEG Federal Executive committee met in Brisbane for our first official meeting on 4th June. The elected office bearers have been listed in the last issue of Preview.

Preview

The transfer of Preview from Melbourne to Brisbane has been relatively seamless but for one noteworthy omission. There was no mention of the next ASEG conference in the February issue, resulting from a communications problem for which we apologise. We can assure the Conference Committee of continuing publicity in all Preview issues until the date of the conference.

Publications

The principal matter discussed at the meeting was the future of ASEG publications, particularly Preview and Exploration Geophysics. Suggested changes have been reported to members by Greg Blackburn in the October 1995 issue of Preview. Membership preferences have also been aired in a summary of the survey of members published in our last issue. The previous Federal Executive and the Publications Committee have strongly recommended Preview and Exploration Geophysics be combined in order to reduce the substantial cost of publications.

At this stage the new Federal Executive is concerned that the proposed changes may compromise quality and they also want to confirm cost savings. Submissions were tabled from the current printers, Jenkin Buxton Printers Pty Ltd, and from RESolutions, Resource & Energy Services in Perth, to take greater responsibility for the publications and the advertising to support them. RESolutions publishes PESA NEWS, the national newsletter of the Petroleum Exploration Society of Australia.. Further study of the submissions is needed and they have been passed on to a special committee to be established in Brisbane under Steve Hearn. The committee will thoroughly investigate all possibilities before changing the current quality publications. It was pointed out at the meeting that PESA went down the path of combining their newsletter and technical journal but found that it did not work.

The Conference Volume has been identified as a major factor in the cost of publications and further consideration is being given to possible economies. One option under consideration is a smaller Conference Volume containing page and figure limited papers to be submitted by a strict deadline. Outstanding papers which did not meet the deadline would be considered for publication in an Exploration Geophysics volume closely following the conference.

Whatever changes to the publications are decided will be scheduled for the first issue of 1997 (not far away) so I urge interested members to contact the Federal Executive if they have more to say on the matter.

Financial Report

An approximate summary of the status of the ASEG Federal Accounts is as follows:

Account	Amount at June 1996
Basic Working Account	$13 513
Reserve Account	$61 736
Sands Account	$47 714

Robyn Scott
ASEG Federal Secretary

ASEG People Profiles: The New Federal Executive

In Preview #61 we introduced your new Federal President, Henk van Paridon. In this issue you will meet Honorary Secretary Robyn Scott, Committee Members Noll Moriarty and Koya Suto and Editor Mike Shalley. There will be more in the next issue.

Preview Editor, Mike Shalley

Mike was a primary school teacher in an earlier life but felt the call of the wild and went off to the University of Melbourne to earn a degree in geology (achieved in 1961). That led to employment as an underground geologist with Mount Isa Mines Limited but an interest in geophysics, planted by Colin Kerr-Grant, kept bubbling to the surface. The big oppor-tunity arose when MIM's Chief Geologist, Tim Bennett, asked Mike to prove his interest by acting as an instrument operator for a year. He cut his teeth on induced polarisation in the Mount Isa black shale environment (what fun!!).

The pay-off was a company supported year at the University of Tasmania for an honours degree in geophysics. Mike took a new wife with him to Hobart in 1964 and returned the following year with a new baby and a new degree (same wife of course), setting him on a thirty year path of blood, sweat, tears, and all the fun and frustration that is mineral exploration.

The first big advance in exploration methodology was the AMIRA project which gave birth to SIROTEM and Mike was privileged to be associated with that right from the first meeting. Being involved in the development of Australian science and technology with Ken McCracken and his team at CSIRO was a fascinating and rewarding experience.

There was an interlude of four years in academia from 1977 to 1981, teaching Geophysics and Geology at the then Darling Downs Institute of Advanced Education. But the excitement of the chase proved too much and Mike returned to the MIM fold to the same position he'd left, eventually to become the Chief Geophysicist. He retired from full-time work in 1992 but still maintains an interest in the game.

ASEG Secretary, Robyn Scott

Robyn graduated from the University of Sydney in 1986 with a B.Sc. degree, majoring in Mathematics and Geophysics. In 1987 she was employed by BHP Minerals as a core logger, working in an exploration camp in the Kimberley - a marvellous introduction to the great outdoors. It was there that she met her future husband Damian.

In 1988 Robyn accepted a position as a geophysicist with BHP, based in Perth working mainly in base metals exploration on the Lennard Shelf, W.A., and in the Northern Territory. She presented a paper on some of the work on the Lennard Shelf at the 1994 ASEG conference in Perth. She also gained some international experience with a short stint in Thailand conducting gravity surveys.

Robyn has been an associate member of the ASEG since 1988. She served on the Federal Executive committee in Perth in 1991 as the Second Vice President and, after transfer to Brisbane, was a committee member of the Queensland Branch of ASEG.

Robyn transferred to Brisbane in 1993 to work on a variety of base metals projects in the Mount Isa and Georgetown blocks. In particular she worked on several GEOTEM surveys in those areas.

Last year Robyn and Damian were blessed with a beautiful daughter who keeps them both very busy. Robyn continues work on a part time basis as a Project Geophysicist with BHP Minerals Exploration, Brisbane.

Committee Member, Koya Suto

Koya joined the ASEG Federal Executive in 1992 in Melbourne where he was working for Pacific Oil and Gas (CRA's oil arm which deceased in 1994). As a result of POG's closure Koya was retrenched and out of a permanent job for a considerable time, during which he consulted for Sagasco Resources (now Boral Energy) and others.

But it was not easy to find a job for an aged geophysicist from Japan. He even tried a career outside geophysics, marketing casing pipes and boiler tubes. Early in 1996, he was appointed as Senior Geophysicist of Oil Company of Australia and moved to Brisbane. Coincidentally, the ASEG Federal Executive moved from Melbourne to Brisbane at about the same time, so he is serving as a committee member again!

Koya's contribution to the ASEG is mainly in the promotion of Geophysics. At the last conference in Adelaide he organised a session for high school students and teachers. One hundred and twenty-five people gathered and learnt what geophysics and exploration are. Hopefully some of them will take up geophysics as their tertiary subject, and perhaps become ASEG members in the future. Even if this does not happen, he believes that community understanding is an important factor in the development of the discipline and the industry, so the effort is not wasted.

The ASEG Library is another area of Koya's responsibility. It contains close to 1000 items including journals of fellow geophysical societies all over the world. The journals were collected through journal exchange and members' donations. This library contains several journals which cannot be found anywhere else in Australia.

(A more detailed biography is found in earlier issues of "Preview" (April 1993, p.2 and August 1995, p. 51)).

Committee Member, Noll Moriarty

Noll graduated with B.Sc. (Hons) in 1974 from the University of Adelaide with majors in Geophysics and Geology. This was not a good time to be looking for employment in the geophysical industry and, coupled with Noll's then view that geophysicists were strange people, he opted for secondary school teaching. Locations were the hard-to-take Clare Valley (3 years) and Loxton (4 years) where one could easily indulge fantasies of being a wine connoisseur.

The upturn in the petroleum industry in the early 1980s, and the probability of good times for all, attracted Noll to join Delhi Petroleum in 1981 and to pretend that geophysicists were well balanced professionals. He was involved in seismic acquisition, processing and interpretation projects, participating in a number of oil and gas discoveries. During 1984-88 Noll completed an M.Sc. (Hons) degree from Macquarie University by external study, ostensibly to update geophysical skills, although the proximity of the Hunter Valley was not overlooked.

Noll moved to Brisbane in 1989 after Esso took over Delhi Petroleum and closed the Adelaide office. In 1990 he joined Oil Company of Australia, and at present is Regional Manager for the exploration of OCA's Otway Basin permits and the Bodalla Block in the Eromanga Basin.

Noll has (co-) authored four papers, published in Exploration Geophysics and APPESA Journal. Interests centre on seismic acquisition topics, with the aim of getting better quality data yet reducing the cost.

He was vice-president of the Queensland ASEG for two years during 1993-5 and a committee member of the 1992 ASEG 9th Conference and Exhibition held at the Gold Coast. He is a member of ASEG, SEG, EAEG, AAPG and PESA.

ASEG Branch News

South Australia

May/June 1996

Events:

- Geoff Hudson gave us a timely presentation on the Australian Geo-science Council and its role in the Australian Institute of Geoscientists formulation of a registration scheme for geoscientists. Geoff's familiarity with the topic allowed a small forum to evolve. Some general feedback from the branch is presented below.
- SA Branch is gearing up to present a night of industry highlights. At this regular annual event half a dozen locally operating companies volunteer to present Technical and/or Business activity highlights that are of interest to ASEG members.

Issue Feedback - Registration:

Some members voiced concern over the momentum that registration of exploration geoscientists seems to be gaining in some circles. For those present at our meeting on this topic, the need for registration was put in a better perspective. But is it the same perspective that the registration proponents have? Is there a snowball effect building up that we won't be able to resist. There is a difference between professionals with public responsibilities (e.g. reporting to the ASX) and those within resource companies that are subject to rigorous internal procedures for prospects and reserves reviews and calculations. In general there was a feeling that registration wouldn't and shouldn't concern the majority of active professional members. This would include consultants too - unless those individuals were forced by procurement rules to carry some professional indemnity and needed to avail themselves of group cover purchased through a registering body. A casual show of hands at the end of the night revealed no-one with a desire to register with available schemes.

Western Australia

Technical News

For the last technical meeting , on 15 May 1996, both speakers were from Curtin University of Technology. Aboighassem Kamkar Rouhani talked about "Surface and bore-hole resistivity measurements using a two-electrode system in a layered earth". Then, John McDonald spoke on "Physical model test of reconstruction of spatially under-sampled 3-D wavefields".

The next two technical meetings will be held at the Celtic Club, 48 Ord Street, West Perth, on 17 July and 21 August, starting at 6.30 pm.

People News

Norm Uren, Steve Jeffrey and Sam Bullock received silver certificates at the May technical meeting to commemorate their twenty-five years of membership of the SEG. The WA branches of ASEG and AIG are holding a one day seminar "Geophysics for Geologists and Engineers" on 29 July 1996. Two ASEG members, Bill Amman and Andrew Foley, are the principal convenors of this Seminar.

Andre Lebel
Branch Secretary

Conferences

The Australian Society of Exploration Geophysicists 12th Geophysical Conference and Exhibition

Co-hosted by:

The Society of Exploration Geophysicists
Petroleum Exploration Society of Australia

Latest news from the Conference Secretariat comes from the Technical Program and Students' Day Committees.

The former reports that program statistics are as follows:

- 3 streams,
- 14 sessions
- 5 Keynote Speakers
- 100 Oral presentations
- 7 Poster presentations

The program has been built around three parallel streams mixing petroleum, basin studies, minerals, geotechnical, environmental, coal, software, crustal studies and forensic geophysics (a first for Australia?). The aim of the program is to ensure strong highlights on each of the four days of the conference. Oral presentations will be thirty minutes, comprising a twenty-five minute presentation followed by five minutes for questions. Poster papers will be displayed in the Exhibition Hall and supported by a 10-15 minute oral presentation by the author(s).

The opening ceremony is timed for 9.00-10.00 am on Monday 24th February 1997. It will include the ASEG-SEG Honorary Awards. Scheduling of other presentations is planned to allow delegates plenty of time to visit the exhibition as well as to attend paper sessions.

Meanwhile the Students' Day Committee reports action on the organisation of their day, supported by another donation from World Geoscience ($6000). The program comprises approximately seven presentations such as the old favourites:

- "What is geophysics? - An Introduction"
- "Life as a Geophysicist"
- Tour through the Exhibition (very well received in Adelaide).

New features will include:

- "How and where to study Geophysics" and
- "Life as a Geophysics student".

The practical application will be covered by "How Geophysics is used in exploration - A case study". A special students' satchel with handouts, similar to the one distributed at the last conference, will be supplied. We can look forward to an exciting and well attended conference.

From reports of Technical Program and Students' Day Committees (Ed.)

ASEG RF - Donations

The ASEG Research Foundation gratefully acknowledges a donation of $5000 from Woodside Offshore Petroleum Pty Limited.

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Managing Oilfield Data Management

Reprinted with permission from the July 1994 issue of Oilfield Review

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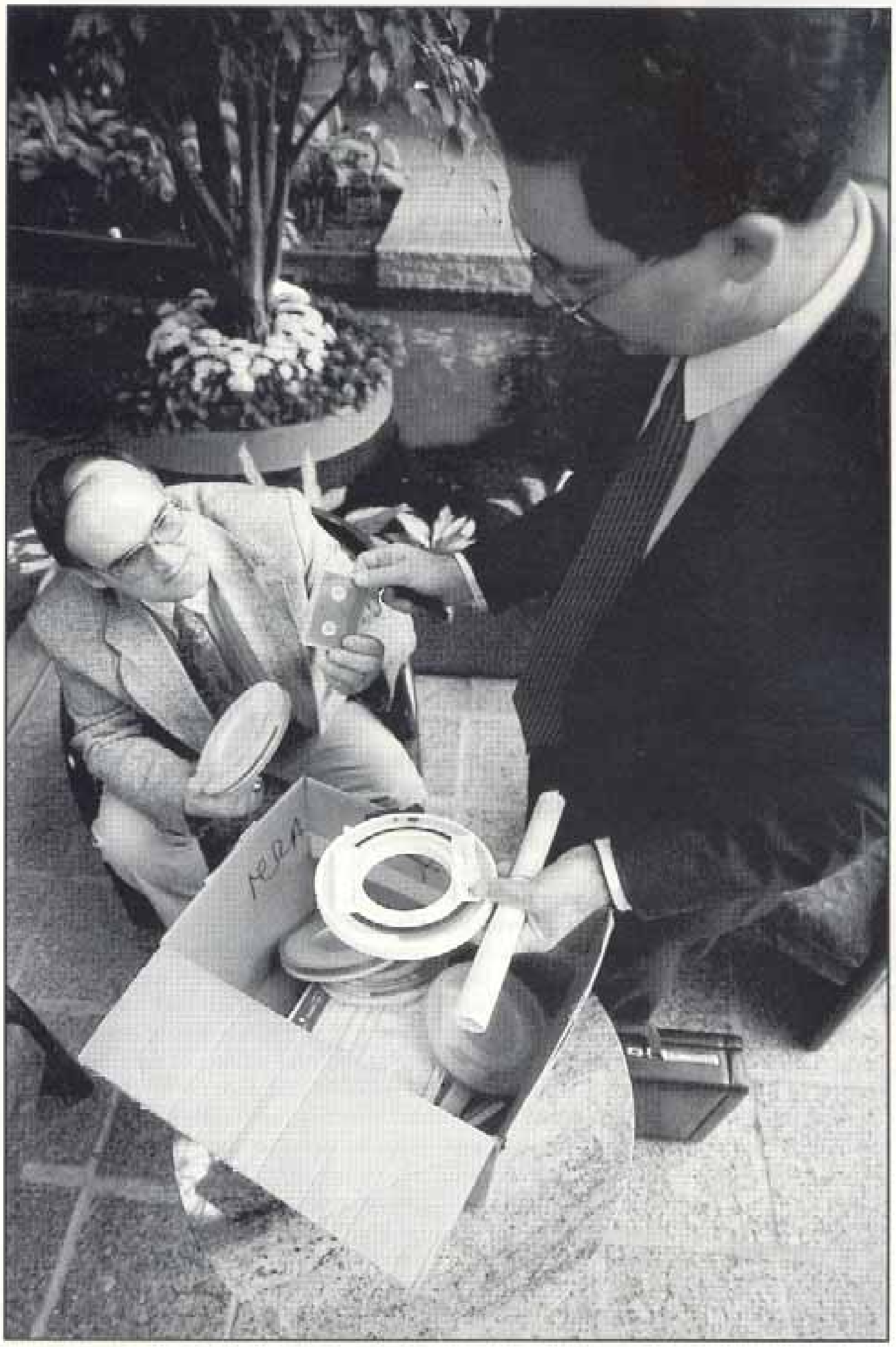
As oil companies push for greater efficiency, many are revising how they manage exploration and production (E&P) data. On the way out is proprietary software that ran the corporate data base on a mainframe, and on the rise is third-party software operating on a networked computing system. Computing standards are making practical the sharing of data by diverse platforms. Here is a look at how these changes affect the geoscientist's work.

Today's exploration and production geoscientist works in a world of untidy data. Maps, logs, seismic sections and well test reports may be scattered on isolated computers. They may exist only as tapes or paper copies filed in a library in Dubai or stuffed in cardboard boxes in Anchorage (*next page*). Often, most of the battle is simply locating pertinent data.[1] Once data are found, the user may need to be multilingual, fluent in UNIX, VMS, DB2, SQL, DLIS and several dialects of SEG-Y.[2] Then, even when data are loaded onto workstations, two interpretation packages may be unable to share information if they understand data differently—one may define depth as true vertical depth, and another as measured depth. The main concern for the geoscientist is not only: *Where and in what form are the data?* but also: *Once I find what I need, how much time must I spend working on the data before I can work with the data?*

Despite this picture of disarray, E&P data are easier to work on now than they were just a few years ago, freeing more time to work with them. Better tools are in place to organize, access and share data. Data organization is improving through more flexible database management software—a kind of librarian that finds and sometimes retrieves relevant data, regardless of their form and location. Access to data is widening through linkage of data bases with networks that unite offices, regions and opposite sides of the globe. And sharing of data by software of different disciplines and vendors, while not effortless, has become practical. It will become easier as the geoscience community inches closer to standards for how data are defined, formatted, stored and viewed.

Data management—the tools and organization for orderly control of data, from acquisition and input through validation, processing, interpretation and storage—is going through changes far-reaching and painful. This article highlights two kinds of changes affecting data management: physical, the tools used for managing data; and conceptual, ideas about how data, data users and tools should be organized.

To understand where E&P data management is going, look at where it has come from. Today as much as 75% of geoscience data are still stored as paper.[3] Yet, the direction of data management is determined by the 25% of data that are computerized.



□*The incredible shrinking data store. Log data from a single well have been transferred from tapes and paper copies in a cardboard box to a 4-mm digital audio tape (DAT), being passed from Karel Grubb, seated, to Mike Wille, both of GeoQuest. This cardboard data store was among 2000 for a project in Alaska, USA. Logs from all 2000 wells were loaded onto 18 DATs for off-site storage provided by the LogSAFE data archive service* (page 40). *One DAT can hold 1.8 gigabytes, equivalent to conventional logs from about 100 wells.*

In this article Charisma, Finder, GeoFrame, IES (Integrated Exploration System), LogDB, LOGNET, LogSAFE and SmartMap are marks of Schlumberger; IBM and AIX are marks of International Business Machines Corp.; Lotus 1-2-3 is a mark of Lotus Development Corp.; Macintosh is a mark of Apple Computer Inc.; VAX and VMS are marks of Digital Equipment Corp.; MOTIF is a mark of the Open Software Foundation, Inc.; PetroWorks, SeisWorks, StratWorks, SyntheSeis, and Z-MAP Plus are marks of Landmark Graphics Corp.; GeoGraphix is a mark of GeoGraphix, Inc.; ORACLE is a mark of Oracle Corporation; POSC is a mark of the Petrotechnical Open Software Corporation; Stratlog is a mark of Sierra Geophysics, Inc.; Sun and Sun/OS are marks of Sun Microsystems, Inc.; UNIX is a mark of AT&T; and X Window System is a mark of the Massachusetts Institute of Technology.

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1. Taylor BW: "Cataloging: The First Step to Data Management," paper SPE 24440, presented at the Seventh SPE Petroleum Computer Conference, Houston, Texas, USA, July 19-22, 1992.

2. UNIX and VMS are operating systems; DB2 is a database management system for IBM mainframes; SQL is a language for querying relational data bases; and DLIS and SEG-Y are data formats.

3. Landgren K: "Data Management Eases Integrated E&P," *Euroil* (June 1993): 31-32.

"Data management" can increasingly be called "computer" or "digital" data management, and its development therefore parallels that of information technology (*right*). In the last 30 years, information technology has passed through four stages of evolution.[4] Viewed through a geoscience lens, they are:

First generation: Back-room computing. Mainframes in specially built rooms ran batch jobs overseen by computer specialists. Response time was a few hours or overnight. Data processing was highly bureaucratic, overseen by computer scientists using data supplied by geoscientists. The highly secure central repository of data, called the corporate data base, resided here. Evolution concentrated on hardware. Data were often organized hierarchically, like branches of a tree that must be ascended and descended each time an item was retrieved.

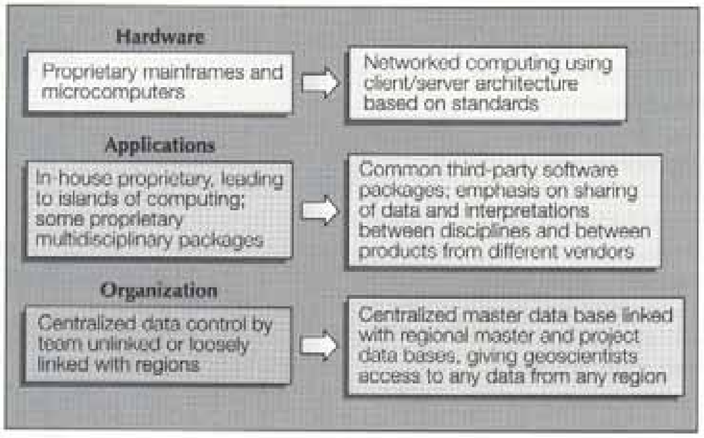
Second generation: Shared interactive computing. Minicomputers were accessed by geoscientists or technicians working at remote keyboards. Response time was in minutes or seconds. Members of a user group could communicate with each other, provided they had the same hardware and software. Bureaucracy declined; democracy increased. Control was still centralized and often exercised through in-house database management software.

Third generation: Isolated one-on-one computing. This was the short reign of the rugged individualist. Minicomputers and personal computers (PCs) freed the user from the need to share resources or work through an organization controlling a centralized system. Computing power was limited, but response time rapid. There were many copies of data, multiple formats and no formally approved data. The pace of software evolution accelerated and data began to be organized in relational data bases, which function like a series of file drawers from which the user can assemble pieces of information.[5]

Fourth generation: Networked computing. Also called distributed computing, this too is one-on-one, but allows memory, programs and data to be distributed wherever they are needed, typically via a client/server architecture.[6] Data are no longer just alphanumeric but also images and will eventually include audio and video formats. Interaction is generally rapid and is graphic as well as alphanumeric, with parts of the data base viewed through a map. Linkage is now possible between heterogeneous systems, such as a VAX computer and an IBM PC. Control of data is at the populist level, with server and database support from computing specialists who tend to have geoscience backgrounds. Interpretation and data management software evolves rapidly and tends to be from vendors rather than home grown. Sometimes the network connects to the mainframes, which are reserved for data archiving or for a master data base (more about this later). Mainframes are also reemerging in the new role of "super servers," controlling increasingly complex network communication.

To one degree or another, all four generations often still coexist in oil companies, but most companies are moving rapidly toward networked computing.[7] This shift to new technology—and, recently, to technology that is bought rather than built in-house—is changing the physical and conceptual shapes of data management. Since about 1990 two key trends have emerged:

- *The monolithic data store is being replaced, or augmented, with three levels of flexible data storage.* A single corporate data store[8] used to feed isolated islands of



Evolution in petroleum computing parallels evolution of computing in general.

Three Elements of a Successful E&P Data Model

Jack Breig
POSC

Comprehensive information coverage

A successful data model captures all kinds of information used in the E&P business, as well as sufficient semantics about the meaning of data, to ensure that it can be used correctly by diverse applications and users, in both planned and unplanned ways. In other words, a semantically rich data model optimizes the sharing of data across different disciplines.

Useful abstractions

The complexity and volume of information managed by the E&P industry is overwhelming. This is a serious impediment to information exchange, especially where information is generated by professionals in dissimilar business functions. The successful data model reveals to the user the places of similarity in information semantics. This capability provides business opportunities both for users, in accessing data from unexpected sources, and for application developers to target new, but semantically similar, business markets.

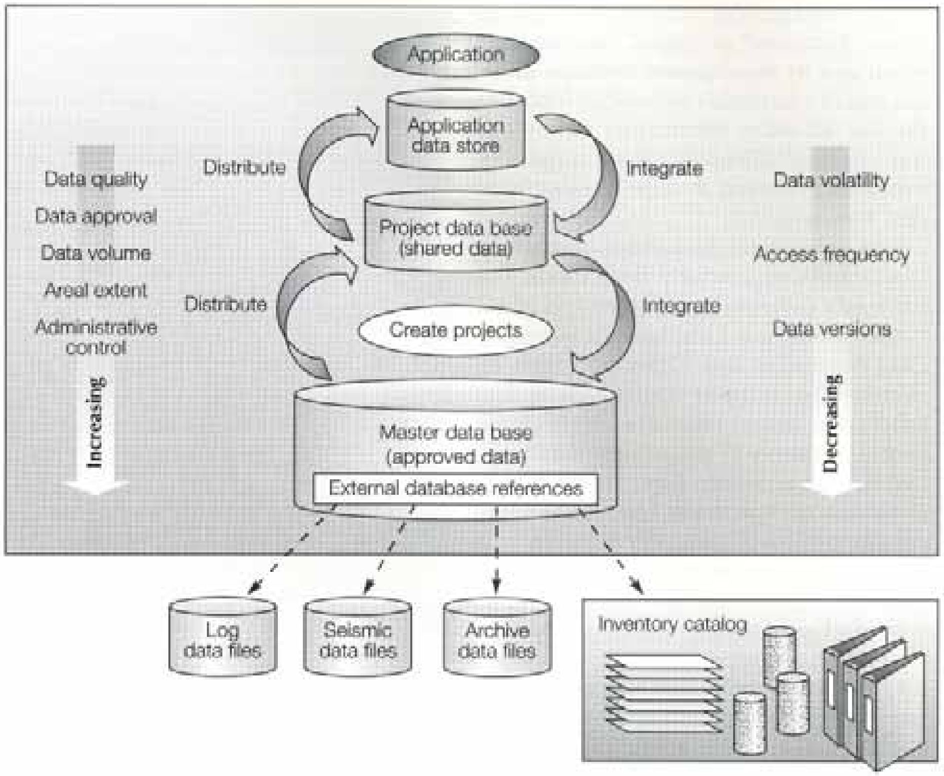
Implementable with today's and tomorrow's technology

A data model is successful today if it has a structure, rules and semantics that enable it to be efficiently implemented using today's database management tools. A data model will be successful for the long term if it can accommodate newer database management products, such as object-oriented, hybrid and extended relational database management systems.

computing, each limited to a single discipline. For example, a reservoir engineer in Jakarta might occasionally dip into the corporate data store, but would have no access to reservoir engineering knowledge—or any knowledge—from Aberdeen. Oil companies today are moving toward sharing of data across the organization and across disciplines. Nonelectronic data, such are cores, films and scout tickets,[9] may also be cataloged on line. A new way of managing data uses storage at three levels: the master, the project and the application.

- *E&P computing standards are approaching reality.* The three data base levels cannot freely communicate if one speaks Spanish, one Arabic and the other Russian. Efforts in computing standards address this problem on two fronts. One is the invention of a kind of a common language, a so-called data model, which is a way of defining and organizing data that allows diverse software packages to share different understandings of data—such as, is a "well" a wellhead or a borehole?—and therefore exchange them (see "Three Elements of a Successful E&P Data Model," *previous page*). Data models have been used in other industries for at least 20 years, but only in the last few has a broadly embraced E&P data model begun to emerge. On the other front is development of an interim means for data exchange, a kind of Esperanto that allows different platforms to communicate. In this category is the Geoshare standard, now in its sixth version.[10]

We look first at the data storage troika, and then at what is happening with standards.



Structure and properties of the three-level scheme for data management. Data shown at the bottom may be kept outside the database system for better performance.

A New Data Storage Troika

In the days of punch cards, corporate data were typically kept on a couple of computerized data bases, operated by mainframes. Flash forward 30 years to networked computing, and the story gets complicated. Instead of a couple, there are now tens or hundreds of machines of several types, linked by one or more networks. And instead of one or two centralized data bases, there tends to be many instances of data storage: master data base, project data base and application data stores (*above*). Sometimes the old corporate data base has been given a new job and a new name. Instead of holding all the data for the corporation, it now holds only the definitive instances, and so is renamed the "master." There may be one centralized master, but typically there is one master per operating region or business unit.

4. This evolutionary scheme was described by Bernard Lacroute in "Computing: The Fourth Generation," *Sun Technology* (Spring 1988): 9. Also see Barry JA: Technobabble. Cambridge, Massachusetts, USA: MIT Press, 1992.

   For a general review of information technology: Haeckel SH and Nolan RL: "Managing by Wire," *Harvard Business Review* 71, no. 5 (September-October 1993): 122-132.

5. A relational data base appears to users to store information in tables, with rows and columns, that allow construction of "relations" between different kinds of information. One table may store well names, another formation names and another porosity values. A query can then draw information from all three tables to select wells in which a formation has a porosity greater than 20%, for example.

6. Client/server architecture, the heart of distributed computing, provides decentralized processing with some level of central control. The client is the workstation in the geoscientist's office. When the geoscientist needs a service—data or a program—the workstation software requests it from another machine called a server. Server software fulfills the request and returns control to the client.

7. For an older paper describing a diversity of computer systems in Mobil: Howard ST, Mangham HD and Skruch BR: "Cooperative Processing: A Team Approach," paper SPE 20339, presented at the fifth SPE Petroleum Computer Conference, Denver, Colorado, USA, June 25-28, 1990.

8. This article distinguishes between a data store and a data base. A data store is a collection of data that may not be organized for browsing and retrieval and is probably not checked for quality. A data base is a data store that has been organized for browsing and retrieval and has undergone some validation and quality checking. A log data store, for example, would be a collection of tapes, whereas a log data base would have well names checked and validated to ensure that all header information is correct and consistent.

9. A scout ticket is usually a report in a ring binder that includes all drilling-related data about a well, from the time it is permitted through to completion.

10. For a description of the evolution of the Geoshare system: Darden S, Gillespie J, Geist L, King G, Guthery S, Landgren K, Pohlman J, Pool S, Simonson D, Tarantolo P and Turner D: "Taming the Geoscience Data Dragon," *Oilfield Review* 4, no. 1 (January 1992): 48-49.

In the master data base, data quality is high and the rate of change—what information scientists call volatility—is low. There are not multiple copies of data. Although the master data base can be accessed or browsed by anyone who needs data, changes in content are controlled by a data administrator—one or more persons who decide which data are worthy of residing in the master data base. The master data base also contains catalogs of other data bases that may or may not be on-line. The master is often the largest data base, in the gigabyte range (1 billion bytes), although it may be overshadowed by a project data base that has accumulated multiple versions of interpretations. The master may be distributed over several workstations or microcomputers, or still reside on a mainframe.

From the master data base, the user withdraws relevant information, such as "all wells in block 12 with sonic logs between 3000 and 4000 meters," and transfers it to one or more project data bases. Key characteristics of a project data base are that it handles some aspects of team interpretation, is accessed using software programs from different vendors and contains multidisciplinary data. The project may contain data from almost any number of wells, from 15 to 150,000. Regardless of size, data at the project level are volatile and the project data base may contain multiple versions of the same data. Updates are made only by the team working on the project. Interpretations are stored here, and when the team agrees on an interpretation, it may be authorized for transfer to the master data base.

A third way of storing data is within the application itself. The only data stored this way are those used by a specific vendor's application program or class of applications, such as programs for log analysis. Application data stores are often not data base management systems; they may simply be a file for applications to read from and write to. Applications contain data from the project data base, as well as interpretations performed using the application. Consequently, the data may change after each work session, making them most volatile. Because applications were historically developed by vendors to optimize processing by those specific applications, applications from one vendor cannot share data with applications from other vendors, unless special software is written. Vendors have begun to produce multidisciplinary applications, and many applications support the management of interpretation projects. In addition, the proprietary nature of application data stores will change as vendors adopt industry standards (see "Razing the Tower of Babel—Toward Computing Standards," page 45). As a result of these changes, data management systems of the future will have just two levels, master and project.

The Master Level

The master data base is often divided into several data bases, one for each major data type (next page). A map-type program is usually used to give a common geographic catalog for each data base. An example of this kind of program is the MobilView geographical interface (see "Case Studies," below).

Because the master data base is sometimes cobbled together from separate, independent data bases, the same data may be stored in more than one place in the master. BP, for instance, today stores well header information in three data bases, although it is merging those into a single instance. An ideal master data base, however, has a catalog that tells the user what the master contains and what is stored outside the master. An example is the inventory and location of physical objects, such as floppy disks, films, cores or fluid samples. This is sometimes called virtual storage. The master data base, therefore, can be thought of as not a single,

Case Studies

Mobil Exploration & Producing Technical Center

A sign on the wall in one of Mobil's Dallas offices sums up the most significant aspect of how Mobil is thinking about data management: "Any Mobil geoscientist should have unrestricted and ready worldwide access to quality data." The sign describes not where the company is today, but where it is working to be in the near future.

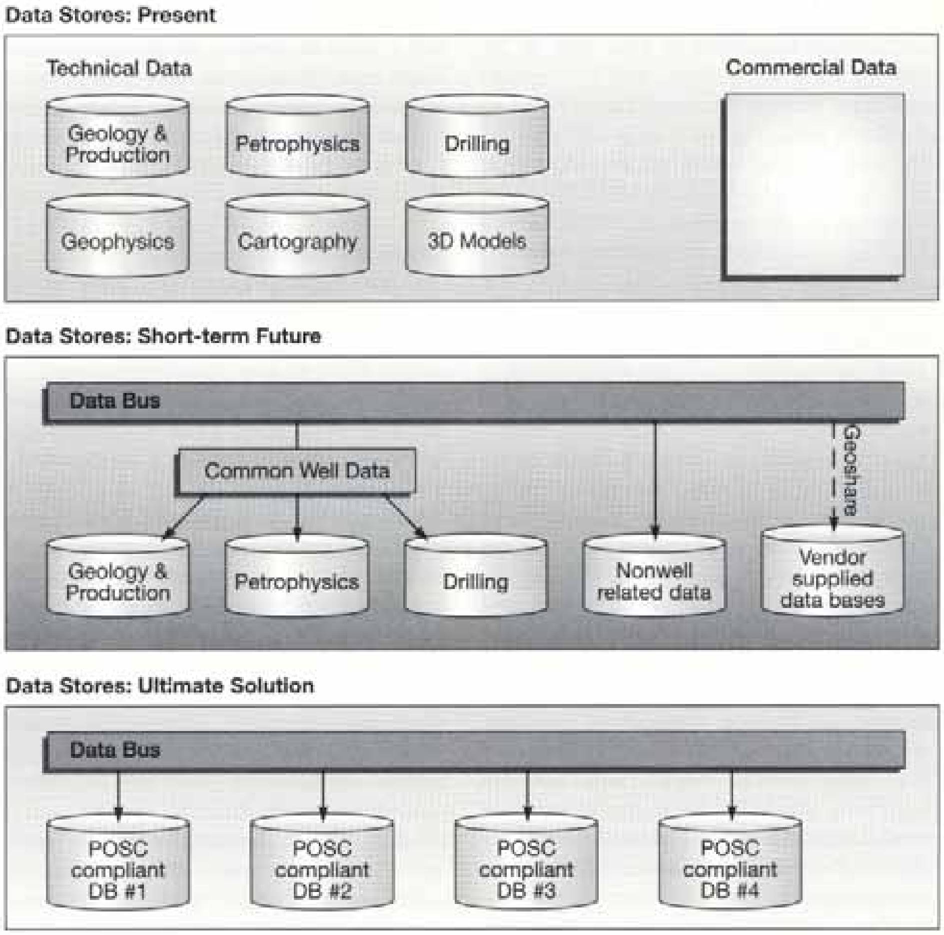
The emphasis on data management is driven by Mobil's reengineering of its business. Data management is affected by fundamental changes in the current business environment and in how data are used within this environment.

Traditionally, exploration funds were allocated among the exploration affiliates, largely in proportion to the affiliate size. Within a changing business environment requiring a global perspective, funds should be allocated to take advantage of the best opportunities regardless of location. The organization as a whole is also leaner, placing more demands on a smaller pool of talent. A petrophysicist in Calgary may be called to advise on a project in Indonesia. All geoscientists, therefore, need to understand data the same way. When an interpretation and analysis are performed with the same rules, right down to naming conventions, then not only can data be shared globally, but any geoscientist can work on any project anywhere.

A second motivation for restructuring data management is a change in who is using data. Mobil was traditionally structured in three businesses: Exploration, Production, and Marketing and Refining. Exploration found oil for its client, Production, which produced oil for its client, Marketing and Refining. Now the picture is not so simple. Exploration's client may also be a government or national production company. Production may also work as a consultant, advising a partner or a national company on the development of a field. Now, with a broader definition of who is using data, there is a greater need for data that can be widely understood and easily shared.

For the past three years, the company has been moving to meet this need. In 1991, Mobil established 11 data principles as part of a new "enterprise architecture." The company is using the principles as the basis for policies, procedures and standards. Mobil is now drafting its standards, which include support of POSC efforts, down to detail as fine as "in level five of Intergraph design, a file will have geopolitical data."

Mobil is reengineering data management on two fronts, technology and organization. Technology changes affect the tools and techniques for doing things with data: how they are validated, loaded, stored, retrieved, interpreted and updated. Organizational changes concern attitudes about who uses what tools for what ends. Both sides carry equal weight. This involves a realization that technology



BP's master data base: present, near future and long term. Currently, the master is divided into discrete data bases and associated applications that have been built to address the needs of specific disciplines. The advantage of this approach is that data ownership is clearly defined. Disadvantages include duplicate data sets, difficulty ensuring integrity of data shared by more than one discipline, and increased data management workload. The near-term solution increases the permeability of walls separating disciplines, and the ultimate solution dissolves these walls, making use of standards established by the Petrotechnical Open Software Corporation (POSC).

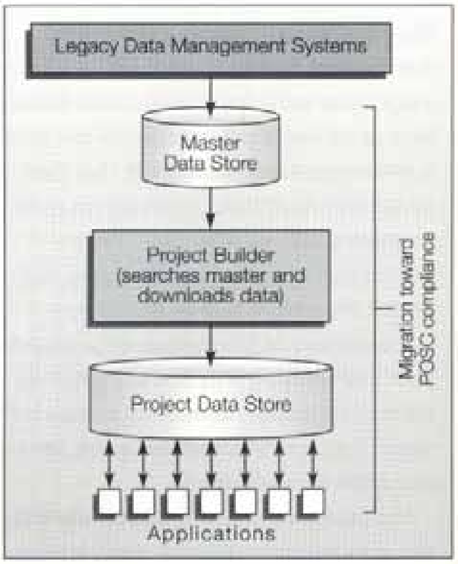
alone doesn't solve problems. It also involves the "people side," most importantly, the attitude of geoscientists toward data management.

An example of a new way to manage the people side is the formation of a series of groups coordinated by the Information Technology (IT) department called Data Access Teams, which expedite data management for the Mobil affiliates. A Data Access Team comprises Dallas staff and contractors who validate, input, search and deliver data to an affiliate site. Each site, in turn, collaborates with the team by providing a coordinator familiar with the local business needs and computer systems. Another means of addressing the people side of data management is making data management part of a geoscientist's performance appraisal. This becomes increasingly important as more data go on-line.

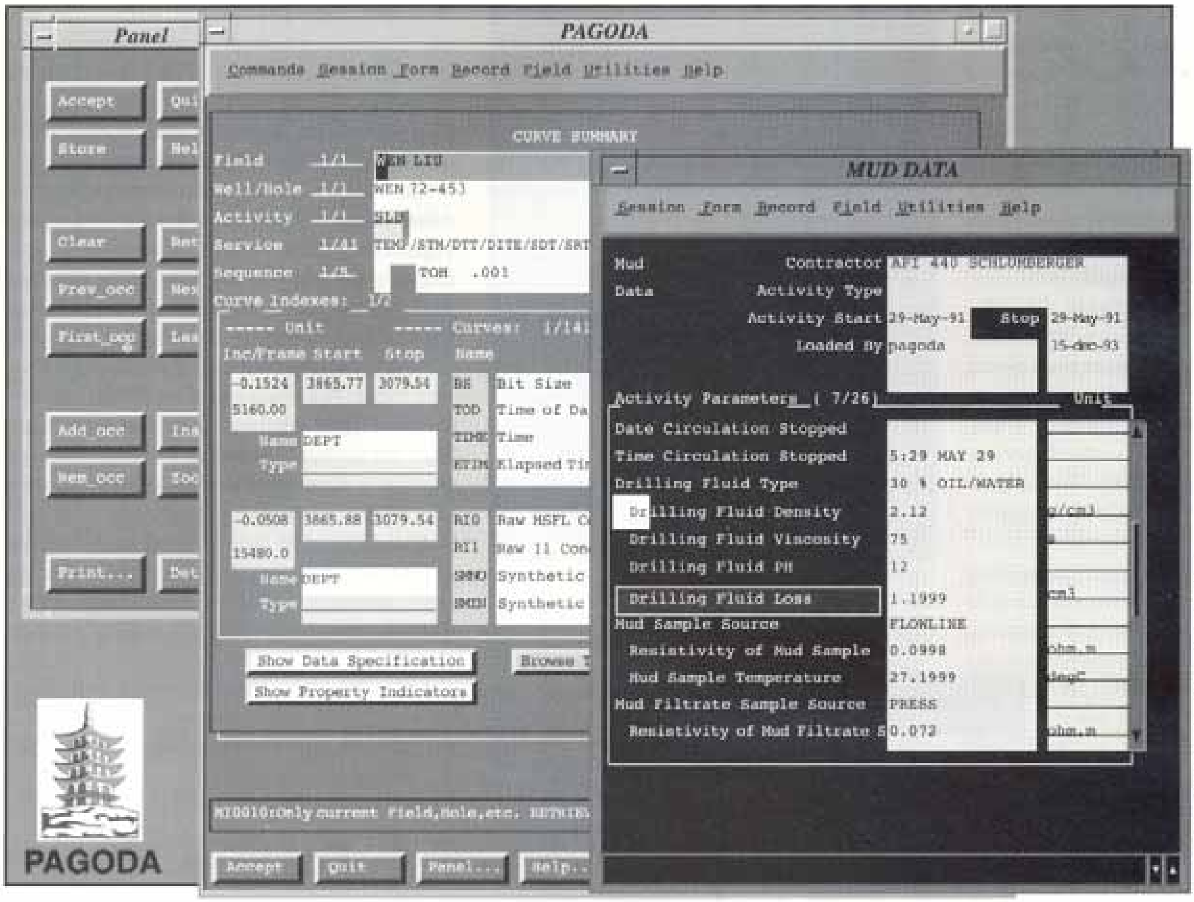
In the past, geoscientists would rifle closets and ask colleagues for data. Any bad data would get tossed or worse, ignored. Now, if a geoscientist finds bad data, it is that individual's responsibility to alert the data administrator and have the problem corrected. The new thinking is that data quality isn't someone else's job; it has to become part of the culture.

A fundamental component of Mobil's IT strategy is a common storage and access model. Typically, each of the affiliates maintains its own, stand-alone E&P database system, along with links into the central data bases in Dallas. The local systems have evolved independently because local needs can vary. Frontier areas, for example, work only with paper data, whereas Nigeria is nearly all electronic. Despite these differences, a common data storage and access model was endorsed by all affiliates in the early 1990s.

This model incorporates access to existing data sources as well as the concept of master and project data stores (right). The master data base maintains the definitive version of the data while the project data base is maintained as a more ephemeral working environment interfacing with the applications. The project builder serves as a



Overview of Mobil's data management model. This model, developed in the early 1990s, is part of a strategy for migration to POSC compliance.



Courtesy of Shell Internationale Petroleum Maatschappij BV.

Activity screen in PAGODA. The control panel at left allows the user to obtain details about selected fields in the main screen and navigate the system. The central screen shows curve summary information, and the mud data screen gives details of mud properties.

Case Studies

geographical search, retrieval and archival mechanism. The master and project data stores are based on the POSC Epicentre model and implemented in the Open System/UNIX environment. The model calls for gradual replacement of most of the legacy data bases, based on business drivers. The company will maintain selected legacy systems for the foreseeable future, but in a way that minimizes resources and does not involve formal development.

Being competitive in the current business environment requires a change in business processes. This change from a local focus to a global perspective is particularly important in IT. Within Mobil's E&P division, the major component of this initiative is a paradigmatic shift in the way data are handled at all levels and the development of a POSC-based data storage and access model. In the context of the corporate IT mission, this strategy was developed from the ground up, with input from all Mobil affiliates.

Unocal Energy Resources Division

Unocal is an integrated energy resources company that in 1993 produced an equivalent of 578,000 barrels of oil per day and held proven reserves equivalent to 2.2 billion barrels of oil.1 By assets, Unocal ranked thirteenth worldwide in 1993, compared to Mobil in second place.2 Exploration and production is carried out in about ten countries, including operations in Southeast Asia, North America, former Soviet Union and the Middle East.

Unocal began a reorganization in 1992 that will eventually converge most all exploration activities at a facility in Sugar Land, Texas, USA. Concurrent with this restructuring is a change, started in 1990, in the physical database system—from IBM mainframes running in-house database, mapping and interpretation software, to third-party software on a client/server system. The group responsible for overseeing this shift is Technical Services, based in Sugar Land (next page). Here, 13 staff scientists and five on-site contractors manage 200 gigabytes of data on about two million wells. This is the largest portion of the company's one terabyte of E&P data, and is accessed by about 275 users in both exploration and business units.

The Technical Services group performs two main tasks: it supports client/server-based geoscience applications, and it maintains and distributes application and database systems. There are 23 software systems under its wing: 11 geophysical applications, five mapping and database applications, five geologic applications and two hard-copy management systems, which are catalogs of physical inventories such as seismic sections and scout tickets. Altogether, the 23 systems represent products from at least 20 vendors,

(continued on page 40)

1. Unocal 1993 Annual Report: 8.
2. *National Petroleum News*. "Oil Company Rankings by Marketers with Assets of $1 Billion or More," (June

comprehensive library, but as a large digital filing cabinet and a catalog directing the user to other filing cabinets that may be adjacent, across the hall or across the ocean, and may contain data in any form—digital, paper, cores and so on.

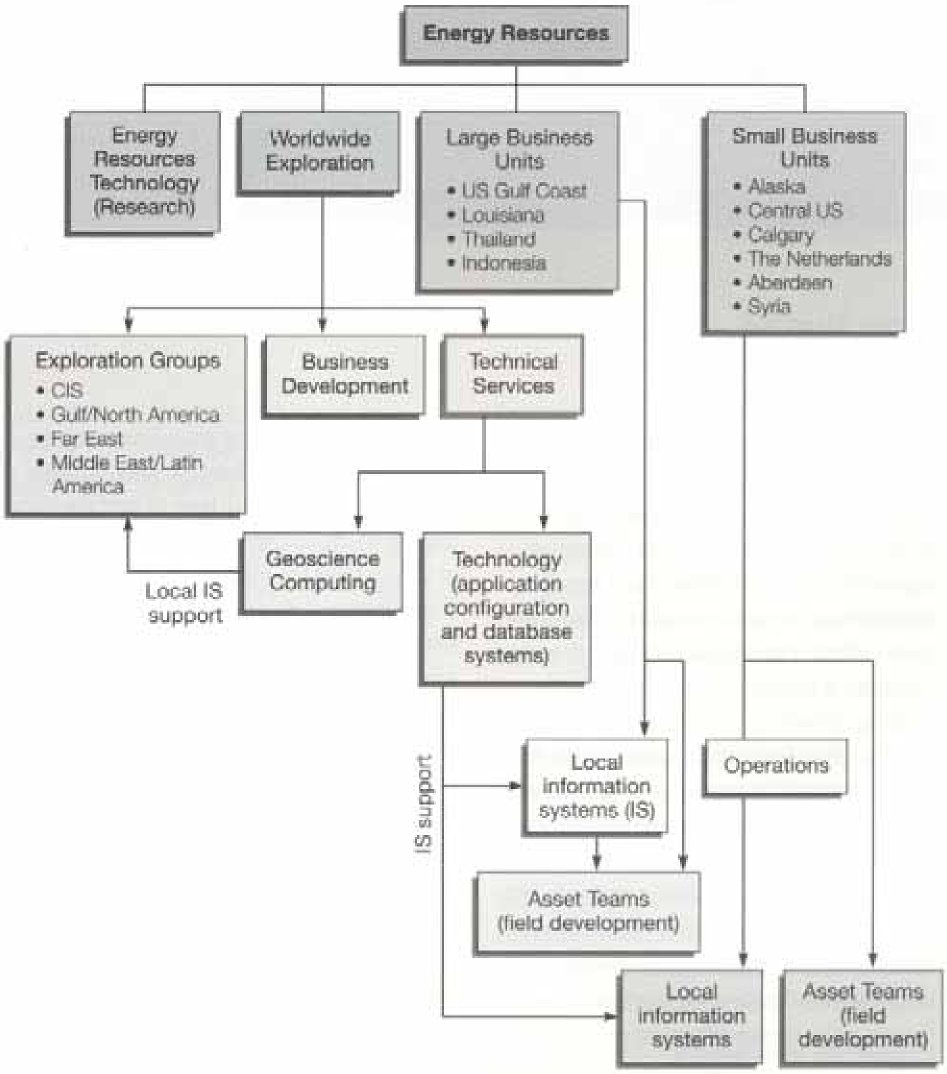
One component of storage at the master level is the archive. The name implies long-term storage with infrequent retrieval, but the meaning of archive is shifting with new ways of organizing and accessing data. An archive may be an off-site vault with seismic tapes in original format, or an on-site optical disk server with seismic data already formatted for the interpretation workstation. There are countless variations, with differing degrees of "liveness" of the data. Two examples of archives are the PAGODA/LogDB and LogSAFE systems.

The PAGODA/LogDB system is a joint development of Shell Internationale Petroleum Maatschappij (SIPM) and Schlumberger. PAGODA designates the product in Shell Operating Companies and Affiliates; the LogDB name is used for the Schlumberger release. The objective of the joint development was to produce a safe storage and retrieval system for information gathered during logging and subsequent data evaluation.

The PAGODA/LogDB system comprises software and hardware for loading, storing and retrieving data acquired at wells, such as wireline logs, data obtained while drilling, borehole geophysical surveys and mud logs. Original format data are scanned during loading to ascertain header information and the integrity of the data format. All popular data formats are supported. Once scanning is complete, well identifiers are validated against a master list of well names. Extracted header information is written to ORACLE tables—a type of relational database table—and bulk data are transferred to a storage device, such as an on-line jukebox of optical disks, magnetic disks or other archival media. Once data are validated and loaded, they can be quickly viewed, searched and retrieved for export to other applications (previous page).

The PAGODA/LogDB system fulfills two roles. As an off-line archival data base, the system is capable of storing terabytes of data that are safely held on a durable medium and can be retrieved and written to disk or tape. Exported data can be provided in either original format or via a Geoshare linkage (page 46). As an on-line data base, the system makes all header information available for browsing and searching. The systems are supported on VAX/VMS, Sun/OS and IBM/AIX operating systems.

The PAGODA and LogDB systems are essentially the same. To date, PAGODA has been installed in most of Shell's larger Operating Companies, where log data held on



□A data management organization chart for Unocal's Energy Resources division. The company's Technical Services group, based in Sugar Land, Texas, contributes to data management for the four exploration groups, which are also based in Sugar Land, and large and small business units. The business units are moving their regional data models toward a single standard.

earlier systems or in tape storage are being migrated to PAGODA. The PAGODA system also caters to the storage of Shell proprietary data formats and calculated results. The LogDB system has been installed in several oil companies and government agencies and is being made available as a loading and archive service at Schlumberger computing centers worldwide. The LogDB system can be coupled to the Finder data management system, in which well surface coordinates can be stored together with limited log sections for use during studies.

The LogSAFE service performs some of the same functions, but not as a tightly coupled data base. It is an off-line log archive that costs about half as much as an internal database system, yet can deliver logs over phone or network lines in a few hours. For oil companies that prefer a vendor to manage the master log data base, the LogSAFE system functions as an off-site data base, accessed a few times a week. For large companies—those with more than about 15 users of the data base—it functions as an archive, accessed once or twice a month.

□Bob Lewallen, senior log data technician with Schlumberger, returning 90 gigabytes of log data to the LogSAFE vault in Sedalia, Colorado, USA. Original logs are copied to two sets of DATs stored in the vault. A third backup is kept in a fireproof safe off-site. To ensure data integrity, data are validated and rearchived every five years.

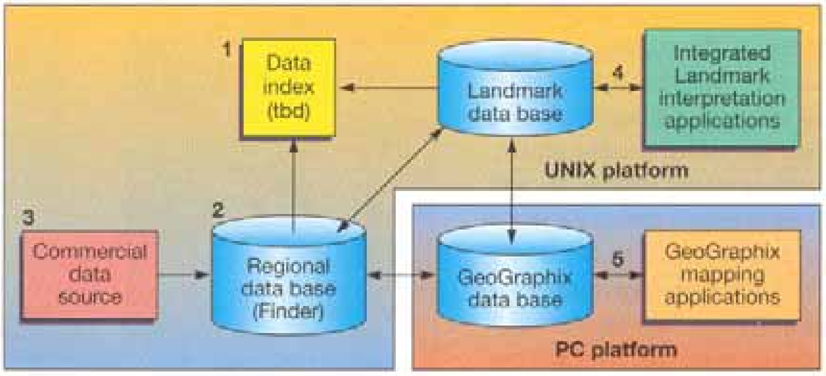
The LogSAFE system places logs from any vendor in a relational data base, validating data and storing them in their original format. Any tape format can be read and paper copies digitized. Before it is entered into the data base, the entire file is inspected to make sure it is readable, and the data owner is informed of any problems in data quality. Validated data are then archived on DATs (left). By the end of 1994, data will also be stored for faster, automated retrieval on a jukebox of optical disks. Clients have access only to their own data, and receive a catalog of their data and quarterly summaries of their holdings. The LogSAFE system is based in Sedalia, Colorado, USA, at the same facility that houses the hub of the Schlumberger Information Network. This permits automatic archiving of Schlumberger logs that are transmitted from a North American wellsite via the LOGNET service, which passes all logs through the Sedalia hub.

LogSAFE data can be accessed several ways, giving it the similar flexibility and "live" feel of an in-house data base. Data are either pulled down by the user, or

making Unocal advanced in its move from in-house software (right).

Jim Green, who manages Unocal's exploration computing services, lists two essential ingredients for successful management of E&P data: training for users of new data handling systems and automated tools for moving data. By 1995, Unocal will move all computerized E&P data from flat-file, hierarchical systems to ORACLE-based relational systems.3 A company-wide program is bringing geotechnicians up to speed on data loading and quality checking.

The diversity of Unocal's software underscores the importance of managing multiple versions of data. The company is encouraging vendors to develop a family of automated software tools: data movers, editors, loaders, unloaders and comparitors. Of particular importance are comparitors,



□Architecture of Unocal's interpretation applications and data stores. Pair-wise links connect all platforms. Long-term evolution is toward the UNIX platform.

1 Catalog of digital and hard-copy data
2 Best Unocal data from past projects and commercial sources
3 Managed and converted by Geoscience Computing
4 SeisWorks, StratWorks, Z-MAP *Plus*, SyntheSeis, PetroWorks, etc.
5 Application for interpretations

which scan two project data bases or a project and a master data base and produce a list of differences between them. Quick identification of differences between versions of data is essential in deciding how to update projects with vendor data or how to update the master data base with geoscientists' interpretations from a project or regional data base. Today this comparison is done manually. "The client/server environment cannot be considered mature until we have robust, automated data management tools," Green says.

A debate within Unocal concerns finding the best way to organize the work of geotechnicians, who load data and contribute to quality assurance (next page). The main issue is whether geotechnicians are most effective if they work by geographic area, as they do now, or by discipline. The advantage of focusing geotechnicians by area is that they learn the nuances of a region, and develop

3. A flat-file data base contains information in isolated tables, such as a table for porosity data and another for paleontology data. The tables cannot be linked. A relational data base allows linkage of information in many tables to construct queries that may be useful, such as "show all wells with porosity above 20% that have coccolithus." Flat file data bases are simple and inexpensive. Relational data bases are complex, expensive and can be used to do much more work.

pushed from Sedalia at client request. Data are transferred either over commercial or dedicated phone lines, or more commonly, through the Internet. Internet connections are generally faster than phone lines, and allow transmission of 500 feet of a borehole imaging log in 5 to 10 minutes.

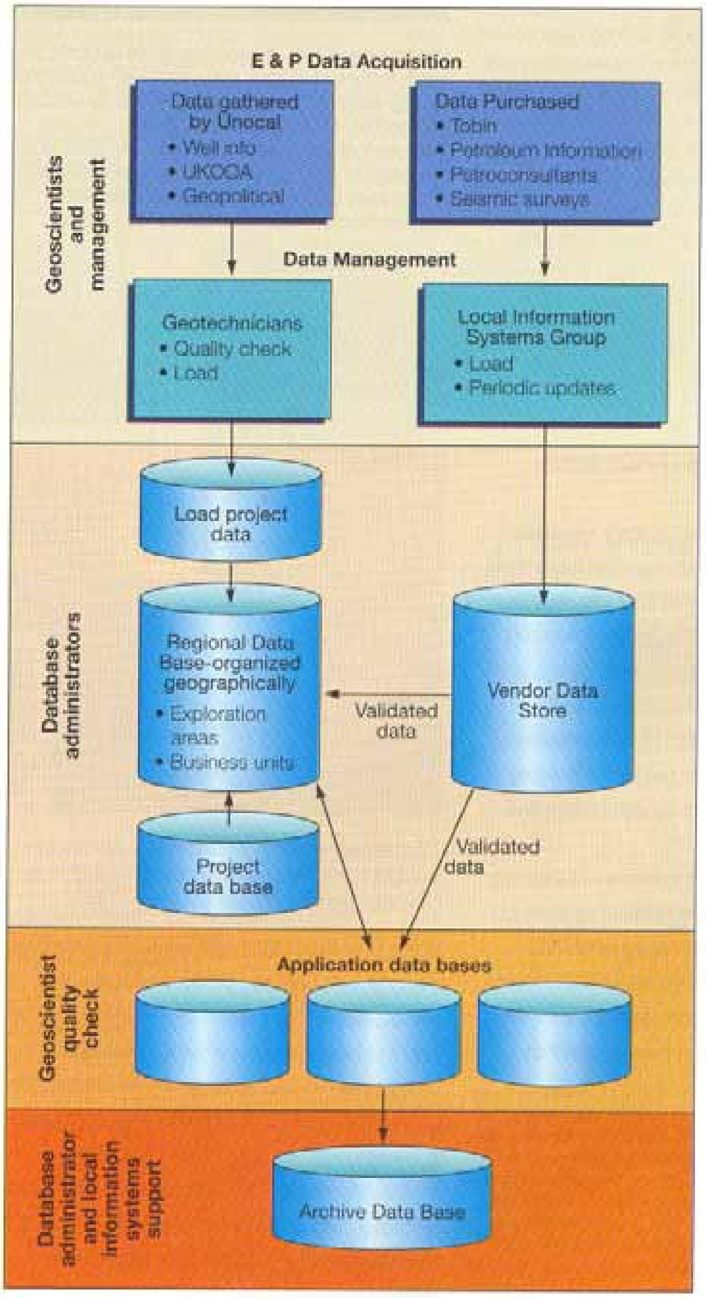
In operation since 1991, the LogSAFE service now serves 70 clients and holds data from 13 countries. As oil companies continue to look to vendors for data management, the LogSAFE service is expected to expand from its core of North American clients. Today it handles mostly logs and a handful of seismic files, but is expected to expand to archive many data types.

The Project and Application levels

To the geoscientist, the project data base is like a desktop where much of the action takes place. Relevant resources from the master data base are placed in the project data base. To work on project data, users move it from the project level into the application software. The process of interpretation, therefore, involves frequent exchange

cohesion with other team members and a sense of ownership of the data. The advantage of organizing geotechnicians by discipline—seismic, paleontology, logs and so on—is a deeper understanding of each data type and better consistency in naming conventions and data structure. The optimal choice is not so obvious. Complicating the picture is the changing profile of the typical geotechnic-ian. Ten or 15 years ago, a geotechnician held only a high school diploma and often preferred to develop an expertise in one data type. Today, many have master's degrees and prefer a job with greater diversity that may move them toward a professional geoscience position.

Whichever way Unocal moves, Green says, the company is addressing a change in data culture. Geotechnicians today are increasingly involved in broader matters of data management, including the operation of networks and interapplication links. "We need both technicians and geoscientists who understand what to do with a relational data base," Green says, "who understand the potential of interleaving different kinds of data. The future belongs to relational thinkers and that's what we need to cultivate."



☐Unocal's data flow and division of labor. Vendor data are initially kept separate from Unocal data, mainly for quality assurance.

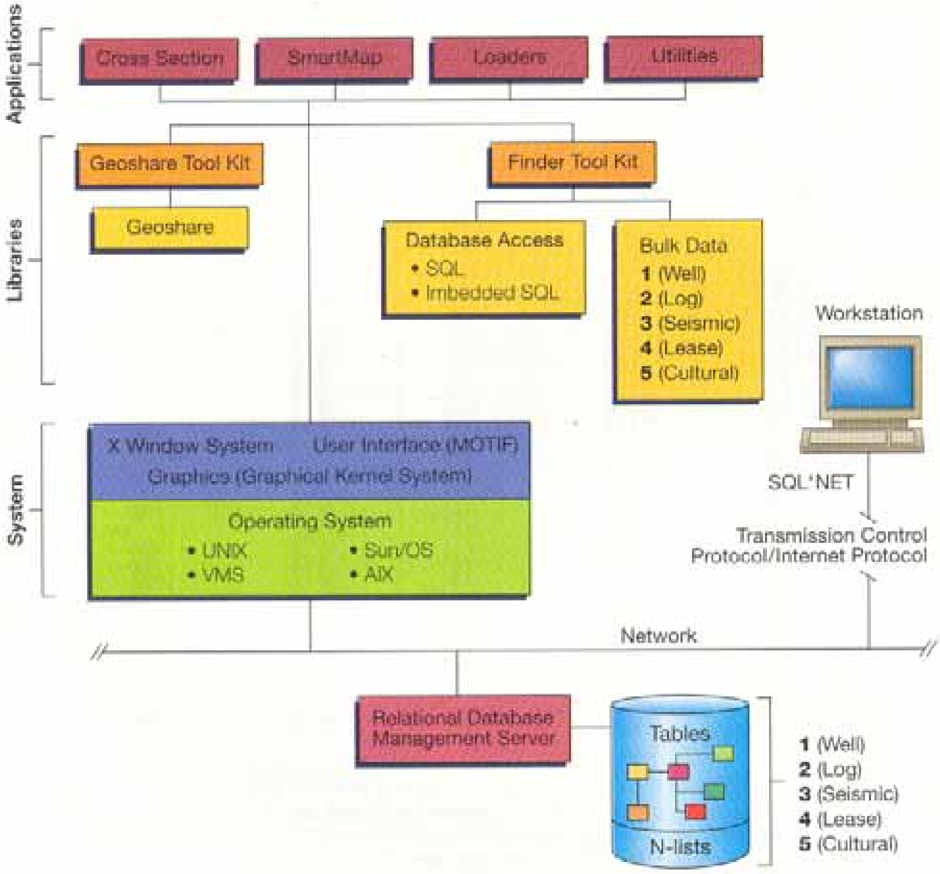
between the project and application levels, and when a team of geoscientists arrives at an interpretation and wants to hold that thought, it is held in the project data base.

The distinction between the levels is not rigid. For example, software that works at the project level may also overlap into the master and application levels. What sets apart project database systems is where they lie on the continuum of master-project-application. Two examples are the Finder system, which manages data at the project and master levels, and the GeoFrame system, which manages project data for interpretation applications.

The Finder system wears two hats. It functions as a data base, holding the main types of E&P data, and as a data access system, providing a set of programs to access and view data (below).[11] The Finder system consists of three main components: the data, interfaces to the data, and the underlying data model, which organizes the data.

The data bases reside in two places. Inside the relational data base management system are parametric data, which are single pieces of data, such as those in a log header. Usually, relational data bases like the one Finder uses (ORACLE), cannot efficiently handle vector data, also called bulk data. These are large chunks of data composed of smaller pieces retrieved in a specific order, such as a sequence of values on a porosity curve or a seismic trace. For efficiency and resource minimization, vector data are stored outside the relational structure, and references to them are contained in the data base management system. Data bases are typically set up for the most common types of data—well, log, seismic, lease and cultural, such as political boundaries and coastlines—but other data types and applications can be accessed. The Finder system also includes tools for database administrators to create new projects, new data types, new data base instances and determine security. Users can move data between the master and project levels.

The component most visible to the user is the interface with the data base and its content. There are several types of interfaces. The most common is an interactive map or cross section (next page). Another common interface is the ORACLE form. Typical forms looks like a screen version of the paper form used to order data from a conventional library (page 44, top). In the future,



Structure of the Finder system. The system lets the geoscientist work with five kinds of bread-and-butter data: Well, log, seismic, lease and cultural.

1 Well data are an encyclopedic description of the well. The 50-plus general parameters include well name, location, owner, casing and perforation points, well test results and production history.

2 Logs are represented either as curves or in tabular form. Multiple windows can be displayed for crosswell correlations. Log data are used to select tops of formations and are then combined with seismic "picks" to map horizons, one of the main goals in mapping.

3 Seismic includes the names of survey lines, who shot them, who processed the data, how it was shot (influencing the "fold") and seismic navigation data. Also listed are "picks," the time in milliseconds to a horizon, used to draw a subsurface contour map through picks of equal value.

4 Lease data include lease expiration, lessee and lessor and boundaries.

5 Cultural data include coastlines, rivers, lakes and political boundaries.

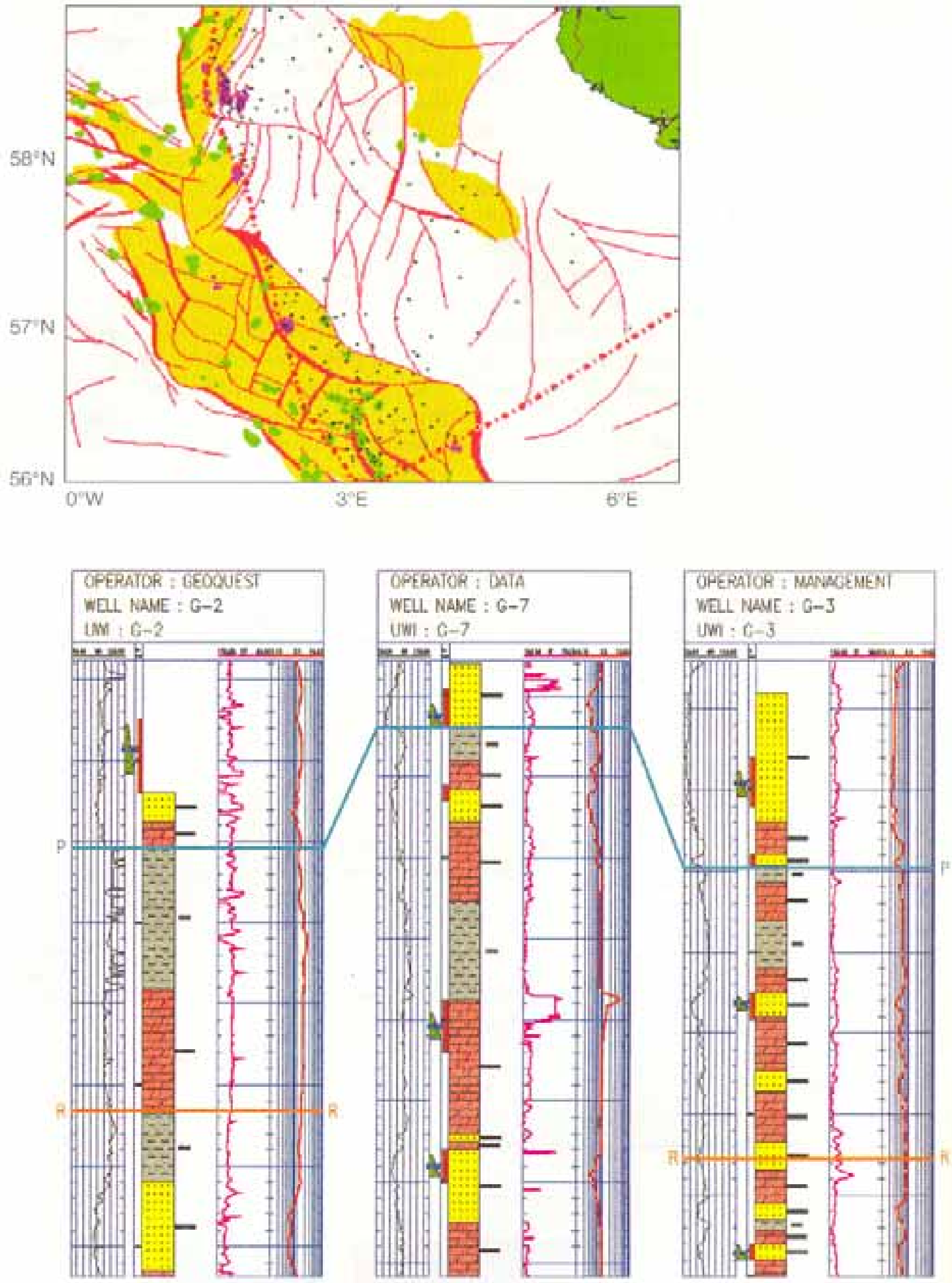
forms will also be multimedia, merging text, graphics and maps. The user also interacts with the data base through unloaders—utilities that convert data from an internal representation to external, standard formats—and through external applications, like a Lotus 1-2-3 spreadsheet.

A more powerful interface is Standard Query Language (SQL—often spoken "sequel"), which is easier to use than a programming language but more difficult than spreadsheet or word processing software.[12] The Finder system includes at least 40 common SQL queries, but others that will be used often can be written and added to a menu for quick access, much like a macro in PC programming. Often, a database administrator is the SQL expert and works with the geoscientist to write frequently used SQL queries. A point-and-click interactive tool for building SQL queries is also available for users with little knowledge of SQL.

The less visible part of the Finder system, but its very foundation, is the data model. Today, the Finder data model is based on the second and third versions of a model called the Public Petroleum Data Model (PPDM), which was developed by a nonprofit association of the same name.[13] To satisfy new functionalities, the Finder model has evolved beyond the PPDM in some areas, notably in handling seismic and stratigraphic data. The evolutionary path is moving the Finder model toward the Epicentre/PPDM model, which is a merger of the PPDM model with Epicentre, a model developed by another industry consortium, the Petrotechnical Open Software Corporation (POSC).

In the last two years, the Finder system has gone through several cycles of reengineering, making it more robust, more flexible and easier to use. Updates are released twice a year. Since 1993, for example, about 50 new functions have been added. Four changes most notable to the user are:

- easier user interface. Full compliance with MOTIF, a windowing system, speeds access to data, and makes cutting and pasting easier.



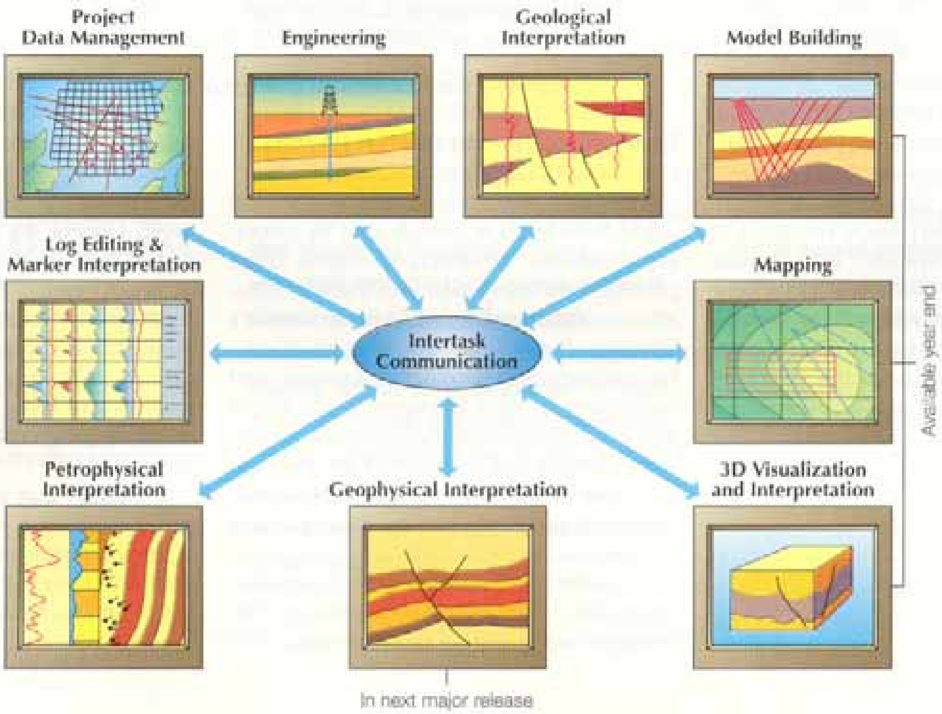
Two interfaces of the Finder system. The most popular interfaces are graphical. Two examples are the SmartMap software (top) and the Cross Section module (bottom). SmartMap software positions information from the data base on a map, and allows selection of information from the data base by location or other attributes. The user can tap into the data base by point-and-click selection of one or more mapped objects, such as a seismic line or a well. The Cross Section module is used to post in a cross-section format depth-related data, such as lithology type, perforations and, shown here, formation tops. Wells are selected graphically or by SQL query, and can be picked from the base map.

11. For an accessible review of data bases and database management systems: Korth HF and Silberschatz A: Database System Concepts. New York, New York, USA: McGraw-Hill, Inc., 1986.

12. This language, developed by IBM in the 1970s, is for searching and managing data in a relational data base. It is the database programming language that is the most like English. It was formerly called "Structured Query Language," but the name change reflects its status as a de facto standard.

13. PPDM Association: "PPDM A Basis for Integration," paper SPE 24423, presented at the Seventh SPE Petroleum Computer Conference, Houston, Texas, USA, July 19-22, 1992.

An ORACLE form for a scout ticket. The 80 types of forms preprogrammed into the Finder system do more than display data. They include small programs that perform various functions, such as query a data base and check that the query is recognizable—that the query is for something contained in the data base. The programs also check that the query is plausible, for instance, that a formation top isn't at 90,000 feet [27,400 m]. Forms may perform some calculation. The well form, for example, contains four commonly used algorithms for the automated calculation of measured and true vertical depth. Forms can be accessed by typing a query or clicking on a screen icon. A form showing all parameters available for a well, for example, can be accessed through the base map by clicking on a symbol for a well.

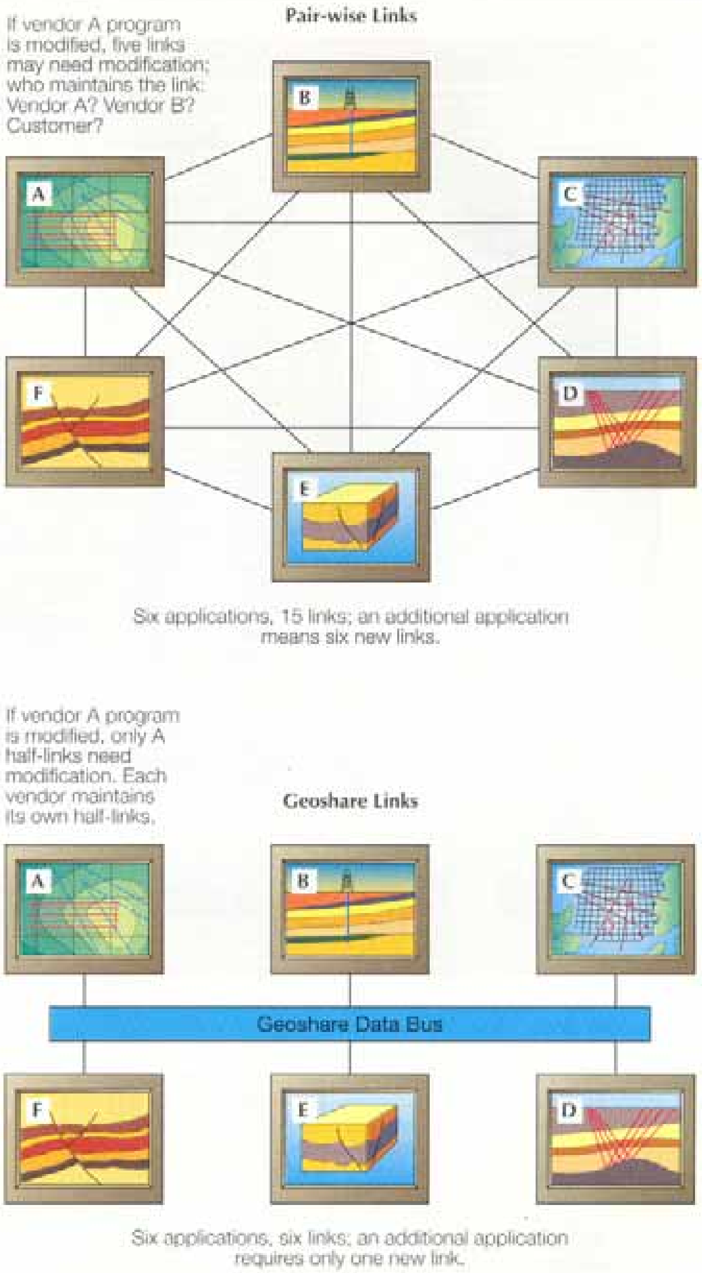


The GeoFrame reservoir characterization system. The GeoFrame system is a suite of modular applications that are tightly linked via a common data base and package of software that handles intertask communication. This software automatically makes any change in the data base visible to each application. It also allows the user to communicate directly between applications. For example, a cursor in a cross-section view will highlight the well in the map view.

- data model expansion. The data model now accommodates stratigraphic and production data and improves handling of seismic data.
- mapping and cross-section enhancements. As the data model expands, graphical capabilities expand to view new kinds of data. Enhancements have been made to cross-section viewing, and additions include 3D seismic overlay and bubble mapping. A bubble is a circle on a map that can graphically display any data in the data base. A circle over a well, for example, can be a pie chart representing recoveries from a drillstem test.
- enhanced data entry. All data loaders have the same look and feel. Loaders have been added that handle data in Log Interpretation Standard (LIS), generalized American Standard Code for Information Interchange (ASCII) and others.

Unlike the Finder system, which works mainly on the master or project level, the GeoFrame reservoir characterization system works partly on the project level but mainly on the application level. The GeoFrame system comprises control, interpretation and analysis software for a range of E&P disciplines. The system is based on the public domain Schlumberger data model, which is similar to the first version of Epicentre and will evolve to become compliant with the second version. Applications today cover single-well analysis for a range of topics: petrophysics, log editing, data management, well engineering and geologic interpretation *(previous page, bottom)*. Additions expected by the end of the year include mapping with grids and contours, model building and 3D visualization of geologic data.

GeoFrame applications are tightly integrated with a single data base, meaning, most importantly, that there is only one instance of data. From the user's perspective, tight integration means an update made in one application can become automatically available in all applications. (Loose integration means data may reside in several places. The user must therefore manually ensure that each instance is changed during an update). Project data management is performed within GeoFrame applications, but it may also be performed by the Finder system, which is linked today to the GeoFrame system via the Geoshare standard (see "Petrophysical Interpretation," *page 13*).



Pair-wise versus data-bus linkage of applications.

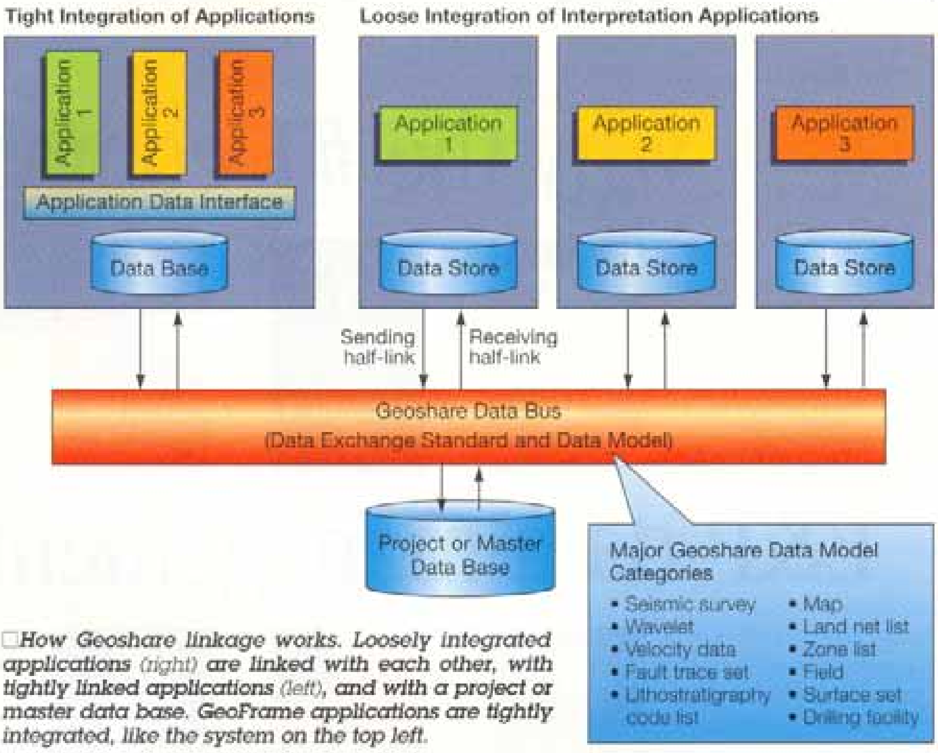
Razing the Tower of Babel—Toward Computing Standards

Moving data around the master, project and application levels is complicated by proprietary software. Proprietary systems often provide tight integration and therefore fast, efficient data handling on a single vendor's platform. But they impede sharing of data by applications from different vendors, and movement of data between applications and data bases. Nevertheless, many proprietary systems are entrenched for the near term and users need to prolong the usefulness of these investments by finding a way to move data between them.

A common solution is called pair-wise integration—the writing of a software link between two platforms that share data. This solution is satisfactory as long as platform software remains relatively unchanged and the number of linked platforms remains small. Unocal, for example, maintains five such links at its Energy Resources Division in Sugar Land, Texas (see "Case Studies," page 38). A revision to one of the platforms, however, often requires a revision in the linking software. With more software updates and more platforms, maintenance of linking programs becomes unwieldy and expensive.

A solution that sidesteps this problem is called a data bus, which allows connection of disparate systems without reformatting of data, or writing and maintaining many linking programs *(above)*. A data bus that has received widespread attention is the Geoshare standard, which was developed jointly by GeoQuest and Schlumberger and is now owned by an independent industry consortium of more than 50 organizations, including oil companies, software vendors and service companies. The Geoshare system consists of standards for data content and encoding—that is, the kind of information it can hold, and the names used for that information. It also includes programs called half-links for moving data to and from the bus (right). Geoshare uses a standard for data exchange—which defines what data are called and the sequence in which they are stored—that is an industry standard called API RP66 (American Petroleum Institute Recommended Practice 66). The Geoshare data model is evolving to become compatible with the Epicentre data model and its data exchange format, which is a "muscled" version of the Geoshare standard.

Half-links are programs that translate data into and out of the Geoshare exchange format. There are sending and receiving half-links. The sending half-link translates data from the application format into a format defined by the Geoshare data model, and the receiving half-link translates data from the Geoshare format into a format readable by the receiving application. Schlumberger has written half-links for all its products, and many half-links are now being developed by other vendors and users. As of July this year, 20 half-links were commercially available. This number may double by year end.



How Geoshare linkage works. Loosely integrated applications** (right) **are linked with each other, with tightly linked applications** (left), **and with a project or master data base. GeoFrame applications are tightly integrated, like the system on the top left.

There are significant differences between sending and receiving half-links, and in the effort required to write them. The sending half-link usually has to just map the application data to the Geoshare data model. This is because the Geoshare data model is broad enough to accept many ways of defining data—like a multilingual translator, it understands almost anything it is told. The receiving half-link, however, needs to translate the many ways that data can be put in the Geoshare model into a format understandable by the receiving application. Look at a simple example.

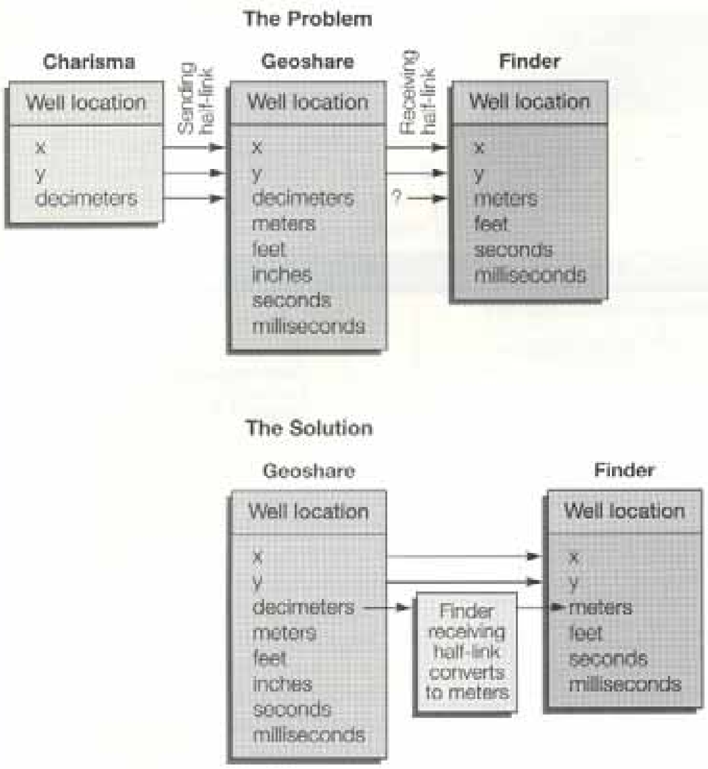
What is Object-Oriented—*Really*?

The term "object-oriented" has become increasingly misunderstood as its usage expands to cover a broad range of computer capabilities. The meaning of object-oriented changes with the noun it precedes—object-oriented interface, graphics and programming. What makes them all object-oriented is that they deal with "objects"—usually a cluster of data and code, treated as a discrete entity. The lumping together of data is called encapsulation.

An object-oriented interface is the simplest example. It is a user interface in which elements of the system are represented by screen icons, such as on the Macintosh desktop. Applications, documents and disk drives are represented by and manipulated through visual metaphors for the thing itself. Files are contained in folders that look like paper folders with tabs. Files to be deleted are put in the trash, which is itself an object—a trash can or dust bin. Object-oriented displays do not necessarily mean there is object-oriented programming behind them.

The object-oriented interface to data, at a higher level, involves the concept of retrieving information according to one or more classes of things to which it belongs. For example, information about a drill bit could be accessed by querying "drill bit" or "well equipment" or "parts inventory." The user doesn't need to know where "drill bit" information is stored to retrieve it. This is a breakthrough over relational database queries, where one must know where data are stored to access them.

When software developers talk to geoscientists about the power of an "object-oriented program," they are often referring to object-oriented graphics, which concerns the construction and manipulation of graphic elements commonly used in mapping, such as points, lines, curves and surfaces. Object-oriented graphics describes an image component by a mathematical formula. This contrasts with bit-mapped graphics, in which image components are mapped to the screen dot by dot, not as a single unit. In object-oriented graphics, every graphic element can be defined and stored as a separate object, defined by a series of end points. Because a formula defines the limits of the object,



Sending and receiving Geoshare half-links. Conversion of data—here, units of depth—to a form understandable by the receiving application is the job of the receiving half-link between Geoshare and the Finder system. A well location can be a point with reference to one of several features, such as the kelly bushing, a formation top or a seismic surface.

Suppose you want to send a seismic interpretation from a Charisma workstation to the Finder system. Both the Finder and Charisma systems recognize an entity called "well location." In the Charisma data model, well location is defined by X and Y coordinates and by depth in one of several units, such as decimeters. The Finder data model also defines well location by X and Y coordinates, but it does not yet recognize decimeters. The Finder model understands depth as time (seconds or milliseconds), inches, feet or meters (above). The Geoshare data model can understand all units of depth, so the Charisma sending half-link therefore has only to send decimeters to the Geoshare bus. The Finder receiving half-link, however, must recognize that depth can be quantified six ways—feet, inches, meters, decimeters, seconds and milliseconds. In this case, the Finder receiving half-link provides the translation of decimeters into a unit understandable by the Finder system.

Writing a receiving half-link typically takes six to nine months, which is an order of magnitude longer than writing a sending half-link. The main difficulty in writing a receiving half-link is that it attempts to act like a large funnel. It tries to translate data from Geoshare's broad data model into the application's focused data model, so it has to consider many possible ways that data can be represented in the Geoshare model. The ideal receiving half-link would look at every way a fact could be represented, and translate each possibility into the variant used by the receiving application. For example, many interpretation systems use a variant of a grid structure to represent surfaces. Such surfaces may represent seismic reflectors or the thickness of zones of interest. Geoshare provides three major representations for such surfaces: grids, contours and X, Y and Z coordinates. If the receiver looks only at incoming grids, the other two kinds of surface information may be lost. The policy taken by a receiver should be to look for any of these possibilities, and translate into the internal representation used by the applications.

it can be manipulated—moved, reduced, enlarged, rotated—without distortion or loss of resolution. These are powerful capabilities in analyzing representations of the earth and mapped interpretations.

"Object-oriented" to a programmer or software developer tends to mean object-oriented programming (OOP). It does not necessarily imply new functionalities or a magic bullet. Its most significant contribution is faster software development, since large chunks of existing code can often be reused with little modification. Conventional sets of instructions that take eight weeks to develop may take only six weeks when done in OOP. It is analogous to modular construction in housing, in which stairs, dormers and roofs are prefabricated, cutting construction time in half.

The next wave in data bases themselves is a shift toward object-oriented programming, in which the user can define classes of related elements to be accessed as units. This saves having to assemble the pieces from separate relational tables each time, which can cut access time.

POSC's Epicentre model uses essentially relational technology but adds three object-oriented concepts:

- **unique identifiers for real-world objects**
- **complex data types to reflect business usage**
- **class hierarchy for the drill bit example above.**

Further reading:

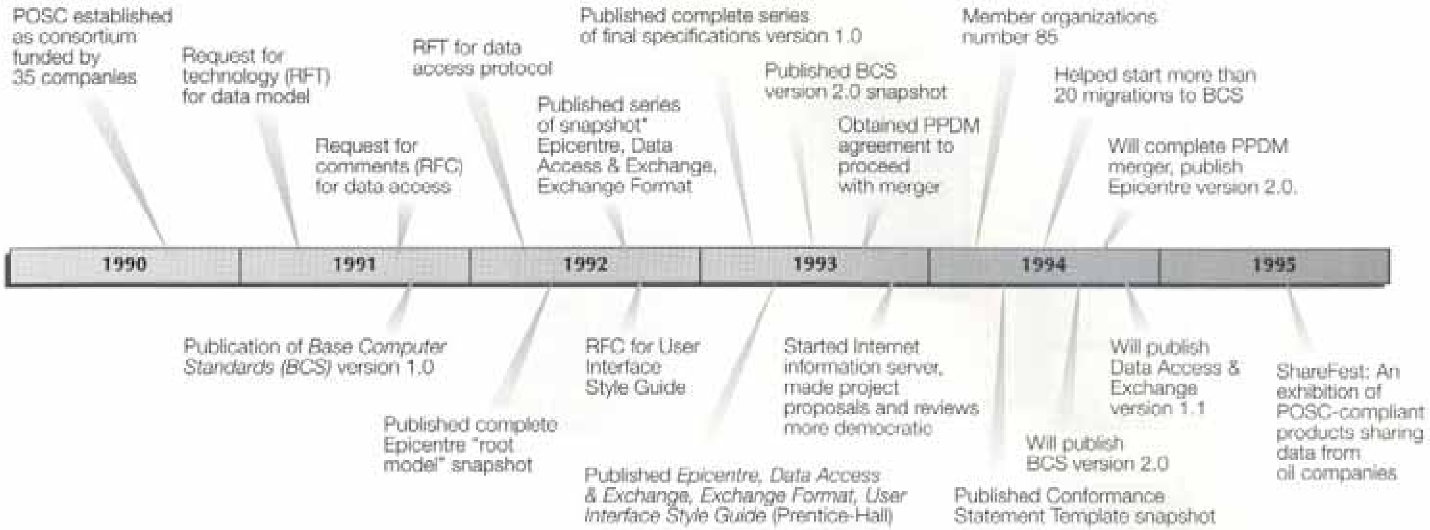
Tryhall S, Greenlee JN and Martin D: "Object-Oriented Data Management," paper SPE 24282, presented at the SPE European Petroleum Computer Conference, Stavanger, Norway, May 25-27, 1992.

Zdonik SB and Maier D (eds): "Fundamentals of Object-Oriented Databases," in Readings in *Object-Oriented Database Systems*. San Mateo, California, USA: Morgan Kaufmann Publishers, Inc., 1990.

Nierstrasz O: "A Survey of Object-Oriented Concepts," in Kim W and Lachovsky FH (eds): *Object-Oriented Concepts, Databases*, and Applications. New York, New York, USA: ACM Press, 1989.

Williams R and Cummings S: *Jargon: An Informal Dictionary of Computer Terms*. Berkeley, California, USA: Peachpit Press, 1993.

Aronstam PS, Middleton JP and Theriot JC: "Use of an Active Object-Oriented Process to Isolate Workstation Applications from Data Models and Underlying Databases," paper SPE 24428, presented at the Seventh SPE Petroleum Computer Conference, Houston, Texas, USA, July 19-22, 1992.



□*Milestones in POSC efforts.*

* A snapshot is an interim version, like an alpha or beta test in engineering.

The Geoshare standard can link two programs if they can both talk about the same data, even if not in the same vocabulary, such as the Finder and Charisma systems talking about "well location." But two programs have a harder time communicating if they don't understand the same concept. By analogy, a Bantu of equatorial and southern Africa could not talk with a Lapp about snow since the Bantu have no word for snow. In the E&P world, this problem of a missing concept happens about a third of the time when linking applications through the Geoshare standard. But there is a way around it. Look again at an example.

The Finder system and IES Integrated Exploration System, which is an interpretation system, both have conventions for designating wells. For the IES system, a well has a number, which can be determined in various ways, and a nonunique name. For the Finder system, a well is known by a specific kind of number, its API number. The Geoshare data model accepts all conventions. When a formation top is picked in the IES system, the top is labeled by well name and number. If it were shipped that way to the Finder system through Geoshare, the Finder system would not recognize the well because it is looking for an API number. The solution is to add a slot in the IES data model for the API number. The IES system itself does not use this slot, but when it sends data to the Finder system, the IES sending half-link adds the API number to the message, enabling the Finder system to recognize the well.

While the Geoshare standard is designed to function as a universal translator, the E&P community is working toward a common data model that will eventually eliminate the translator, or at least reduce the need for one. Recognition of the need for a common data model and related standards arose in the 1980s as technical and economic forces changed geoscience computing.[14] The rise of distributed computing made interdisciplinary integration possible, and flat oil prices shrank the talent pool within oil companies, resulting in smaller, interdisciplinary work groups focused on E&P issues rather than software development.

When work on information standards accelerated in the late 1980s, much of the industry support went to a nonprofit consortium, the Houston-based Petrotechnical Open Software Corp (POSC). An independent effort in Calgary, Alberta, Canada had been established by another nonprofit consortium, the Public Petroleum Data Model Association. Although the PPDM effort was on a smaller scale, in 1990 it was first to release a usable E&P database schema, which has since been widely adopted in the E&P community.[15]

At its inception, the PPDM was generally regarded outside Canada as a local, Calgary solution for migrating from a mainframe to a client/server architecture. The PPDM is a physical implementation, meaning it defines exactly the structure of tables in a relational data base. The effort at POSC is to develop a higher level logical data model, concentrating less on specifics of table structure and more on defining rules for standard interfacing of applications.[16] By analogy, the PPDM is used as blueprints for a specific house, whereas POSC attempts to provide a set of general building codes for erecting any kind of building.

Since 1991, widespread use and maturation of the PPDM—the data model is now in version 3—has increased its acceptance. This has changed POSC's strategy. Today, POSC is preparing two expressions of its Epicentre high-level logical data model, one that is technology-independent, implementable in relational or object-oriented databases (see "What is Object-Oriented—Really?" page 46), and another one to address immediate usage in today's relational database technology. The logical model is called the Epicentre hybrid because it adds some object-oriented concepts to a relational structure, although it leans heavily to the relational side. The first version of the hybrid was released in July 1993. The relational solution, to be released this summer, is POSC's merger of the hybrid and PPDM models, and is called informally the Epicentre/PPDM model. This model allows the few object-oriented features of the hybrid model to be used by relational software (right). The merged model is being tested by a task force comprising PPDM, POSC and several oil companies.

Epicentre Logical Model and Data Access and Exchange Format

An information model based on data requirements and data flow characteristics of the E&P industry

Data Model Expressions of the Logical Model

Epicentre Hybrid	Epicentre/PPDM
Implemented with a relational or partially or fully object-oriented database management system (DBMS)	Implemented with a relational DBMS and operating system or a DBMS bulk storage mechanism for large data sets
Accessed via a POSC-specified application programing interface	Accessed via a vendor-supported interface and a POSC-specified application program interface for complex data types
User accesses a physical data base that is not visibly different from the logical model	User accesses a physical data base that is equivalent to the logical model or visibly different from it
A single data model for applications that have not yet been able to effectively use a relational DBMS, such as reservoir simulators and geographic information systems	Provides a set of highly similar relational data models that can be implemented with current database management system software
Opens a market for vendors of object-oriented DBMS and an evolutionary path for relational DBMS	Provides a market for vendor products that meet the specifications of the logical model

Where is POSC Going?

After two years of developing standards, last summer POSC released version 1.0 of its Epicentre data model. Since then, Epicentre has undergone review, validation, convergence with the PPDM, and use by developers in pilot studies and in commercial products. Release of Epicentre 2.0, which POSC considers an industrial-strength data model, is due this autumn (*previous page*). Today the Epicentre hybrid model as a whole resides in a handful of database and commercial application products. Vendors have written parts of the specifications into prototype software, which is increasing in number, ambition and stability.

POSC has learned hard lessons about building a data model. "There are a lot of very good local solutions," says Bruno Karcher, director of operations for POSC, "that when screwed together make one big, bad general solution. What we have learned is how to take those local solutions, which are flavored by local needs and specific business disciplines, and find a middle ground. We know that the Epicentre logical model is not a one-shot magic bullet. It is guaranteed to evolve."

A key issue POSC is grappling with is the definition of "POSC-compliance," which today remains unspecified. From the user's perspective "POSC-compliant" equipment should have interoperability—seamless interaction between software from different vendors and data stores. The simplest definition of compliance means "applications can access data from POSC data stores," but the E&P community is still a long way from consensus on how this can be achieved practically. POSC has started building a migration path with grades of compliance. In these early stages, compliance itself may mean commitment to move toward POSC specifications over a given period.

A consequence of having all data fit the POSC model is disappearance of the application data store as it exists today—a proprietary data store, accessible only by the host application. For this to happen means rethinking the three levels—master, project and application—and blurring or removing the boundaries between them. Ultimately, there may be a new kind of master data base that will allow the user to zoom in and out of the data, between what is now the master and application levels. There will be fewer sets of data, therefore less redundancy and less physical isolation. At the conceptual level, applications that manipulate data will no longer affect the data structure. Applications and data will be decoupled.

"The problems of multiple data versions and updating may disappear," says Karcher, "but we will be looking forward to new problems, and as-yet unknown issues of data administration, organization and security. I think even when standards are implemented in most commercial products, POSC will continue to play a role in bringing together a body of experience to solve those new problems." —JMK

14. For a later paper summarizing the industry needs: Schwager RE: "Petroleum Computing in the 1990's: The Case for Industry Standards," paper SPE 20357, presented at the Fifth SPE Petroleum Computer Conference, Denver, Colorado, USA, June 25-28, 1990.

15. A schema is a description of a data base used by the database management system. It provides information about the form and location of attributes, which are components of a record. For example, sonic, resistivity and dipmeter might be attributes of each record in a log data base.

16. Chalon P, Karcher B and Allen CN: "AnInnovative Data Modeling Methodology Applied to Petroleum Engineering Problems," paper SPE 26236, presented at the Eighth SPE Petroleum Computer Conference, New Orleans, Louisiana, USA, July 11-14, 1993.

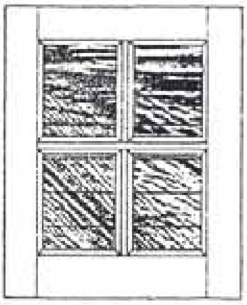
Karcher B and Aydelotte SR: "A Standard Integrated Data Model for the Petroleum Industry," paper SPE 24421, presented at the Seventh SPE Petroleum Computer Conference, Houston, Texas, USA, July 19-22, 1992.

Karcher B: "POSC The 1993 Milestone," Houston, Texas, USA: POSC Document TR-2 (September 1993).

Karcher B: "Effort to Develop Standards for E&P Software Advances," American Oil & Gas Reporter 36, no. 7 (July 15, 1993): 42-46.

Seismic Window

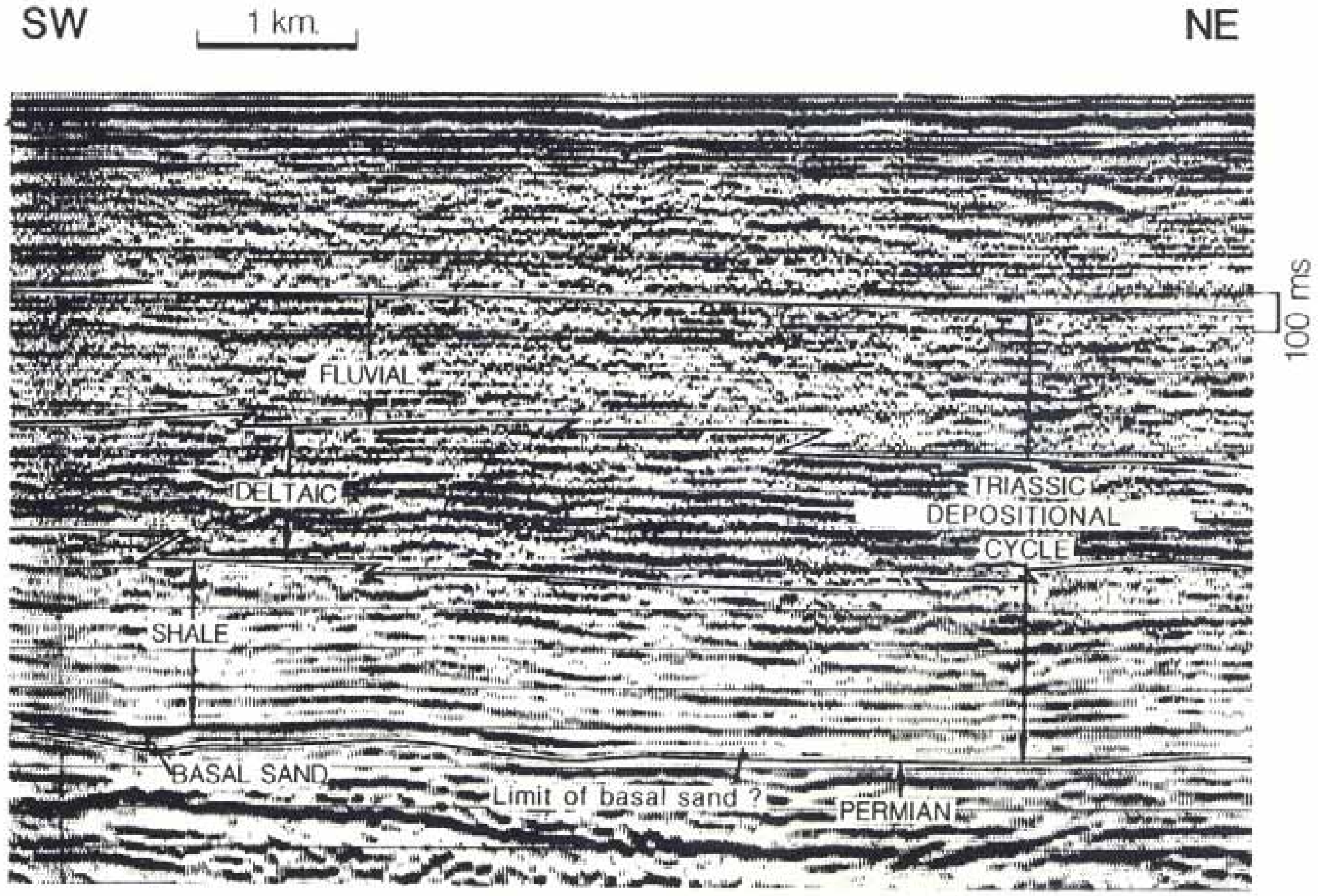
With



Rob Kirk
BHP Petroleum

The following example is taken from the Carnarvon Basin, Western Australia.

Carnarvon Basin, Western Australia - second order Triassic cycle (30 Ma+/-). Note basal transgressive (beach) sand overlying the top Permian sequence boundary followed by the transgressive and early regressive Locker Shale. The high stand Mungaroo Formation is characterised by a high amplitude and continuity deltaic facies and a variable amplitude, discontinuous fluvial facies.



UNIPULSE

with

Leonie Jones
University of
Wollongong

In the past few months I have not been inundated with contributions to **UNIPULSE** as I had hoped. I am sure that this lack of response is not indicative of a malaise in geophysics in our tertiary institutions, but simply shows that we are all ever busier trying to do more with less. So for starters, maybe the larger geophysics departments might like to submit something, perhaps a synopsis of material already collated for an annual report? Possible topics might include current research areas, grants awarded, collaborations with industry and government, innovations in teaching geophysics, short courses, summer schools and distinguished visitors. Remember that the aim of this column is to provide an informal forum for publicising geophysical activities in our universities.

As promised in my last column, I am sending out a questionnaire to all university departments involved in geophysics in order to obtain an overall picture of the state of geophysics in Australian universities. The questionnaire has been reproduced in this issue of Preview. It has been designed to gather information on staff, undergraduate and postgraduate courses, areas of specialisation, facilities and current research projects. I hope it will not prove too onerous to complete, and I thank those of you involved for your participation. The results will be reported in a future **UNIPULSE** column.

Again, a reminder! I am still seeking contributions, so here is your chance to promote your current activities. Please send material for **UNIPULSE** column to Dr. Leonie Jones at the address below.

Please send contributions to UNIPULSE column to:

Leonie Jones
School of Geosciences
University of Wollongong
Northfields Avenue
Wollongong NSW 2522

Tel: (042) 213103
or (042) 213841
Fax: (042) 214250

Email: l.jones@uow.edu.au

ASEG University Geophysics Questionnaire

This survey will provide information about the state of geophysical teaching and research in Australian Universities. The results will be reported in a article in **PREVIEW** and hopefully will stimulate further articles. Your replies will be very much appreciated and any further comments you wish to make will be most welcome.

If you are an academic geophysicist and did not receive a copy of the questionnaire below please copy it from Preview and return it to Dr. Leonie Jones at the address opposite. Enlarge the copy if necessary.

Institution:

Department:

Geophysical staff: Please list the names of all staff involved in teaching or research in geophysics. Include level (e.g. lecturer) and specialisation (e.g. mineral exploration - aeromagnetics). Note that a seperate short questionnaire is attached for individual staff responses.

Staffing patterns: Briefly outline how staffing levels in geophysics in your department have decreased or increased over (a) the last 5 years (b) the last 10 years.

Undergraduate teaching in geophysics:

1. Is a geophysics major available?

2. Please list the undergraduate geophysics subjects you offer, showing year or level, name of subject, hors lectures/practicals and credit point load (fraction of a year's load). Indicate whether the subject is taken by geology or geophysics majors.

Honours courses in geophysics:

1. Are Honours courses available in geophysics?

2. Are Honours projects predominately in exploration geophysics or "global" geophysics?

3. What is the source of financial support for Honours projects?

4. Does the Honours degree involve coursework? What percentage is it worth?

ASEG University Geophysics Questionnaire (Continued)

Postgraduate teaching and research

1. Are the following degrees available in geophysics?

MSc (coursework)

MSc (thesis)

PhD

2. Does your department offer postgraduate short courses in geophysics to industry?

Graduate employment

1. How many students graduated in geophysics from your department in 1995.

Undergraduate?	Honours?
Masters?	PhD?

2. Do they all have jobs?

3. What areas have they gone into?

Research:

1. List current areas of research in geophysics, indicating any collaboration with other institutions/industry.

2. How many post-doctoral researchers are there and how are they funded? (list sources of funding)

Geophysical facilities: Please list (on a separate sheet if necessary) what you have in the following categories:

1. Geophysical instruments

2. Computer hardware

3. Geophysical software

4. Any other equipment

INDIVIDUAL STAFF QUESTIONNAIRE

(please photocopy if more are required)

Name:

Level:

e-mail address:

Highest degree (include institution and year):

Industry experience:

Area(s) of specialisation (e.g. mineral exploration - aeromagnetics)

Undergraduate teaching areas: *(please indicate if you also teach outside geophysics e.g. introductory geology or geology for engineers)*

Postgraduate teaching areas/supervision:

Current research projects(s): (include titles of Hons, MSc & PhD projects you are supervising)

Membership

New Members

We welcome the following new members to the Society. Their details need to be added to the relevant State Branch databases.

Queensland

Teresa TULLY
Mining Research
Mount Isa Mines Ltd
Mount Isa QLD 4825

Western Australia

John McDONALD
Curtin University of technology
Dept. of Exploration Geophysics
GPO Box U1987
Perth WA 6001

Kelvin BLUNDELL
43 North Street
Swanbourne WA 6010

Sheryl MURPHY
53 Langham Gardens
Wilson WA 6107

Sergey SHEVCHENKO
8/51 Short Street
Joondanna WA 6060

South Australia

Maurice CRAIG
Bldg 180 Labs
DSTO
PO Box 1500
Salisbury SA 5108

New South Wales

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Tesla-10 Pty Ltd
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University of Ghana
Geology Department
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Accra, GHANA

George ASIAMAH
C/o BHP Minerals
Ghana Inc.
11 Kakfamadu Road
East Cantoments
Accra, GHANA

Michael HARRISON
33 Yonge Street, Suite 610
Toronto, Ontario
CANADA M5E 1G4

DEPT OF EARTH RESOURCES SURVEYS, ITC
Kanaalweg 3
2628 EB, Delft
THE NETHERLANDS

Change of Address

The following changes need to be made to the relevant State Branch databases:

Victoria

CRA Exploration Pty Ltd
From: PO Box 254
Kent Town SA 5071
To: Private Bag 3,
Bundoora MDC,
VIC 3083

Bob SMITH
From: CRA Exploration
Pty Ltd
PO Box 254
Kent Town SA 5071
To: 38 Porter Street
Eltham VIC. 3095

Craig DEMPSEY
From: Marathon Petroleum
Indonesia Ltd
To: BHP Petroleum
120 Collins Street
Melbourne
VIC. 3000

Mark DRANSFIELD
From: 8 Levander Place
Wilson WA 6107
To: 293 Banyule Road
Viewbank
VIC. 3084
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Robert CASTLEDEN
From: CRA Exploration Pty Ltd
826 Whitehorse Road
Box Hill VIC. 3128
To: CRA Exploration Pty Ltd
Exploration Technology & Information Group
Private Bag 3
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4 Research Avenue
Bundoora
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New South Wales

Brian SPIES
From: Schlumberger-Doll Research
Old Quarry Road
Ridgefield CT 06977
USA
To: CRC for Australian Mineral Exploration Technologies
Dept. of Earth Sciences
E5A Level 3
Macquarie University
NSW 2109
AUSTRALIA

Michael LEYS
From: 13 Rowland Street
Blayney NSW 2795
To: 13 Lane Street
Blayney NSW 2799

Western Australia

Ron HACKNEY
From: 62 Hawken Street
Cooma NSW 2630
To: 24 Station Street
Wembley WA 6014

Richard STUART
From: 104 Nanson Street
Wembley
WA 6014
To: 55 Orrel Avenue
Floreat Park
WA 6014

Stephen MASSEY
From: Placer Exploration
9 Love Street
Myaree WA 6154
To: 137 Petra Street
East Fremantle
WA 6158

George SAKALIDIS
From: Magdata Consultants
135 The Esplanade
Mt. Pleasant
WA 6153
To: Magdata Consultants
PO Box 1388
West Perth
WA 6872

Roland HILL
From: C/- Newcrest Mining Ltd
179 Great Eastern Highway
Belmont WA 6104
To: 65 Chaffers Street
Boulder WA 6432

Laurence HANSEN
From: 16 Gairlock Place
Joondalup WA 6027
To: 11 Seneca Gardens
Joondalup WA 6027

Patrick OKOYE
From: 8/111 Hubert Street
East Victoria Park
WA 6101
To: 18/22
King George Street
Victoria Park
WA 6100

Chris LUXTON
From: 58 Weatherley Drive
Two Rocks
WA 6037
To: 114 Casino Road
Glen Forrest
WA 6071

Barry WILLIAMS
From: Western Geophysical
P.O. Box 6383
East Perth WA 6892
To: 29 Lakeview Drive
Edgewater WA 6027

South Australia

Nader FATHIANPOUR
From: School of Earth Sciences
GPO Box 2100
SA 5001
To: School of Earth Sciences
Flinders University of SA
GPO Box 2100
SA 5001

International

David JOHNSON
From: C/- Western Mining Corporation
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To: University of Utah
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Dept. of Geology & Geophysics
Salt Lake City
UT 84112 USA

Karen CRISTOPHERSON
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PO Box 855
Hamilton Central
QLD. 4009
To: Chinook Geoconsulting Inc.
26961 Hilltop Road
Evergreen, CO
804395462 USA

Ken WITHERLY
From: BHP Minerals Inc.
801 Glenferrie Road
Hawthorn
VIC. 3122
AUSTRALIA
To: BHP Minerals Exploration
550 California Street
San Francisco CA
94104 USA

Brian RUMPH
From: 7 Kings Avenue
Roseville NSW 2069
AUSTRALIA
To: 66 Prospect Place
Wapping Wall
London E7 9TJ
UK

Where are they?

Does anyone know the new address of the following members? Last known addresses are given below:

Stephen BIGGINS
Last known address:
10 Richman Avenue
Prospect SA 5082

Stephen ARNOTT
8 Hare Street
Kalgoorlie WA 6430

Andrew WOLSKI
8 Yvonne Street
Yeronga QLD. 4104

Tim ALLEN
PO Box 1231
West Perth WA 6872

Victoria TAN
19/54 Melville Parade
South Perth WA 6151

Michael NELSON
46 Kings Park Road
West Perth WA 6005

Resignations

The following members have re-signed from the society and their details need to be deleted from the relevant state branch databases.

Paul DRAPER
19 Angas Crescent
Marino SA 5049

Kerry GALLAGHER
School of Geological Sciences
Kingston University
Kingston-upon-Thames
KT1 2EE
ENGLAND

Calendar of Events

September 24-27 1996

The 11th Offshore South East Asia Conference & Exhibition World Trade Centre, Singapore
For further details:
Singapore Exhibition Services P/L
2 Handy Road
#15-09 Cathay Building
Singapore 229233
Tel: (65) 338 4747
Fax: (65) 339 5651
E-mail info@sesmontnet.com

Sept 30 - Oct 3 1996

6th Int'l Conference on Ground Penetration Radar Aoba Memorial Hall, Tohoku University, Sendai, Japan
For further details:
Dr. Motoyuki Sato
GPR '96 Technical Chairman
Dept of Resources Engineering
Faculty of Engineering
Tohoku University
Sendai 980-77, Japan
Tel: +81-22-222 1800 ext 4548
Fax: +81-22-222-2144
eml: GPR96@earth.tohuku.ac.jp

Sept 30 - Oct 3 1996

ANZAAS '96 - Defending our Planet Rydges Lakeside, Canberra
For further details:
ANZAAS Congress '96
GPO Box 2816
Canberra, ACT 2601
Tel: Freecall 1800 063 046
November 10-15 1996
SEG Annual Meeting
Denver, USA (see advert p38)
For further details:
SEG, Tulsa USA
Fax: 0011-1-918-493 2074

November 27-29 1996

Nickel 96, Mineral to Market, Kalgoorlie WA Sponsored by AusIMM, AIG and WASM
For further details:
G. Drew, C/- CRAE Pty Ltd
21 Wynyard Street
Belmont WA 6104

December 18-20 1996

33rd Annual Convention and Meeting on Geophysical Instrumentation at National Geophysical Research Institute Hyderabad, India
For further details:
Dr. P. R. Reddy,
Hon Secretary
Indian Geophysical Union
NGRI Campus, Hyderabad
500 007 India

February 23-27 1997

12th ASEG Conference & Exhibition Sydney Convention & Exhibition Centre, Australia
For further details:
ASEG Conference Secretariat
Conference Action Pty Ltd
PO Box 1231
North Sydney NSW 2059
Australia
Tel: =61-2-9956 8333
Fax: +61-2-9956 5154
email: GEOINS1@IBM.NET

March 12-14 1997

The AusIMM Annual Conference Ballarat VIC 3353
For further details:
Conference Secretary
R.M. Croggon,
Univ. of Ballarat
PO Box 663
Ballarat VIC 3353
Tel: =61-53-279 113
Fax: +61-53-279 137

September 14-18 1997

Exploration '97 4th Decennial International Conference on Mineral Exploration Toronto Canada
For further details:
CAMESE
101-345 Renfrew Drive
Markham Ontario Canada
L3R 9S9
Tel: 0011-1-905 513 0046
Fax: 0011-1-905-513 1834
email: 103214.545@compuserve.com

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- **Report on Publications Review**
- **Line Kilometres to Hectares - Aeromagnetic Photograph**
- **PetroBank - For the E&P Data Mountain**
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