HOUSTON GEOLOGICAL SOCIETY 1923

Bulletin

Houston Geological Society

HGS JOBS HOTLINE: 713-785-9729

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1994

Volume 36
Number 5

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Intricate shadows on crossbedding of the Page Sandstone, Peach Canyon, Arizona.
– Photo taken by Bruce I. May

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Bulletin Houston Geological Society

THE MONTHLY BULLETIN OF THE HOUSTON GEOLOGICAL SOCIETY

Houston Geological Society
7171 Harwin, Suite 314.
Houston, TX 77036-2190
Phone (713) 785-6402
FAX (713) 785-0553
Office Hours: 7 a.m. - 4 p.m.

Reservations to the General Meetings

Reservations are made by calling the HGS office. At the meeting, names are checked against the reservation list. Those with reservations will be sold tickets immediately. Those without reservations will be asked to wait for available seats and a $5.00 surcharge will be added to the price of the ticket. All who do not honor their reservations will be billed for the price of the meal. If a reservation cannot be kept, please cancel or send someone in your place.

Prices for January Meetings

General Dinner Meeting,
and Poster session,
Post Oak Doubletree Inn,
January 10, $20.00

Environmental and Engineering
Geologists, H.E.S.S. Building
January 12, $2.00

International Explorationists,
and Poster session,
Post Oak Doubletree Inn,
January 17, $22.00

North American Explorationists,
H.E.S.S.,
January 24, $20.00

Luncheon Meeting
January 26, $15.00

To Submit Articles and Announcements

Manuscripts, inquiries, or suggestions should be directed to the Editor, c/o HGS Bulletin. Deadline for copy is six weeks prior to publication. **All copy must be prepared on a word-processor and submitted on a disk** along with an identical hard copy output of the text. Most popular software programs will be compatible with our equipment, please call about any particular problems.

To Advertise in the Bulletin

Call John King at 358-8604 for information about advertising in the Bulletin.

Editing

The Editorial staff meets at 5:30 on the first Wednesday evening of the month to discuss the content and improvement of the coming issues.

Layout

The page layout is produced using QuarkXpress 3.1.1 on a Macintosh Quadra 950.

Type

Typefaces used in the Bulletin are New Baskerville, Optima, Eurostile and Souvenir.

Bulletin Committee

HGS JOBS HOTLINE 713-785-9729

The Bulletin Houston Geological Society (ISSN 0018-6686) is published monthly except July and August by the Houston Geological Society, 7171 Harwin, Suite 314, Houston, Texas, 77036. Subscription to the Bulletin Houston Geological Society is included in the membership dues ($18.00 annually). Subscription price for non-members within the contiguous U.S. is $25.00 per year. For those outside the contiguous U.S. the subscription price is $46.00 per year. Single copy price is $3.00. Second class postage is paid in Houston, Texas.

POSTMASTER: Send address changes to Bulletin Houston Geological Society, 7171 Harwin, Suite 314, Houston, TX 77036-2190

Seeking Nominations

Each year the HGS Awards Committee is responsible for nominating qualified individuals for various AAPG, GCAGS and HGS awards. With a membership of over 5000 individuals, it has become increasingly difficult for the Awards Committee to have knowledge of all qualified candidates. Many individuals with excellent credentials are undoubtedly passed by every year because we are not aware of their activities. If you know of someone who you think is deserving of an award or honor, please contact Dan Bonnet at 650-8008 no later than February 1, 1994.

Specific awards for which we are seeking nominations are:

HGS
a) Distinguished Service- given to members who have rendered long term and valuable service to the society.
b) Honorary Life- given to members who have distinguished themselves in the science of geology, or have contributed outstanding service to the Society.
Past winners can be found in the front of the HGS directory.

GCAGS
a) Distinguished Service
b) Honorary Life
c) Outstanding Educator
Past winners can be found in the front of the GCAGS Transactions.

AAPG
a) Sidney Powers Memorial Award
b) Honorary Membership
c) Michel Halbouty Human Needs Award
d) Public Service Award
e) Distinguished Service Award
f) Journalism Award
Past winners and a description of each award can be found in the December issue of the AAPG bulletin.

Please think hard of people deserving of recognition so their contributions will not go unnoticed.

PRESIDENT'S COMMENTS

Dan Bonnet and the HGS Awards Committee Recognize Achievements as Well as the Importance of Volunteer Efforts.

Happy New Year! Here's hoping that the coming year is healthy and happy for us all. The coming of the new year always seems to bring to my mind how much things change. One of the few certain things in life is change. It has always seemed to me that happiness is measured at least in part by our ability to manage change positively. We in the domestic energy business should be recognized experts by now!

Rather than "stream of consciousness" rambling (as above), I'd like to use this column to highlight some of the things the HGS does that I think are particularly worthwhile and that I didn't know about until I got involved in HGS "management." I do this in part to let you know so that you can take advantage of the services offered but also with the hope that you might find yourself interested in one of our programs and volunteer to help out. *My personal experience has been that volunteering is a net sum gain.* This has been especially true with the HGS.

When I was preparing to award the HGS's Outstanding Earth Science Teacher Award at the September evening meeting, it brought to mind just how much our Awards Committee does. Dan Bonnet had just faxed me the citation and it seemed as if we were talking on one subject or another at least once a month. The award was a plaque and $250, but the importance of it in my opinion is the recognition and the encouragement it gives. This committee also gives Outstanding Student Awards which recognize the achievements of Earth Science students from six area universities. There is one award for each university, and a biography of each awardee is compiled and published in the Bulletin. They also receive a cash award. The committee judges the student poster sessions and awards a best poster award at our April evening meeting. At the Houston Engineering and Science Fair, Dan and his committee judge the Earth Science category and present awards. The committee also distributes $150 contributions in support of the Science Olympiad and the Science Fair.

In addition to activities in support of students, the Awards Committee is also responsible for recommending professionals for GCAGS and AAPG awards. This usually involves some research and the preparation of biographical information.

Dan and his committee judge the quality of the technical presentations at the general dinner and luncheon meetings and award a "Best Paper" award each year (it's a really nice mineral specimen). Dan also arranges for a plaque or engraved paperweight as a commemorative gift for each of our general meeting speakers. When I was VP (which is also Technical Program Chairman), I was very rarely turned down when inviting a speaker. That probably wasn't because of the plaque, but the speakers were always very appreciative of the remembrance.

Awards are also given out to our own members to recognize service to our Society.

If you are aware of someone that you think our Awards Committee should know about, please forward your recommendation to Dan Bonnet at the HGS office.

See you at the meetings!

John M. Biancardi

CONVERSATION CORNER

What's Going On??

I decided to survey the last three issues of HGS Bulletin and AAPG Explorer in order to estimate the level of interest on government affairs. I examined the September through November issues of these publications. The results surprised me. There have been 19 articles on the general subject ranging from short, personal letters to the Editor to comprehensive and authoritative reviews of Texas Railroad Commission programs.

On the up-side, it was good to see the first three parts of Lori Wrotenbery's articles from the Texas RRC. It was also gratifying to see responses to issues presented to the membership by the Ad Hoc Committee. One member from Carlsbad, California, wrote to the *Bulletin* (September issue) stating that he would never vote for any Libertarian candidate if their views, as expressed by Libertarian spokesman Kormylo, reflected the mentality of that party. (It's still a free country.) Likewise, a local HGS member thought John Kennedy's editorial against an import fee might have been tongue-in-cheek, except that the article was a reprint of Kennedy's Oil and Gas Journal editorial of January of this year. (Displaced state-side geologists seem to see this issue differently than internationalists.)

It does not appear, however, that support for the Task Force for Registration of Geologists and Geophysicists in Texas is what it should be. Pete Rose, Dan Titerle, and Dave Rensick have done an outstanding job of explaining this issue and in soliciting funds for the Task Force. Please read their articles in the October and November issues of the Bulletin. Also, if you agree with their objectives, send $35 or more to the Task Force at 8800 Bluff Springs Rd., Austin, TX 78774. Those who practice (or who may someday practice) environmental geology or hydrogeology could be particularly and seriously impacted by failure of legislation to register geologists. Don't plan on complaining - down the road - to Pete and company if you don't support them now, when help is needed.

Jack Howard
Ad Hoc Committee on
Education Regarding Government Affairs

This Bulletin Brought To You By: Optical Opportunities

HGS *Bulletin* and *Directory*. Talk about great eye contact for your advertising dollar: six thousand members, viewing ten *Bulletin* editions and one *Directory* annually - that's 132,000 optical opportunities on the first pass! Webster (Joe Webster - a former petroleum geologist/ad copywriter) defines an optical opportunity as one eyeball viewing one advertisement.

Eyeball the *Bulletin's* new easy reading format, crisp, clear advertising, and highly visible cover. Glance at your well-thumbed *Directory* edition and consider how often you refer to it. Further consider how well your company logo, message or personal business card would look in either publication.

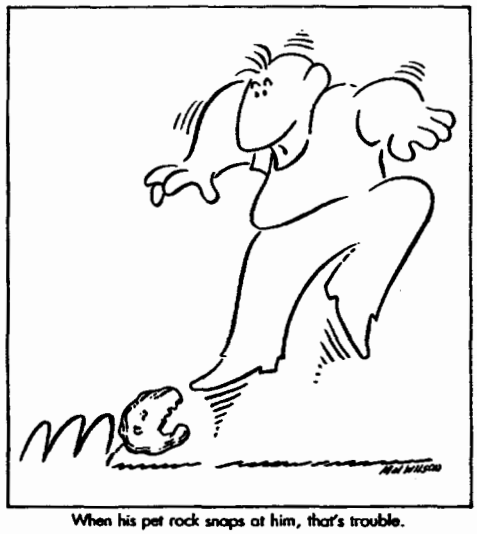
Wouldn't you like to be a part of this growing and very vital component of the Houston Geological Society? It's easy. There are rates for every budget, and modern technology facilitates the inclusion of your ad in a forthcoming edition.

Use a PC or photography to customize your message, and furnish it in a "camera-ready" form to the HGS office on Harwin St. "Camera-ready" means a film positive or laser print suitable for scanning into the printer's PC (Dot matrix prints do not scan well). Arrangements also exist to transmit digital data directly to Four Star Printing's office. Copy is due a full month before publication.

HGS advertisers are wonderful folks. They support a great publication, and society in a positive way, and receive excellent coverage any way you look at it. While we salute them, here we invite you to join them and see for yourself the power of optic opportunity. Call today at 785-6402, or 358-8604.

John King
HGS Advertising Chairman

Cartoons submitted by Bill Roberts



When his pet rock snaps at him, that's trouble.

Help Students, Help Yourself

This is a crucial time for the HGS Foundation. Scholarships are provided from the interest received on assets. With today's lower interest rates, the Foundation must increase its financial base to continue aiding at least six undergraduate students annually. While there are many financial sources available to graduate students, the Foundation is one of the few for undergraduates. We need thoughtful supporters like you. Your gift is a seed to help pay tuition, textbooks, and housing expenses for students of today and tomorrow.

Please take a few minutes today and make a generous check payable to the HGS Foundation, 7171 Harwin, Suite 314, Houston 77036. The students need you.

COMMENTARY

The Bulletin staff regrets the exclusion of the three figures referred in this December 1993 printed comment by Gary Lanier. The following is our complete reprint with appropriate maps.

Odd Number of Contours

The premise implied in this article (Quick Look Techniques September 1993, Odd Number of Contours) is that it is common practice for geological mappers to contour incorrectly around "finite faults." I've reviewed hundreds of prospect submittals in the past several years and I do not recall this as being a common error. However, there is something very frightening about this map (even after correcting the contouring problem pointed out by Subsurface Consultants) which is not addressed. Do you see the problem?

The major down-to-east fault is compromised of three fault segments as shown on Figure 2. There is enough structural information available on this map to construct fault planes for each of the three faults. Fault plane A contours reasonably well (Figure 3.) Fault planes for B and C are shown in Figure 4. The odd behavior of these fault planes would make me very suspicious of this map. I would tend to think that there was some kind of correlation bust from upthrown to downthrown in this example or that the fault solution is incorrect.

The most common mapping error I encounter while evaluating prospect submittals is mis-located fault traces. This results from mappers not utilizing fault plane maps. Most of prospect submittals I have seen do not contain fault plane maps. Fault cuts are usually (correctly) annotated on the submitted structure maps so that subsurface data are available to construct fault plane maps. If you construct fault plane maps from the provided fault cuts and redraw the fault traces on the provided structure maps using the same general contouring, you are likely to discover a very different map...the attic prospect disappears! If fault cuts are not provided, reconstruct the fault planes as I have done with the above mapping problem.

Gary J. Lanier

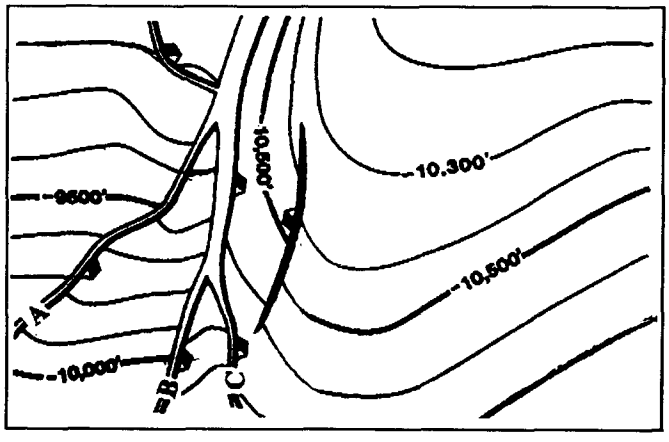


Figure 1

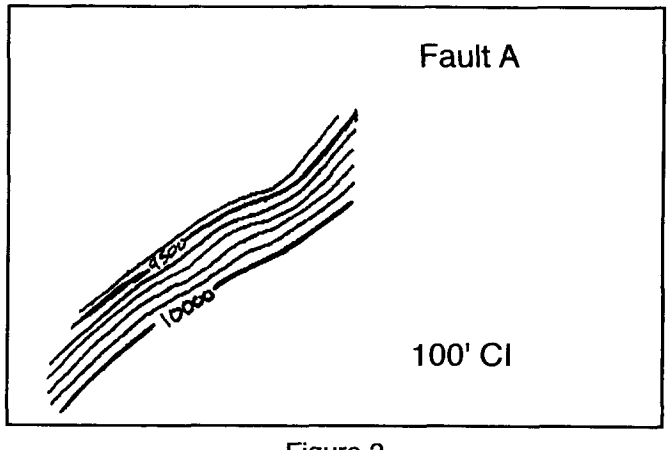


Figure 2

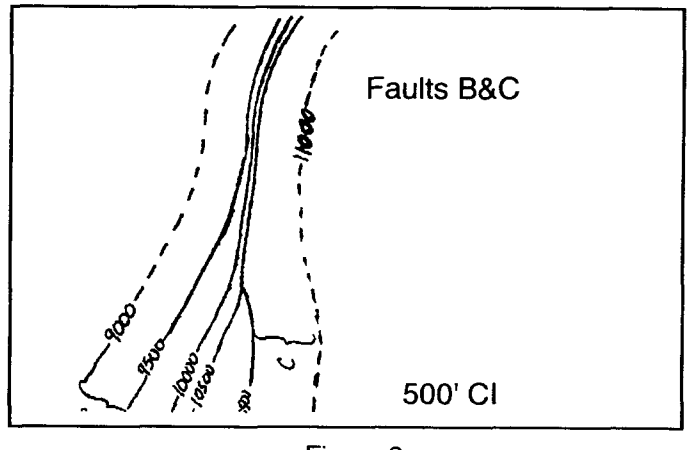


Figure 3

HGS DONATION/SPONSOR CONTRIBUTION MENU

The Houston Geological Society has many excellent activities and programs worthy of financial support. Typically, our dedicated program chairpersons must solicit contributions and donations for their activities and programs from the same donor/sponsors who have just been solicited by another HGS committee chairperson. In an effort to simplify this important process, as well as allow potential donor/sponsors to see the full range of deserving HGS programs, we have created this Donation/Sponsor Contribution Menu for your ease and "one-stop shopping". If you take this format to heart and contribute generously all at one time, the HGS committee chairpersons may not have to contact you again near event time, and your designated funds will be provided to them in a more efficient and less time consuming manner. This will also give them more time to concentrate on their activity or program. The HGS Executive Board, the Committee Chairpersons, and all the HGS members "Thank You " for your generous and consistent support.

ENTERTAINMENT	**Dollar Amount**
Golf Tournament	_____
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HGS DINNER MEETING

The Open-Coast Clastic Depositional Model, Theme and Variations

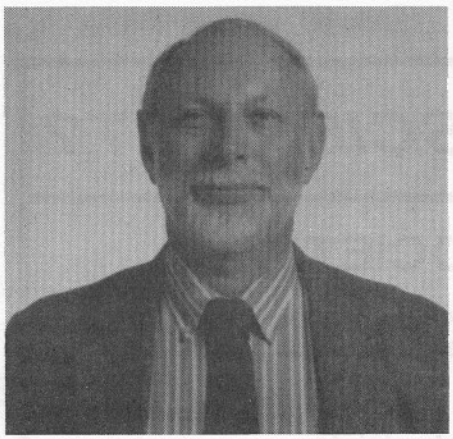
H. Edward Clifton

HGS DINNER MEETING - January 10, 1994
Social Period, 5:30 p.m. Dinner and Meeting, 6:30 p.m.
Post Oak Doubletree Inn

Studies of modern coastal systems indicate that the upward depositional facies sequence- -bioturbated inner shelf - crossbedded upper shoreface - planar-laminated foreshore - nonmarine deposits- -characterizes most open-coast clastic successions. This generalized model has been applied successfully to a variety of ancient coastal deposits, owning largely to consistency of both processes and preservation through geologic time. Any such model, however, must accommodate significant internal variability, imposed by differences in sediment texture, nearshore bathymetric profile, ambient energy, storm events, and relative sea-level change. The resulting variations about the basic theme are reasonably predictable and provide a basis for enhanced paleo-environmental understanding. Ignoring them, however, can lead to misinterpretation of ancient coastal deposits.

As one example, the fine-grained, low-energy, microtidal Texas Gulf shorefaces have a distinctive vertical sequence that contrasts sharply, as one might expect, with that of the more energetic Pacific coast. The Gulf of Mexico sequence also differs, however, to nearly the same degree from that generated in a similar low-energy, microtidal setting on coarse-grained Mediterranean coasts.

H. EDWARD CLIFTON - Biographical Sketch



Ed Clifton joined Conoco in 1991 after serving 30 years with the U.S. Geological Survey, most of it with the Branch of Pacific Marine Geology in Menlo Park, California. He received his Bachelors degree in geology from Ohio State University in 1956 and a Ph.D. from Johns Hopkins in 1963, where he studied under Francis Pettijohn. His career with the USGS focused largely on comparative analysis of modern and ancient shallow marine depositional systems and culminated in numerous publications. In 1969 and 1970 he accumulated 80 days of underwater research from an undersea habitat as an aquanaut in Tektite man-in-the sea experiments. In 1978-1981, he served as Chief of the Branch of Pacific Marine Geology. He has been active in professional societies and was elected National President of SEPM (Society for Sedimentary Geology) in 1986. In addition to his USGS responsibilities, Ed has taught at San Francisco State University, University of California at Santa Cruz, and at Stanford University, where he served as Adjunct Professor of Geology from 1982 - 1991. After spending two years in Conoco's Research Lab in Ponca City, where his focus was largely on sequence stratigraphy and sedimentology of Lower Jurassic units in the North Sea, Ed has recently moved to Houston to join a project directed toward the applications of sequence stratigraphy.

HGS LUNCHEON MEETING

APATITE FISSION TRACK ANALYSIS APPLIED TO THE MARGINS OF THE GULF COAST BASIN

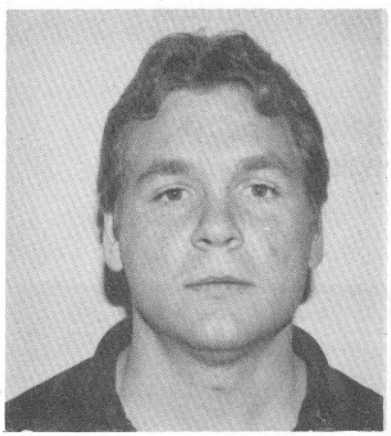
Raymond A. Donelick and Jeff Corigan

HGS LUNCHEON MEETING – January 26, 1994
Social Period, 11:30 a.m., Luncheon and Meeting, 12:00 p.m.
The Houston Club

Trace quantities of radioactive uranium occur in apatite grains. When one of these uranium nuclei decays by nuclear fission, the two resultant nuclear fragments repel each other and tear a damage trail through their host apatite crystal lattice. Damage trails of this type are called fission tracks, and they can be made visible using conventional light microscopes by immersion in acid solution. The measurable characteristics of the fission tracks in apatite (i.e., their number, length, width) contain a wealth of information regarding the thermal history that the host rock has experienced during its geological evolution.

Apatite fission track ages from 12 Precambrian granitic samples from the Llano Uplift vary from 182±50 Ma to 425±72 Ma (95% confidence intervals), with mean track lengths varying from 11.2±0.1 μm for the same samples. While not systematic, ages generally increase from east to west. Zircons from these samples are metamict, indicating that rocks presently exposed in the Llano Uplift did not experience temperatures greater than ~225±25°C since Precambrian time. A single sample from a Pennsylvanian sandstone (Smithwick Formation), located just east of the Llano Uplift, gives an apatite fission track age of 241±18 Ma, and a mean length of 11.9±0.2 μm. Using available stratigraphic constraints, it is inferred that the Llano basement samples were at temperatures of <70°C prior to initiation of the Ouachita orogeny during Pennsylvanian time. Subsequent heating of the Llano basement samples associated with the Ouachita orogeny is evident in the apatite fission track data. The ages and track length distributions are all consistent with the Llano basement samples having been heated to temperatures of ~90-120°C due to burial of the Llano by a 1-2 km thick Pennsylvanian to Permian molasse sequence (Strawn to Cisco Groups) derived from the Ouachita orogeny. Based on numerical modeling of the apatite fission track data, we interpret the variability in ages and mean track lengths to reflect small magnitude (<1 km) differential loading of the Llano Uplift due to westward thinning of this molasse sequence. From late Permian (?) through Jurassic time, samples cooled from ~90-120°C, based on model results, to <40°C, based on stratigraphic constraints. This early Mesozoic stage of cooling is attributed to erosional unroofing associated with extensional collapse of the Ouachita orogen during initial opening of the Gulf of Mexico. Mild reheating of these samples to >60°C due to deposition of ~1 km of Cretaceous to Early Tertiary (?) strata across the Llano region is needed to explain the low percentage of tracks in the 14-16 μm range. Final cooling of these samples below ~60°C did not occur until post-Paleogene (?) time. This late stage cooling is interpreted in terms of regional Tertiary erosion along the outer rim of the Gulf of Mexico basin due to flexural upwarping associated with basinward loading of the crust.

RAY DONELICK -
Biographical Sketch



R. A. (Ray) Donelick started Donelick Analytical in 1991 in order to provide fission-track related services to the energy industry. In addition to his being a sole proprietor, Ray is currently an Adjunct Assistant Professor at Rice University and a Research Scientist at The University of Texas at Austin. Ray received his Bachelor of Science degree in Geology from the University of Miami in 1983 and his Masters and Doctoral degrees in Geology from Rensselaer Polytechnic Institute in 1986 and 1988 respectively. He continues to focus his research efforts toward the development of improved techniques for the application of apatite fission track analysis to the study of geological problems.

Chair's Column

Happy New Year!

We have something a little out of the ordinary for our February 28 meeting, when we hold a joint meeting with the local chapter of the Association of International Petroleum Negotiators. Dr. Richard Smith, Director of Asian Studies at Rice University will present "The Importance of Cross Cultural Understanding - China as an Example".

Coincidentally, the AIPN will be holding a conference on "Cultural Impacts on International Negotiations" March 9-11 in the Woodlands,TX. For more information, call Mr. Mick Jarvis at 366-5728.

We welcome Mary M. Page, a charter member of the group, to the committee as coordinator for Announcements and Company Representatives. The network has grown, and we need more volunteers to assist in this vital role! Please call ! Also, various members of the committee will be looking for ways to strengthen our Company Representative network. You may be called!

GEO 94: Middle East Geosciences Conference & Exhibition, April 25-27, 1994. Featured topics: Reservoir Characterization, 3-D Seismic and (of course!) Carbonate Stratigraphy. Field Trips offered are: Trias-Jurassic of Oman; and Modern Arid Sedimentology of the Gulf.

-Thom Tucker, Chair

International Explorationists Committee Members 1993-94

Chair: ***Thom Tucker,***
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Technical Program: ***Lyle Baie***
New Ventures-SETSCO 777-1222

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Finances & Tickets: ***Ed Loomis***
Amoco 366-3079

Announcements and Company Representatives: ***Mary M. Page***
GeoPro Services 367-4061

Directory: ***Herb Duey***
Consultant 531-0950

PROGRAM NOTE:

The importance to our membership of this month's talk will be the significance of the Paleozoic play in the Middle Eastern countries which issue exploration/production leases. The play will, of course, add to the Saudi reserves.

-Lyle Baie, Technical Program

INTERNATIONAL EXPLORATIONISTS

Geologic Setting for Additional Paleozoic Petroleum Potential in the Middle East

Louis Christian

HGS Dinner Meeting – January 17, 1994
Social Period, 5:30 p.m., Dinner and Meeting, 6:30 p.m.
Post Oak Doubletree Inn

The greater Middle East Sedimentary Basin holds about 60% of world-wide oil reserves, and in recent years has produced up to nearly 40% of world-wide annual oil production, depending on changing political and economic conditions in the Middle East and elsewhere.

For approximately half a century most oil has been produced from Upper Jurassic Carbonates and Middle to Lower Cretaceous Carbonates in Saudi Arabia, Iran, and the Emirates, from Lower Cretaceous deltaic sandstones in Iraq, Kuwait, and northern Saudi Arabia, and from Lower Miocene to Eocene carbonate reservoirs in Iran and Iraq.

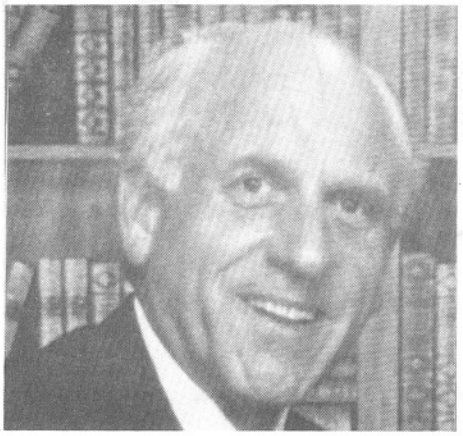
Beginning in 1989 and 1990 this picture began to change significantly. Major to giant-sized Paleozoic discoveries of oil, plus gas and condensate, were reported on shelf areas west and southwest of the main Jurassic producing fields of Saudi Arabia. As far north as Jordan and Turkey, other discoveries of unknown commerciality, have been reported from Permian, Carboniferous and Devonian sandstone reservoirs.

Some of these are destined to become major or giant sized producing fields. For example, Saudi Aramco's Hawtah discovery, southwest of Riyadh, is scheduled to start producing in 1994 at a rate of 150,000 BOPD from Permo-Carboniferous sandstones.

Several geologic traits favor further Paleozoic oil discoveries along the western shelf-slope of the Middle East Basin. Pre-Hercynian subcrop geology, with known major north-trending fault blocks, the presence of oil-prone, mature Silurian source rocks in adjacent subbasins, known Triassic and younger isochron thinning and compaction over old structural highs and old topographic highs, and structural interference patterns between regional Paleozoic north-south axes and late Cretaceous-Tertiary northwest trending structures combine to create a strong geologic rationale for expanding current Paleozoic exploration northward beyond the borders of Saudi Arabia into parts of Iraq, Iran, Jordan, Syria, and Turkey, and to the south, in certain structurally higher parts of the Emirates.

Selective areas are prospective for Paleozoic oil, but thermally overmature areas will, of course, be largely prospective for gas. Preliminary maturation fairways have been mapped regionally, to highlight the oil potential areas.

LOUIS CHRISTIAN - Biographic Sketch



Louis Christian began his exploration in California with Chevron. Subsequently, he has held assignments in the Philippines, Libya , Tunisia, and Indonesia for Mobil Oil. His interest in Middle East petroleum exploration dates to 1982, having worked on Iraq, Abu Dhabi, Kuwait, Yemen, etc. This presentation summarizes Mr. Christian's current work as an independent consultant, integrating his many years of experience in the area.

POSTER SESSION

at the January 17 meeting,
on the Maturation History of
the Arabian Platform and
Eastern Mediterranean

R.S. Bishop &
P.P. McLaughlin, Exxon

INTERNATIONAL BRIEF

PERU ADOPTS NEW HYDROCARBONS LAW*

In keeping with President Alberto Fujimori's overall plan to rebuild the national economy, the government of Peru has been following strict economic stabilization measures including deregulation of prices, wages, exchange and interest rates, elimination of subsidies, simplification of tariffs, and elimination of restrictions on the flow of capital and foreign trade. It has also begun privatization of government business activities, and on 13 September 1993 passed Peru's new Organic Law for Hydrocarbons, Law 26221, which provides the legal framework for deregulation, privatization, and reorganization of the petroleum sector.

At a forum sponsored by Simon Petroleum Technology for representatives of the petroleum community in Houston, The Peruvian Minister of Energy and Mines, Dr. Daniel Hokama, described his country's commitment to stability and economic growth, and to private development of its oil and gas resources. Legal Advisor to the Minister, Dr. Oscar Arrieta, described the technical, fiscal, and contractual aspects of Peru's new petroleum law.

The law includes a number of revisions of terms that will make it more attractive to foreign investors, and provides for creation of a new state company under private law, PERUPETRO S.A., to promote investment in hydrocarbon exploration, negotiate contracts, and market through third parties. Dr. Hokama said, "It is essential that the State be a regulator, rather than an executor, of production activities." Many of the activities of the old state oil company, Petroperú, are being offered to the private sector. Its service stations and shares in SOLGAS are already in private hands, and the process will continue.

An oil operations contract for Petromar Petroperú's offshore operation, will be signed with Petrotech as soon as the pending problem with AIG is resolved.

The New Law

The "Organic Law of Hydrocarbons" is based on the previous law, and ensures the validity of existing contracts. It also permits current contractors to take advantage of new incentives within 60 days of the new law's effective date. It provides for two types of agreements: a license agreement, in which the investor is the owner of the hydrocarbons produced and has free disposal rights; and the familiar service contract, in which the investor receives a percentage of the hydrocarbons delivered to Perupetro S. A. Other types of contracts proposed by the investors will also be considered. Foreign companies must establish a branch or partnership in Peru, and appoint a Peruvian representative.

The Contract

Investors may hold as many contracts as they wish and the size of the contract area will be limited only by the investment represented by the proposed work program. The work program will be guaranteed by a bank guaranty. Contract terms are limited to 30 years for liquid hydrocarbons, and 40 years for natural gas. A 7-year exploration program is included in the term. The party may request a 5-year maximum suspension period between the exploration and exploitation phases if there is no means to transport the liquid production. The maximum is 10 years in the case of gas. There is no obligation to supply the local market.

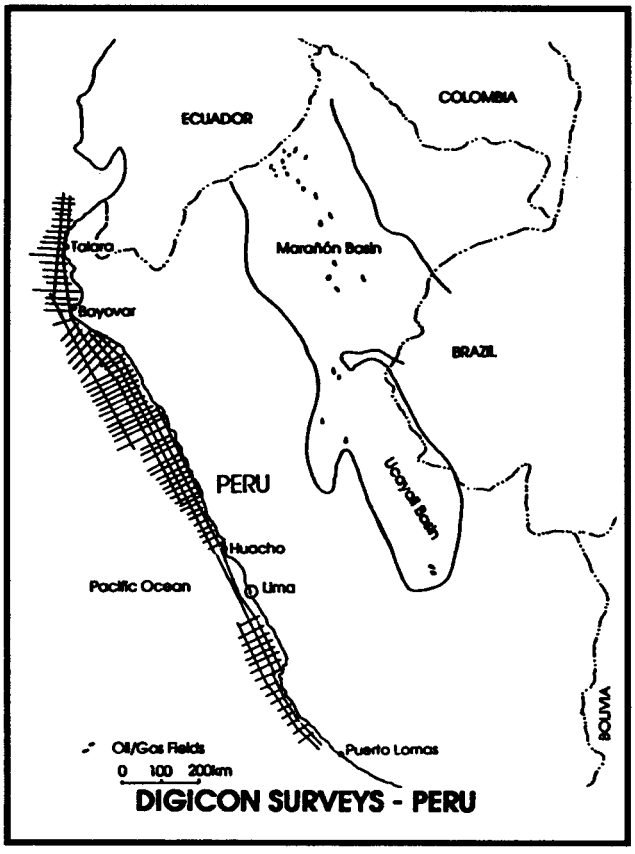
Fiscal Aspects

Taxes levied will be those in force at the time the contract is signed. Income tax is 30% on net profit plus 10% of the amount remitted. The combined rate is 37%, which may be paid in cash or kind. Contractors with license agreements pay a royalty to the State. Importation of goods for the exploration operation is free of all duties, as is export of hydrocarbons produced. The investor is guaranteed availability of foreign currency, and free to dispose of it in Peru or abroad. Accounting records may be kept in foreign currency.

Data Available

Apart from data in the Petroperú, or Perupetro archives, which can be viewed in Lima, Simon Petroleum Technology (SPT) has several major multi-discipline evaluation studies of the Marañón and Ucayali basins including recently acquired seismic data, extensive reprocessing of prior data, structural and stratigraphic analysis, new biostratigraphic, geochemical, and sedimentological analysis, prospect definition, reservoir engineering, and an assessment of the petroleum geology and hydrocarbon potential of the basins. Interested parties should contact: R. Wayne Carpenter, Simon Petroleum Technology, Houston, Texas, U.S.A., Telephone: 1-713/953-7441, Fax: 1-713/953-9343.

SPT formed a consortium in 1992 with Ribiana, Inc. and Petroperú to conduct a 10,000 km seismic survey over the Peruvian continental shelf. The survey, which is the most ambitious, and the first of its kind in 20 years, was shot by the M/V "Digicon Explorer", and has now been completed in record time. It is available in three segments: Phase I, Bayovar to Huacho, 5000km: Phase II Ecuador to Bayovar, 2500 km: Phase III Haucho to Puerto Lomas, 2500 km: or by individual lines, 200 km minimum. Interested parties should contact: Scott A. Humphrey, Digicon Geophysical Corp., Houston, Telephone: 1-713/630-4222, Fax: 1-713/630-4311: London, Jim Martin, Telephone: +44 342328111; Singapore, Elwyn Jones, 65-258-1221.



**Reprinted with permission from the International Exploration Newsletter, Oct. 1993.*

BASINS OF THE WORLD

A symposium in memory of Dr. Rudy Schwarzer
Adjunct Professor of Geology, Rice University

Friday, February 25, 1994, 1:00-4:00 p.m.
Rice University Campus

Room 131 - Anderson Biological Laboratories
(next to Keith Wiess Geological Lab)

The Department of Geology and Geophysics of Rice University will present a lecture and poster series - "Basins of the World" - on February 25, 1994. This half-day session, in honor of Dr. Schwarzer, long-time adjunct and friend of the department, will feature three faculty members and be followed by a poster session featuring the worldwide projects of the Rice's Geology and Geophysics graduate students.

Speakers are:

Albert W. Bally
Southeast Mexico, The Regional Setting for the Last Giant Fields of North America

Manik Talwani
Geophysical Methods for Subsalt Exploration in the Gulf of Mexico

Peter R. Vail
Preliminary Results from European Basin Correlation Program

If planning to attend, please make reservations with the department at 713-527-4880.
For more information, contact Martha Lou Broussard at the same number.

Simpson and Viola Groups in the Southern Midcontinent

A Workshop Sponsored by the Oklahoma Geological Survey
March 29–30, 1994; Norman, Oklahoma

This seventh annual Workshop is designed to transfer information that will aid in the search for, and production of, our oil and gas resources. The Simpson and Viola Groups (Ordovician in age) are major sandstone and carbonate reservoirs that have yielded large volumes of oil and gas, and that have a great potential for yielding additional hydrocarbons by the use of advanced-recovery technologies. Papers should be surface or subsurface studies dealing with the geologic setting, depositional environments, and diagenetic history of these strata and/or reservoirs, or deal with reservoir characterization and the engineering factors that influence hydrocarbon accumulation or hydrocarbon production.

Our Workshop will focus on the Simpson and Viola Groups (or equivalent rocks) in the southern Midcontinent, including Oklahoma and contiguous parts of Kansas, Missouri, Arkansas, Texas, New Mexico, and Colorado. It will consist of 20 papers presented orally and 15 informal poster presentations, and will be attended by 200–300 participants. The proceedings (including extended abstracts for the posters) will be published by the OGS about one year after the meeting: we expect manuscripts to be completed and submitted shortly after the workshop.

NORTH AMERICAN EXPLORATIONISTS

Balanced Cross Sections of the Arbuckle-Ardmore Region, Southern Oklahoma: Implications for Interpreting Strike-Slip Deformation

by Steve Naruk

North American Dinner Meeting – January 24, 1994
Social Period, 5:30 p.m., Dinner and Meeting, 6:30 p.m.
H.E.S.S. Building, 3121 Buffalo Speedway

The structures of the Arbuckle Mountains and Ardmore Basin have long been considered definitive examples of strike-slip deformation. These interpretations are questionable, however, because estimates of the amount of strike-slip on the main fault (the Washita Valley Fault) vary from as little as 3 miles to as much as 40 miles, and both well and seismic data show that the major faults of the area dip only 40-50°.

This paper presents a series of highly constrained, balanced and palinspastically restored vertical cross sections which show that the observed structures may be entirely dip-slip compressional structures. The overall structure is that of a large scale passive duplex. The master strike-slip "propeller" fault, which appears to reverse its dip and sense of throw along strike, is interpreted as the roof and floor thrusts bounding a plunging basement wedge. The Arbuckle Anticline itself is interpreted as a fault-bend fold in the hanging-wall of the roof thrust. The apparent releasing bend in the master strike-slip fault appears to be a triangle zone in the footwall of the roof thrust. The apparent positive flower structures adjacent to the Arbuckle Anticline are interpreted as second-order, detached folds in the roof sequence of the duplex. These new interpretations suggest that many of the structural criteria thought to be characteristic of strike-slip structures, are in fact characteristic of dip-slip passive duplexes involving basement.

STEPHEN J. NARUK - Biographical Sketch

Steve Naruk is a Senior Geologist with the New Resources group of Shell Western E&P Inc. He received his Ph.D. and M.S. in structural geology from The University of Arizona, and his BS in geology and geophysics from Yale University. He is currently part of a closely integrated E & P team responsible for evaluating and developing unconventional plays such as the Austin Chalk, as well as new conventional plays in mature areas such as California. Previous assignments with Shell include structural research projects covering Alaska, West Texas, Nevada and California. He is the author of numerous journal articles on a variety of topics in structural geology.

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Session IA will cover technical changes in the past 10 years and uncertainties related to site characterization and source characterization.

Robert Dahlquist, Esq.
Session IB will discuss the role of legislation on remediation and the implications.

Michael Kavanaugh, Ph.D., P.E., D.E.E.
Session II will present case histories from Responsible Parties, views on liability, technologies, and related costs.

William Colglazier, Ph.D.
Session III will cover partnerships between the regulatory community and private industry.

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national ground water association

To request a brochure contact Trisha Freeman or to register contact Teresa or Pat at **(800) 551-7379 or (614) 761-1711** or write to NGWA, 6375 Riverside Dr., Dublin, OH 43017.

ENVIRONMENTAL/ ENGINEERING GEOLOGISTS

Environmental Geology and Cyclostratigraphy of the Pleistocene in the Northern Gulf of Mexico Region

by Peter K. Trabant

HGS Environmental/Engineering Committee Evening Meeting - January 12, 1994,
Social Period, 6:30 p.m., Program 7:00 - 8:00 p.m.
Houston Engineering and Scientific Society (HESS) Bldg.
3121 Buffalo Speedway

High-resolution seismic records from the northern Gulf of Mexico reveal the fine-scale details of the seismic stratigraphy at the shelf edge and within deep water depositional environments. The high frequency records, commonly used for offshore engineering studies, provide an excellent tool towards understanding the detailed relationship between climate, sea level and the resulting seismic stratigraphy. Applications include: paleo-environmental studies, reservoir engineering, petroleum exploration and the assessment of sea floor engineering properties. Quality high-resolution seismic records permit the correlation between small scale climatic changes and the 3-D configuration of sedimentary deposits, including systems tracts and short term events such as slumping and diapiric movements.

PETER K. TRABANT- Biographical Sketch

Dr. Trabant has been an independent consultant in marine geology and geophysics to the offshore petroleum industry for the past 19 years. He received his Ph.D. and M.S. degrees in geological oceanography from Texas A&M, and his B.S. in geology from the University of Miami. His work involves the interpretation of multi-sensor geophysical data for the installation of offshore structures and pipelines, and the production of environmental and engineering reports for regulatory agencies. His clients include major and independent oil companies, engineering and geophysical service companies, while his activities have been worldwide. His secondary activities involve teaching and research on the applications of seismic sequence stratigraphy to high resolution geophysical data in: petroleum exploration; reservoir studies; seafloor engineering; and paleoclimatology. He is the author of the textbook: Applied High Resolution Geophysical Methods: Offshore Geoengineering Hazards published by Prentice Hall.

Continuing Education

The Department of Geoscience of the University of Houston is pleased to announce the following courses for the Spring 1994 semester:

GEOL 3101	Big Bend Field Trip	TBA
GEOL 3378	Intro Atmospheric SCI	10-11:30 a.m. TTH
GEOL 4397	Intro to Earthquakes	4-5:30 p.m. MW
GEOL 6341	Geochemistry I	5:30-7 p.m.TTH
GEOL 6344	Stable Isotopes	5:30-7 p.m. TTH
GEOL 6397	Advanced Hydrogeology	5:30-7 p.m. MW
GEOL 6397	Tect & Sedim Basin of So. America	7-8:30 p.m. MW
GEOL 6339	Igneous Petrology	7-8:30 p.m. MW
GEOL 6397	Seismic Data Acquisition	7-8:30 p.m. MW
GEOL 7320	Seismic Velocity	7-8:30 p.m. TTH
GEOL 7330	Potential Field Methods	5:30-7 p.m. MW
GEOL 7335	Geophysical Interpretation	5:30-7 p.m. TTH

Registration for these courses is scheduled for early Jan. 1994. For more information contact Cassandra Heavrin - 713-743-3401.

South Texas College of Law Course

South Texas College of Law is sponsoring its 5th annual continuing education course on **Environmental Law Symposium** on January 27-28, 1994. The course is aimed at environmental and oil & gas lawyers and other professionals involved in the oil & gas and environmental areas. Approved by AAPL for Recertification Credits is pending. Tuition for non-legal environmental professionals is $175.00 For more information, call (713) 646-1757.

ENVIRONMENTAL/ ENGINEERING FEATURE

Update on Railroad Commission Programs Part 5 of a 5 Part Series (Reprinted from a Railroad Commission Report)

by Lori Wrotenbery
Director of Environmental Services
Oil and Gas Division Railroad Commission of Texas

V. Oil Spill Cleanup Standards

In April of 1992, the Railroad Commission issued interim guidelines for the cleanup of crude oil spills. The guidelines contain numerical standards and step-by-step procedures to promote consistency in cleanups across the state, but give a responsible operator the flexibility to chose an appropriate cleanup method for a specific spill site.

These guidelines are interim. The Commission has begun the process of adopting standards and procedures for oil spill cleanup by rule by redrafting the interim guidelines into the form of a proposed rule. The proposed rule was published in the Texas Register for public comment on March 30, 1993.

A. Scope

The interim guidelines apply to the cleanup of soil contaminated by spills from exploration and production operations, including pipelines. There are two key limitations on the scope of these guidelines.

First, they apply only to spills of crude oil. The Commission will address the cleanup of produced water spills separately.

Second, they apply only to spills into soils in non-sensitive areas. They do not apply to spills in sensitive areas, such as spills into surface water bodies, in areas with shallow groundwater, or in parks, wildlife refuges, or residential areas. Spills in these sensitive areas may require more extensive cleanup. The Commission will determine cleanup requirements for spills in sensitive areas on a case-by-case basis.

B. Standards and Procedures

The interim guidelines outline the following steps for the cleanup of a crude oil spill into soil:

1. Remove all free oil immediately.
2. Delineate the affected area, both horizontally and vertically.
3. Bring all soil containing over one percent by weight (10,000 parts per million (ppm)) total petroleum hydrocarbons (TPH) to the surface for remediation of disposal.
4. Handle all soil containing over five percent by weight (50,000 ppm) TPH using special procedures to prevent stormwater contamination.
5. Achieve a final cleanup level of one percent by weight TPH as soon as technically feasible, but not later than one year after the spill. the operator may select any technically sound cleanup method that will achieve the final cleanup level.

The guidelines also outline reporting requirements for cleanup activities. The reporting requirements build upon the reporting requirements under the Commission's current rules[75] and vary depending on the size of the spill. For spills over 10 barrels, the operator must submit to the Commission analyses of samples representative of the spill site to verify that the final cleanup level has been achieved.

The Commission used the one weight percent TPH cleanup level in the interim guidelines after studying the constituents of crude oils, reviewing the scientific literature on spill cleanup, and considering the cleanup standards of other agencies and states. It varies from the cleanup standard established by the Texas Water Commission for underground storage tank cleanups because of the different risk factors presented by crude oil spills, such as the lower benzene content of crude oil as compared to gasoline. The cleanup level of one weight percent TPH after one year is consistent with the land-spreading criteria in IOGCC's guidelines for state oil and gas waste management programs.

C. Relation to RCRA

Although most crude oil spills are exempt from regulation under the RCRA hazardous waste management program,

Continued on page 23.

[75] Rule 20 (Notification of Fire, Breaks, Leaks, or Blowouts), 16 Tex. Admin. Code § 3.20.

CALL FOR GEOLOGICAL PAPERS

FOR 1994 GSA SECTION AND ANNUAL MEETINGS

SOUTH-CENTRAL SECTION
March 21–22, 1994
Holiday Inn West Holidome
Little Rock, Arkansas

Abstract Deadline:
Past due 1993

Submit completed abstracts to
William Bush
Arkansas Geological Commission
3815 Roosevelt Ave.
Little Rock, AR 72204
(501) 324-9165

NORTHEASTERN SECTION
March 28–30, 1994
Holiday Inn–Arena
Binghamton, New York

Abstract Deadline:
Past due 1993

Submit completed abstracts to
H. Richard Naslund
Department of Geological Sciences
SUNY
Binghamton, NY 13902-6000
(607) 777-4313

NORTH-CENTRAL SECTION
April 28–29, 1994
Western Michigan University
Kalamazoo, Michigan

Abstract Deadline:
January 6, 1994

Submit completed abstracts to
Ron Chase
Department of Geology
Western Michigan University
Kalamazoo, MI 49008
(616) 387-5500

CORDILLERAN SECTION
March 21–23, 1994
San Bernardino Hilton
San Bernardino, California

Abstract Deadline:
Past due 1993

Submit completed abstracts to
Joan E. Fryxell
Department of Geological Sciences
California State University
5500 University Parkway
San Bernardino, CA 92407-2397
(909) 880-5311

SOUTHEASTERN SECTION
April 7–8, 1994
Virginia Tech
Blacksburg, Virginia

Abstract Deadline:
Past due 1993

Submit completed abstracts to
A. Krishna Sinha
Department of Geological Sciences
Virginia Tech
Blacksburg, VA 24061-0420
(703) 231-5580

ROCKY MOUNTAIN SECTION
May 4–6, 1994
Tamarron Resort
Durango, Colorado

Abstract Deadline:
January 13, 1994

Submit completed abstracts to
Jack A. Ellingson
Geology Department
Ft. Lewis College
Durango, CO 81301
(303) 247-7244

GSA Annual Meeting
Seattle, Washington, October 24–27, 1994

Abstract Deadline: July 6, 1994

Submit completed abstracts to
Abstracts Coordinator
Geological Society of America • 3300 Penrose Place • P.O. Box 9140 • Boulder, CO 80301-9140
(303) 447-8850

1994 ABSTRACT FORM REQUEST

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Please send ____ copies of the 1994 GSA abstract form. I understand that the same form may be used for all 1994 GSA meetings—(the six Section Meetings and the Annual Meeting).

Name _____

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GOVERNMENT AFFAIRS

TNRCC Consolidation Update

Texas Natural Resource Conservation Commission

On September 1, 1993, the Texas Water Commission (TWC) and the Texas Air Control Board (TACB) merged to form the Texas Natural Resource Conservation Commission (TNRCC). The TNRCC is one of the largest and most comprehensive state environmental protection agencies in the nation. It includes almost 3,000 employees, 15 regional field offices and will have regulatory oversight for protecting air, water and land resources in Texas from pollution.

TNRCC GOALS

The TNRCC will focus on providing environmental protection for Texas citizens in the most effective and efficient manner possible To achieve this, the TNRCC has established a number of priorities:

- By the year 2000, reduce the amount of hazardous waste and toxics discharged in Texas by 50 percent, municipal solid waste going to landfills by 50 - 60 percent and pollution to Texas waterways by 30 - 50 percent.
- Meet all requirements of the Federal Clean Air Act.
- Be responsive to Texas citizens seeking information or reporting environmental problems.
- Develop a more efficient enforcement process and eliminate enforcement backlogs.
- Provide increased technical assistance to help Texas businesses and local governments comply with environmental standards.
- Ensure the timely issuance of permits to Texas businesses and local governments that meet environmental standards.
- Manage limited resources wisely to provide the highest level of environmental protection possible with the funding received.
- Ensure that TNRCC actions and decisions consistently meet the test of fairness and common sense.
- Provide a working environment that will promote high morale and productivity among TNRCC employees.

GOVERNING BOARD

Under Senate Bill 2, which creates the TNRCC, the current three-member Texas Water Commission will preside over the new agency. The legislation dissolves the nine-member TACB board effective September 1, 1993. The TNRCC, however, will confer and consult with TACB board members and will invite them to serve on key task forces and advisory groups.

CONSOLIDATION PROCESS

Work on the consolidation began following the 1991 legislative session. Governor Ann Richards formed the Environmental Agencies Transition Committee, which devoted some 18 months to an overall review concerning how the two agencies operate. The committee produced suggestions for maximizing resources and increasing efficiency. Those suggestions are being interwoven into the final consolidation plan as it develops.

Utilizing a total quality management approach, consolidation planning by the TWC/TACB has involved the full participation of both staffs. Consolidation teams were formed in the areas of permitting, enforcement, hearings, rulemaking, agenda, field operations, budget and planning, financial administration, facilities, agency operating policies and procedures, and purchasing. The teams were charged with identifying the best practices in use by either agency. For instance, the consolidated agency will utilize the rulemaking process developed by the TACB. That process requires that proposed rules come before the Commission for discussion from conceptualization through adoption so that the public has an opportunity for input during each step of development.

AGENCY STRUCTURE

The structure of the TNRCC will include seven program clusters: the Commissioners, the Executive Director, Waste Management, Air Quality, Water Resource Management, Legal and Regulatory Services, and Administration.

TACB program areas are reflected in the Air Quality cluster. The cluster will consist of four divisions: air policy, air quality planning, permitting and enforcement, and air monitoring operations.

The TNRCC will feature a number of new initiatives:

- An Enforcement Policy Division has been created to streamline and upgrade TNRCC enforcement policy, and to direct a criminal enforcement unit;
- A new Program Evaluation Unit will conduct efficiency audits and suggest steps for increased effectiveness;
- The Small Business Advocate is a resource for the tens of thousands of small businesses in Texas that now must meet a variety of federal clean air regulations;
- A new Environmental Training Division will operate a training academy to bring new technical employees up to speed more quickly and to increase the overall technical skills of agency staff;
- A Permit Caseworkers Unit will be established to facilitate the permitting of job-creation projects and to serve as a point of contact regarding permitting issues in general;
- An Agriculture and Rural Assistance Division has been created to focus exclusively on agricultural permitting and enforcement, and to provide technical assistance to dairy and feedlot operators.
- A TNRCC Electronic Bulletin Board will be available via telephone for anyone with a computer and modem. It will provide agency rules, frequently used forms with instructions, as well as TNRCC items of general interest.

PERMITTING, INSPECTIONS AND ENFORCEMENT

Immediately upon consolidation, there will be no substantial change in the

point of contact or the manner in which permits are issued, inspections are conducted or enforcement proceedings are initiated. The regulated community with air permits will be served by TACB personnel and those with TWC permits by TWC personnel. Over time, however, the consolidated agency will move to "whole facility" permitting, inspections, and enforcement procedures, This will first require the cross-training of personnel as well as the completed installation of the Texas Regulatory Activities Compliance System (TRACS). This "super computer" system will consolidate all information about a regulated customer into one format and location. An air quality data base will also be built and consolidated into the system. TRACS should be fully operational by late fall. The goal is to implement "whole facility" actions within two years.

Consolidated actions will occur in some areas immediately. For instance the TACB Stage II vapor recovery program (to control vapors that escape when gas is pumped) will be consolidated with the TWC's Petroleum Storage Tank (PST) program to allow more efficient use of staff involved in those two programs.

There will be significant emphasis at the TNRCC to streamline permitting, enforcement and inspection procedures. Efforts underway have already reduced the time it takes to receive a TWC permit by 30 - 50 percent. In addition, TWC backlogs of wastewater permit applications have been eliminated. Backlogs in municipal solid waste and hazardous waste applications will be eliminated by April 1994. Air permitting will see the same efficiencies applied as it comes into a single system.

The TNRCC will also feature a Permit Caseworkers Unit, established to expedite significant job-creation projects through the permitting process and to provide a point of contact regarding permitting matters in general. Also, permitting and enforcement matters related to agriculture will be brought under a newly formed Agriculture and Rural Assistance Division to provide additional focus and assistance.

A review of the TWC's enforcement process, now underway, should yield improvements to the consolidated agency by early fall. The goal is to better facilitate regulated entities that will aggressively correct violations as well as decrease the time it takes to complete enforcement actions involving repeat violations or uncooperative operators.

REGIONAL OFFICES

The TNRCC will operate 15 regional offices. The service areas of each will conform to the legislatively mandated Uniform State Service Region (USSR) plan. The USSR standardizes service areas for all state agency regional offices. Upon consolidation, the TNRCC field staff will total approximately 650.

The TNRCC has consolidated (TWC / TACB) regional offices in San Antonio, Lubbock, Austin, Amarillo, San Angelo and Abilene. Remaining regional offices will be consolidated as lease agreements expire or are renegotiated. The goal is to have TNRCC consolidated offices in all 15 regions by September, 1994.

The Field Operations Division central office in Austin will have a division director with program directors for air, water and waste. This four-member central office management team will participate in decision-making within the respective programs.

Each TNRCC regional office will be managed by a regional manager who also will have program managers for air, water and waste.

MAILING ADDRESS

The TWC's current mailing address will become the official mailing address of the TNRCC. That address is:

Texas Natural Resource
Conservation Commission
P.O. Box 13087
Austin, TX 78711-3087

All correspondence intended for Austin TNRCC units should be mailed to the P.O. Box address. This will guarantee the quickest delivery via the agency's centralized mail room. State law requires all agency mail be processed through a centralized mail room because the agency receives fee payments through the mail.

PHONE NUMBER

The TACB's current agency general information telephone number became the official main phone number of the TNRCC effective September 1, 1993. That number is:

512 / 908 - 1000

COMMISSION AGENDA MEETINGS

The TNRCC plans to hold a "policy agenda meeting" once a month at which proposed rules and other policy issues would be discussed and public input received.

Once adequate facilities can be developed at the TNRCC's Park 35 complex in north Austin, agenda meetings will be held at that location.

Update on Railroad Commission Programs, Continued from page 20.

spills from crude oil transmission pipelines are not. EPA's hazardous waste regulations may apply to the cleanup of spills from these pipelines if the contaminated soils fail the toxicity characteristic test for benzene or other toxic constituents.

EPA has received requests from several states, including Texas, to suspend application of the new toxicity characteristic rule[76] to petroleum-contaminated soils and other media. The states are concerned that applying hazardous waste regulations to the cleanup of soils and other media contaminated by petroleum product spills will hinder cleanup efforts by creating delays, increasing costs, and straining the existing hazardous waste disposal capacity. EPA deferred application of the toxicity characteristic rule to wastes from underground storage tank (UST) cleanups for much the same reason.

EPA recognized this problem and has proposed to suspend the toxicity characteristic rule for media contaminated by non-UST petroleum products for three years[77] In the proposal, the term "petroleum product" is defined to include crude oil. The proposed suspension would be effective only in those states that certify to EPA that they have programs in place to effectively manage the cleanup of petroleum product spills.

[76] 55 Fed. Reg. 11798-11877 (March 29, 1990).

[77] 57 Fed. Req. 61542-61556 (December 24, 1992).

GCAGS CONVENTION CITY LOCATION QUESTIONNAIRE

For 42 years, the Gulf Coast Association of Geological Societies, known as the GCAGS, has held its annual convention every October in one of its member society cities. Of the 12 local societies that comprise GCAGS, three have never held an annual convention (East Texas, Southeastern, and Alabama) allowing the other nine member societies to host the convention every ***nine*** *years. Since dedicated volunteer members must be found in each city to work on the convention, this nine year schedule has not been burdensome to the memberships, even for the larger three societies who must also host the annual AAPG National convention every six years. Unfortunately, declining memberships have left many of the smaller societies undermanned in some cases to form committees to hold the GCAGS when it has rotated to their city recently. Even more importantly, due to the considerable expense guarantees demanded by convention center and hotel facilities in every city, and the recent large losses incurred at Jackson and now Shreveport, it is time to consider alternative options for future convention years.*

HGS has over 5000 of the GCAGS membership of less than 8,000 total members. The Houston membership is consistently represented at over 50% of registrants at all recent GCAGS conventions. Due to the serious financial questions raised by the recent small city GCAGS conventions, the HGS Executive Board felt that we should poll the membership about future GCAGS convention options, and offer these results to the GCAGS Board in an advisory capacity when HGS President John Biancardi attends the mid-year GCAGS meeting in March.

Let us know what you think by answering our questionnaire, and be sure to add any additional comments at the end of the page. Thank you for your interest and cooperation.

Please circle the appropriate choice:

Does the host city location affect your decision to:

a) attend as a registrant	yes	no
b) submit a paper or poster	yes	no
c) exhibit your service or product	yes	no

Which of the nine cities should we continue to visit in the traditional nine city rotation, assuming that all of them wish to continue to host the convention?

Houston	Corpus Christi	Baton Rouge
San Antonio	Lafayette	Jackson
New Orleans	Austin	Shreveport

Should GCAGS visit a non-local society Gulf Coast city as a wildcard convention location, much like AAPG National will do in 1996 with our visit to San Diego?

Yes No No Opinion

Would you be more inclined to attend a GCAGS convention located in the following suggested Gulf Coast cities?

Pensacola Biloxi Other _____ No Other _____

Should GCAGS follow the practice of the AAPG Midcontinent section and hold its convention EVERY TWO YEARS, instead of an annual convention?

Yes No No Opinion

If the GCAGS convention continues to be held annually, should the format of every second year be altered to be more streamlined and focused like a research conference?

Yes No No Opinion

Please indicate if you attended the recent GCAGS Conventions?

Shreveport '93 Jackson '92 Houston '91 None

If you did not attend, please write down the principal reason for not attending in the space provided below. Thank you again for taking the time to participate in this fact finding process.

Comments: _____

Mail to : GCAGS Convention Questionaire
Houston Geological Society, 7171 Harwin, Suite 314 • Houston, Texas 77036

Return by March 1st.

GULF COAST HIGHLIGHT

Low-resistivity Readings on Logs Point to Over-looked Pay Zones*

By Louise Durham

Low-resistivity zones are easy to overlook, but Gulf Coast operators tap them for substantial hydrocarbon production.

It seems there's always something to get excited about in the oil patch. Right now, it's low-resistivity pay.

"This is one of the hottest things going on," notes Robert Sneider, Houston consulting geologist and engineer. He says he gets calls from around the world virtually every day from people in the industry who want more information on low-resistivity or low-contrast (LRLC) reservoirs.

Sneider was one of several contributing editors for the recently published atlas, "Productive Low Resistivity Well Logs of the Offshore Gulf of Mexico." The book is the culmination of a two-year (roughly) project, which was a collaborative effort between the Houston and New Orleans geological societies. Anadarko Petroleum Corp. Geologist Dwight (Clint) Moore spearheaded the project. Local society chairmen were Glen Shelton in New Orleans and W.A. Hill in Houston.

The editors of the atlas consider low-resistivity zones to be those with less than 2 ohm-meters measured by the deep induction log, while low-contrast zones are those with less than 1.5 times the resistivity of the shale base line.

Their alternative definition for these zones is "anything you would have trouble convincing others to complete."

While LRLC pay has been recognized for many years, particularly in the Gulf of Mexico (GOM), its economic importance has only recently come to light. These zones frequently range over wide areas and contain many thousands of barrels of hydrocarbons.

"Industry has a never-ending thirst for low-resistivity pay." says Moore, who mulled over the idea for a Gulf-wide atlas for 10 years. But, such a project was well nigh impossible until the federal government initiated a liberal log-release program in late 1989 for all GOM wells.

Moore's fervor for LRLC pay initially was triggered back in the 1970s when his Mississippi wildcatter father played the Lower Tuscaloosa, which Moore describes as infamous for low resistivity owing to its high chlorite content. The lesson he learned here was to look at the exceptions and not just the rules, which is axiomatic to the concept of low-resistivity pay.

But old habits die hard, and the common reaction to a low-resistivity log measurement is to ignore the interval because it must be wet. That reaction may stem from past behavior, when LRLC reservoir production was held proprietary by the operators for competitive reasons.

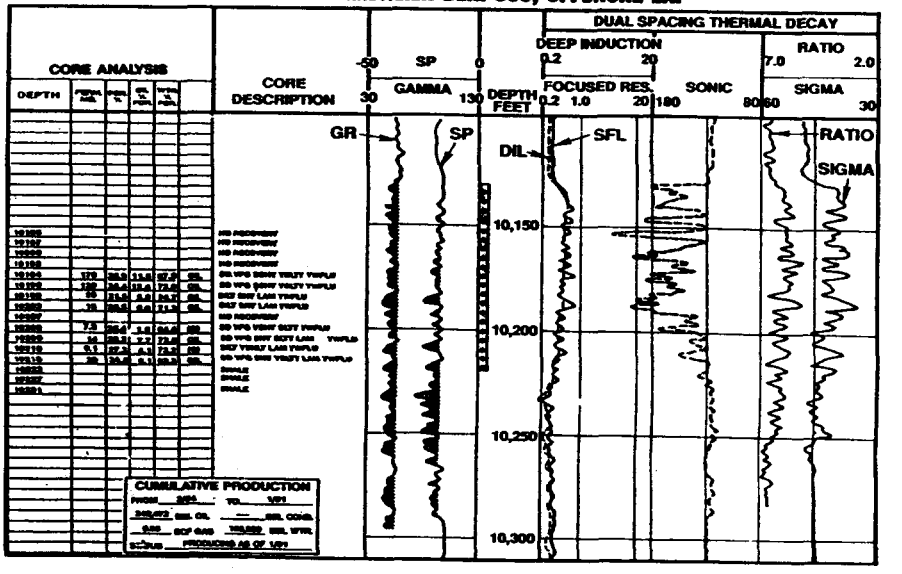
And, in some instances, companies contacted by the Houston Geological Society and New Orleans Geological Society project participants were actually unaware that some of their old properties are producing from these zones.

The principal geologic causes of LRLC reservoirs, according to Sneider and Harold Darling, who is with Schlumberger Well Services, include laminated intervals; dispersed and structural clay; altered framework grains; grain size, clay-lined burrows; and disseminated conductive minerals, such as pyrite.

Clay minerals are by far the most common cause of LRLC reservoirs because of their water-filled microporosity and the ability to exchange cations with pore fluids.

These reservoirs occur in an array of depositional systems, such as channel fills, delta-front and toe deposits, shingled turbidites, and deepwater fans, including levee-channel complexes.

To build the petrophysical models to evaluate LRLC zones, the knowledge of the environments and causes of these reservoirs must be combined with an understanding of wireline tools and their



**Reprinted with permission from Gulf Coast Oil World, 93*

responses. The tool response is unique to the mineral type and abundance, which means it's crucial to know, or estimate, the mineralogy of a zone to model it correctly.

For example, the LRLC zones with clay minerals and grain size differences will exhibit misleading resistivity values because these both retain immovable water. Reservoirs comprised of thinly bedded laminae will yield resistivity measurements that represent a composite value because the tool will average through the section.

That means the "Archie" devotees who check out these LRLC zones will find that the old approach just doesn't cut it here. Plugging the deep-induction log resistivity reading from the LRLC interval into the Archie water-saturation equation is just about guaranteed to give a water-saturation value that is way on the high side. The deep-induction log resistivity measurement is always skewed toward the low-end of the log scale by the conductive agent in the rock and the contained fluid.

Sneider is a staunch advocate for laboratory analysis as the definitive evaluation for LRLC pay. This includes the study of the rock by use of thin sections, scanning electron microscopy and x-ray diffraction. As Moore points out, "Only then will you know".

The effort expended to unravel the intricacies of these reservoirs often can be handsomely rewarded. The mean average production of the 150 GOM examples included in the LRLC book is 550 MMBO or 5 BCFG, while the comparable average of all completions in the Gulf is 380 MMBO or 5.6 BCFG.

Published low-resistivity zone oil completions represent just 0.7% of the total GOM completions to date, but they produce more than the average oil well in the Gulf.

About 25% of the well log examples in the atlas are for gas wells, which present an even greater challenge than LRLC oil pay identification. While oil is visible in the sidewall cores, gas won't be obvious, particularly if the mud logger misses the gas show or lacks confidence in it.

But tapping into LRLC gas zones can pay off in a big way. Shell Oil Co. zeroed in on one of these zones at the High Island A-350 Field in the GOM where seven wells have given up almost 100 BCFG since production began in late 1977. The producing "H" Sand laminae range in thickness from 1/8-inch to 1/2-inch.

There may be more published examples of LRLC reservoirs to come. The atlas project participants are not ones to rest on their laurels, and according to Moore, there's a good possibility that a sequel publication will appear in 1995. That publication will take a look at logs from around the globe.

It may be a good idea to dust off the old passport.

1993–1994 ADVERTISING RATES FOR THE HOUSTON GEOLOGICAL SOCIETY MONTHLY BULLETIN AND ANNUAL DIRECTORY

COMPLETE AND MAIL TO:

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7171 Harwin, Suite 314
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November, 1992 B.A.F.

Advertise In The Annual Directory

Once again the Houston Geological Society (HGS) and the Geophysical Society of Houston (GSH) will publish a joint membership *Directory*. This directory is distributed to over 7,500 members of both societies.

Advertising space will be available in the joint *Directory*. By advertising in the *Directory*, your company can reach all parts of our diverse industry including domestic/international exploration and production, environmental, engineering, mining, and academia. Your advertisement would also be a visual support of the two societies.

Our black and white advertising rates are:

Cover (front-inside or back-inside)	$1000
Full page	750
Half page	400
Business card	50

A full is 8 1/2" x 11" (8 1/4" x 10 3/4" for advertisement). Please submit your camera ready artwork and check by **January 31, 1994** to:

Roy E. Clark, Jr.
Exxon Exploration Co.
P.O. Box 2189, Rm 2GW492
Houston, TX 77252-2189

If you have any questions, please contact:

Roy Clark
713-297-7002 Office
713-297-7266 Fax

Steven Shirley
713-287-7487 Office
713-287-5406 Fax

LET'S CELEBRATE

SPRING KICKOFF

Friday, April 1, 1994

HGS TENNIS TOURNAMENT

WESTSIDE TENNIS CLUB
1200 Wilcrest (North of Westheimer)

12 NOON - 5 PM
DIVISION A & B PRIZES

COST - $35.00 includes tennis, lunch, refreshments & trophies

Entry Deadline March 30, 1994

Send check, along with name, phone no. and rank (A, A- or B) to the PTS Laboratories.
Mail to: 4342 W. 1 2th, Houston, TX 77055, Attention: Mike Walker With Questions Call: (713) 680-2291

GEO-EVENTS

MEETINGS

IN HOUSTON

HGA Bridge Club, Briar Club, Timmons & Westheimer, 10:00 a.m. - 2:30 p.m. Jan. 5.

AWG Dinner, Morningside Thai Restaurant 6710 Morningside Drive, Jan. 4. (If attending call Anglia Sweet 556-7067)

SPWLA Westside Luncheon. R.A. Skopec, "Integration of Formation Evaluation Technologies", Radisson Suite Hotel, I-10 & Beltway 8, 11:30 a.m., Jan. 13.

Houston Geo-PC Users Meeting, La Madeleines's. Westheimer and Drexall, 9:30 a.m., Jan. 14. Call Paul Britt (341-1800 ext. 30 after 6:00 p.m. for information)

GSH Noon Luncheon, H.E.S.S., 3121 Buffalo Speedway, 11:30 a.m., Jan. 17.

SPWLA Galleria Luncheon, Marriott Galleria, 1750 West Loop South, 11:30 a.m., Jan. 18.

SIPES Luncheon, Pat Gratton, "Looking Back and Praying Forward: (Government Policies Influencing the Oil Industry), Petroleum Club, 11:30 a.m., Jan., 20.

SPWLA Downtown Luncheon, George Coates, "Pulse Echo NMR Well Logging in Shaley Sands", Petroleum Club, 800 Bell St., 11:30 a.m., Jan. 25.

GSH Environmental SIG Ed Noah H.E.S.S. 5:30 p.m., Jan. 26

HGA Bridge, Briar Club, Timmons & Westheimer, 10:00 a.m. - 2:30 p.m., Jan. 26.

SPWLA Northside Luncheon, Steve Bridges, "Quantitative Open-hole Logging with Very Small Diameter Wireline Tools", Sperry-Sun Cafeteria, 3000 North Sam Houston Pkwy E., 12 Noon, Jan. 27.

HGS JANUARY MEETINGS

JANUARY 10, 1994
(DINNER MEETING)
"The Open-coast Clastic Depositional Model, Theme and Variations"
Ed Clifton
Post Oak Doubletree Inn, 2001 Post Oak Blvd.
Social Period 5:30 p.m.,
Dinner and Meeting 6:30 p.m.
Reservations by name only, telephone 785-6402. Must be made by noon or canceled by noon Friday, Jan. 7.

JANUARY 12, 1994
(EVENING MEETING)
HGS Environmental/ Engineering Geologists
"Environmental Geology and Cyclostratigraphy of the Pleistocene in Northern Gulf of Mexico"
Peter Trabant
H.E.S.S., 3121 Buffalo Speedway
Social Period 6:30 p.m.,
Program 7:00 p.m.,
No reservations required.

JANUARY 17, 1994
(DINNER MEETING)
HGS International Group
"Geologic Setting for an Additional Paleozoic Petroleum Potential in the Middle East" and Poster Session
Louis Christian
Post Oak Doubletree Inn, 2001 Post Oak Blvd.
Social Period 5:30 p.m.,
Dinner and Meeting 6:30 p.m.
Reservations by name only, telephone 785-6402. Must be made or canceled by noon Friday, Jan. 14.

JANUARY 24, 1994
(DINNER MEETING)
HGS North American Explorationists
"Balanced Cross Sections of Arbuckle-Ardmore Region"
Stephen Naruk
H.E.S.S., 3121 Buffalo Speedway
Social Period 5:30 p.m.,
Dinner and Meeting 6:30 p.m.
Reservations by name only, telephone 785-6402. Must be made or canceled by noon Friday, Jan.21.

JANUARY 26, 1994
(LUNCHEON MEETING)
"Apatite Fission Track Analysis Applied to the Margins of the Gulf Coast Basin"
Ray Donelick
Houston Club, 811 Rusk
Social Period 11:30 a.m.,
Lunch and Meeting 12:00, Noon.
Reservations by name only, telephone 785-6402. Must be made or canceled by noon Monday, Jan. 24.

SCHOOLS AND FIELD TRIPS

SEPM School, John Comer & Lisa Pratt, "Organic Geochemistry of Sediments and Sedimentary Rocks", Doubletree at Allen Center, Jan. 10 - 11.

CALENDAR OF EVENTS

January 1994

Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
Come Join The North American Explorationists for Valuable Lectures on a new night (the fourth Monday of each month) at a new location (H.E.S.S. Bldg.)						1
2	3	4 AWG Dinner Morningside Thi	5 HGA Bridge Westheimer & Timmons	6	7	8
9	10 **HGS DINNER MEETING** Ed Clifton Post Oak Doubletree ← *SEPM School, "Organic Geochemistry," Jan. 10-11* →	11	12 **HGS ENVIR/ENG EVENING MEETING** Peter Trabant H.E.S.S.	13 SPWLA Westside Luncheon R.A. Skopec Radisson Suite Hotel	14 Houston Geo-PC Users Meeting La Madeleine's	15
16	17 **HGS INTN'L DINNER MEETING** Louis Christian Post Oak Doubletree GSH Technical Luncheon H.E.S.S	18 SPWLA Galleria Luncheon Marriott Galleria	19	20 SIPES Luncheon Pat Gratton Petroleum Club	21	22
23	24 **HGS NO. AMERICAN DINNER MEETING** Stephen Naruk H.E.S.S.	25 SPWLA Downtown Luncheon George Coates Petroleum Club	26 **HGS LUNCHEON** Ray Donelick Houston Club GSH Environ. SIG Ed Noah H.E.S.S. HGA Bridge Briar Club	27 SPWLA Northside Luncheon Steve Bridges Sperry-Sun Cafeteria	28	29
30	31					

COMMITTEE NEWS

GEOPHYSICAL SOCIETY OF HOUSTON MUSEUM

The Geophysical Society of Houston, with the cooperation and enthusiastic support of North Harris College, has established a public display of vintage geophysical instrumentation. The O. Scott Petty Geophysical Museum has been installed on the second floor of the Winship Building on the North Harris College Campus, 2700 W.W.Thorne Drive. The exhibits document the history of exploration geophysics through the instruments and equipment used to record the basic field data. Included are most of the geophysical displays formerly housed in the Houston Museum of Natural Science Petroleum Hall, elements of the privately owned Petty Collection, and many items from the GSH Museum in the Halliburton Geophysical Services lobby on the Southwest Freeway. Interested individuals are urged to tour this collection during normal weekday college hours.

- Bill Gilchrist
Chairman GSH Museum Committee

The Ad Hoc Committee on Education Regarding Government Affairs needs additional members. The purpose of the Committee is to provide educational information on issues that affect the membership and the oil and gas industry as a whole. Its operating format will be to prepare (or have others prepare) write-ups on one side or the other of named issues. Topics currently identified are listed in the editorial section of this Bulletin.

- Jack Howard
Phone: 578-1376 or 880-9495

Join a HGS Committee in the New Year '94!

SIPES Membership Drive

The Society of Independent Professional Earth Scientists (SIPES) is an association of self-employed earth scientists whose members have been certified by the governing body of the Society as to professional competence and professional ethics. It is the only national organization of self-employed geologists, geophysicists, and engineers primarily involved in domestic energy exploration and development.

If you have twelve years of professional experience beyond a bachelor's degree and have freedom of choice of clients, you may qualify for membership in SIPES. Other requirements are similar to those for AAPG Certification. If you are AAPG Certified, there is a reciprocal clause that streamlines admission to SIPES.

SIPES is concerned with the spectrum of technical, economic, and political factors that affect all of us.

National dues are $60.00 year.
Houston Chapter dues are an additional $25.00 year.

For more information, please contact SIPES Membership Chairman C. David Martin, 496-3488.

SEEKING NOMINATIONS FOR AAPG DELEGATES

Local AAPG members interested in serving as a representative from the Houston Geological Society to the AAPG House of Delegates should contact Pat Gordon at 556-8170 or Martha Lou Broussard at 527-4880 or 665-4428. Members standing for election should be prepared to attend monthly luncheon meetings and the annual House of Delegates meeting held in connection with AAPG's National Meeting. Besides voting as a member of AAPG's governing body, other duties include developing information regarding eligibility of applicants for membership and for certification by AAPG's Division of Professional Affairs.

HOUSTON GEOLOGICAL AUXILIARY

THE BLOWOUT AND DECISIONS, DECISIONS

Get ready for the *Blowout* of the year. All you *Wildcatters* are invited to party at the Petroleum Club, February 5th. There will be a fabulous buffet followed by *"Decisions, Decisions"*, a one act play that you won't soon forget! It is written and directed by the extremely talented **Tom Barber.** Anyone who has seen his work before needs no urging to attend. You will know or know of most of the actors as they are all locally famous geologists. A few names to look for are **Stu Chuber, Denny Bartell, Kip Ferguson, Scott Laurent, Tom McWhorter, Mike Morgan, Ann Rapp, Deborah Sacrey, Pat Shannon** and **Al Wadsworth.** It will be an experience you will remember.

OK, all you oil patch people - members of the Houston Geological Society as well as members of the Houston Geological Auxiliary are invited and everyone can bring guests! Use the invitation form included in this issue of the Bulletin - this is one party you don't want to miss. For more information call **Gwinn Lewis** (468-3768) or **Virginia Barber** (621-4259)

Task Force for
Registration of Geoscientists and
Geophysicists in Texas
8800 Bluff Springs Rd.
Austin, Texas 78774

Co-Chairmen

Pete Rose 512-480-9970

Dan Titerle 210-246-3307

Secretary

Dave Rensink
713-496-0067

ON THE MOVE

Rose Exploration Associates has been formed recently by **Robert J. Coskey, Leo C. Gerard, Logan MacMillan, Brent Miller** and **Mike Wynne,** to provide geologic and engineering consulting services to the petroleum industry. Address is 518 Seventeenth Street, Suite 740, Denver, CO 80202 Tel & Fax: (303) 592-1781. The interdisciplinary group collectively has over 90 years experience in the business. The individuals have been working together informally for the last year and a half for a variety of Rocky Mountain region clients in the areas of regulatory compliance, exploration and production evaluations, economic analysis and resource appraisal.

GEO WIVES SHARE VARIED ACTIVITIES

Geo-Wives is the newcomer branch of the Auxiliary. All active Auxiliary members who have not enjoyed membership for a total of ten years in Geo-Wives are invited to join us. We meet monthly for lunch and a program. If you have not joined our group, you are missing many fun activities. So far this year we have enjoyed the following: a "Get-Acquainted Coffee" in September, we enthusiastically applauded our very own Geo Players when they presented a 3-act play "Dangerous Corner" in October, we travelled to Galveston in November for a tour of Moody Gardens, IMAX Theatre and a lovely lunch, and celebrated the Christmas holidays with a luncheon, ornament exchange and a program of original poetry by Dolores Humphrey.

In January we plan to have a soup and salad luncheon and observe the wizardry of Jeannette Coon when she demonstrates the art of vegetable carving. February will find us touring the Menil collection and enjoying lunch at La Mora Restaurant.

For further information about activities or membership in Geo-Wives please call Linnie Edwards at 785-7115 or Hellen Hutchinson at 877-8479.

HGA MEMBERSHIP FORM

_____
(Your Name)

_____
(Spouse's Name)

_____
Address Zip

_____
Home Telephone

_____
HGS Member's Company

(Dues are $15 per year, check payable to Houston Geological Auxiliary)

Send to:
Mrs. Norma Jean Bacho
38 Charleston North
Sugar Land, TX 77478

GEOWIVES MEMBERSHIP FORM

_____
(Your Name)

_____
(Spouse's Name)

_____
Address Zip

_____
Home Telephone

_____
HGS Member's Company

(Dues are $7.50 per year, check payable to Geowives)

Send to:
Mrs. Hellen Hutchison
10 S. Briar Hollow Lane #63
Houston, TX 77027

TECHNICAL FEATURE

Magnetic Resonance Imaging Log Evaluates Low-Resistivity Pay

By John Austin and Tom Faulkner

Much has been written about low resistivity pay reservoirs and how to identify and evaluate them with conventional wireline logs. It has long been recognized that the total amount of water free to flow or bound to the pore surfaces is the controlling factor on resistivity measurements. Until now no wireline tool existed which could differentiate between these two water types. Yet this differentiation is imperative if log interpretation is to consistently match actual well production results.

Pennzoil has utilized a revolutionary new wireline tool, the magnetic resonance imaging log (MRIL™),to help evaluate low resistivity responses in one of its offshore Gulf of Mexico wells. The well, the Eugene Island 330 C - 10st, was drilled in Block 330, owned by Pennzoil, Pogo, Exxon, Mobil and Cockrell, and operated by Pennzoil. Production began in 1973, and stands at 116 million barrels of oil and 621 billion cubic feet of gas.

Of particular interest to Pennzoil and its partners is the GA-2 reservoir, which has produced 16.5 million barrels of oil. This far exceeds the reservoir's calculated potential reserves. It has long been suspected that significant hydrocarbon contributions have been made to the GA-2 from the interbedded low resistivity portions of the reservoir. It has been hypothesized that these portions have acted as "feeders," able to recharge the highly porous and permeable members because of the large surface area in contact between them. No wireline tool has existed to test this hypotheses.

Magnetic Resonance Imaging

MRIL is a wireline logging service provided exclusively by NUMAR Corporation. It utilizes the phenomenon known as nuclear magnetic resonance to accurately measure free fluid, irreducible water (MBVI) and effective porosity (MPHI). From these a permeability measurement is also derived.

Nuclear magnetic resonance provides a way to manipulate certain atomic nuclei so that they can be counted. It is based on the fact that the nuclei of atoms spin, are charged, have magnetic moments, and therefore act like small magnets. The magnetic resonance imaging log tool is tuned to look at hydrogen protons in the fluid of a rock's pore spaces.

A large permanent magnet is lowered downhole using an electric wireline. As this permanent magnet is pulled across the formation, the hydrogen protons, acting like small magnets, will align themselves with the resultant magnetic field. A radio pulse is then transmitted from the tool which instantly causes the hydrogen protons at a known radius from the center of the magnet to reorientate or "tip" themselves perpendicular to the direction of the permanent magnetic field.

After the pulse, protons will immediately begin to realign themselves with this permanent magnetic field. As they do, a signal is given off and measured. The total magnetic resonance imaging log signal is proportional to the total number of hydrogen protons in the fluid.

By analyzing how quickly hydrogen protons realign with the permanent magnetic field, a determination of the amount of irreducible (bound) fluid and the amount of free fluid present can be made. This is possible because the hydrogen protons in the irreducible fluid realign themselves very much faster than those contained in the free fluid portion.

Conventional Log Data

Figure 1 is a display of the conventional triple combo log over the sections logged with the magnetic resonance imaging log service. The top of the GA-2 sand, which has produced more hydrocarbons than original reserve estimates, occurs at 4,520 feet and continues down past 4,650 feet.

The triple combo log over this interval clearly shows three zones of high resistivity and high porosity that were included in the calculation of hydrocarbon reserves. Also occurring between these three intervals are two intervals of low resistivity of the type not included in the original reserve estimates. The question was whether the lower resistivity zones were hydrocarbon-bearing, water-productive, or non-reservoir rock. The answer could affect reserve estimates and well completion designs.

Another zone of interest occurred

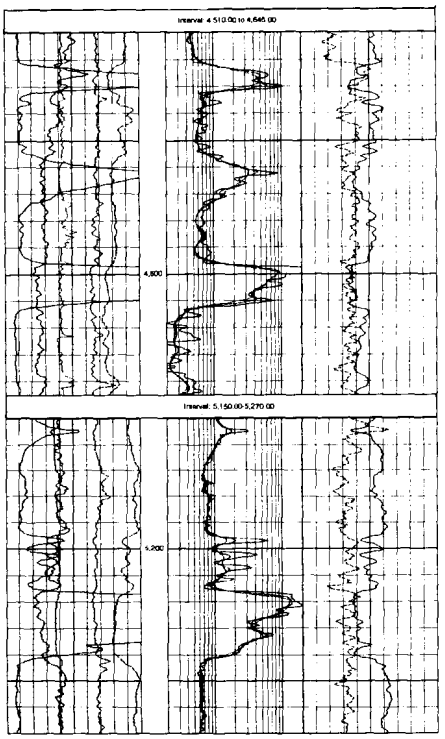

Figure 1

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from 5,192 to 5,241 feet. The conventional log data indicates a section of sand/shale bedding from 5,192 to 5,216 feet, overlying a clean sand from 5,216 to 5,241 feet. The log porosity would tend to indicate that each of the sand interbeds were hydrocarbon productive, but that the larger clean sand appeared to transition to water. Without knowledge of the irreducible water content throughout this interval, this interpretation could not be proved or disproved.

MRIL field Log

Figure 2 is a display of the magnetic resonance imaging field log. Examination of this log reveals that an additional 27 percent of hydrocarbon reserves could be added to the reserve estimates. In fact, all producible fluids above the true oil-water contact at 4,612 feet are hydrocarbon. The low resistivity readings above 4,612 feet were caused by increases in irreducible water content and not movable water.

The magnetic resonance imaging log confirms that the interbedded section for 5,192 to 5,216 feet contains only movable hydrocarbons. The log provides good news for the cleaner section from 5,216 to 5,240 feet. There is no movable water in this section, and all the producible free fluids through this interval are hydrocarbons. This interval has been tested, and is producing 800 barrels of oil per day on a 21/64 inch choke with zero water cut.

Since the magnetic resonance imaging log is a new wireline service, a brief description of the field log is necessary to demonstrate how it was able to change the interpretations made from the conventional triple combo log and obtain the described results.

Track III, at the far right of Figure 2, is a display of the recorded MPHI and MBVI. Both are porosity curves scaled the same as the conventional porosity measurements, 60-0. The MPHI is a measurement of all formation porosity except clays bound porosity normally referred to as effective porosity. This curve would be similar in value to the porosity provided by conventional porosity logs after they were reduced for clay content.

The MBVI is a completely new wireline measurement that records an interval's irreducible matrix water content. The only way that zones of low resistivity can be hydrocarbon productive is if they contain a large amount of irreducible water, and still have free fluid space available for hydrocarbons.

Intervals of increasing MBVI define

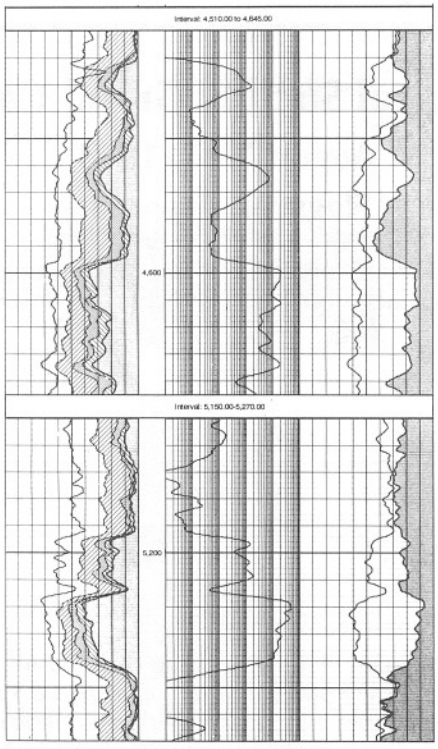

Figure 2

intervals that can have producible hydrocarbons with low resistivity readings. The actual amount of producible fluid available is simply the difference in the MPHI and the MBVI porosity readings. This value is referred to as the free fluid index.

Two sources of irreducible water exist. One is clay bound water, which is simply a function of the amount of clay present in the formation. An estimated value of this clay bound water is normally made during conventional log analysis.

The second source of irreducible water is the surface tension water held by the matrix material, in this case, the sand grains. Until the introduction of magnetic resonance imaging logs, there was no way to even estimate this amount of matrix irreducible water from wireline measurements.

With the use of this truly fundamental measurement of irreducible water, pay zones with low resistivity stick out like a sore thumb, and can only occur over intervals with high readings of MBVI over the low resistivity interval from 4,572 to 4,596 feet, one realizes that the drop in resistivity was not caused by an increase in producible water, but simply by an increase in matrix irreducible water.

This situation occurred because this interval was composed of much finer sand grains which hold more surface tension water than the surrounding intervals of high resistivity. The other interval of low resistivity occurring between 4,532 and 4,555 feet was caused by a combination of irreducible matrix water and clay bound water evidenced by the difference in the MPHI and the density/neutron porosity reading.

Calculating Reserves

Once the magnetic resonance imaging log has confirmed that the entire interval above the oil/water contact at 4,612 feet is of irreducible conditions, the amount of free fluid over the interval. As mentioned earlier, net pay increased by 27 percent in this well bore when the hydrocarbons occurring over intervals of resistivities of 1 ohm-m and less were included.

Similarly, by observing the increase in MBVI from the top to the bottom of the clean sand occurring from 5,216 to 5,240 feet, one realizes the decrease in resistivity is caused by an increase in the irreducible matrix water, and not movable water. The zone contains no movable water, and is at completely irreducible conditions. All the free fluid present is hydrocarbon. This increase in irreducible water was caused by the sand grains becoming finer toward the bottom.

Track II of Figure 2 displays the permeability derived from the magnetic resonance imaging log. This would represent the intrinsic permeability of the rock.

Track 1 to the far left of Figure 2 contains a gamma curve and four raw measurements of the MRIL service. The

Continued on page 39

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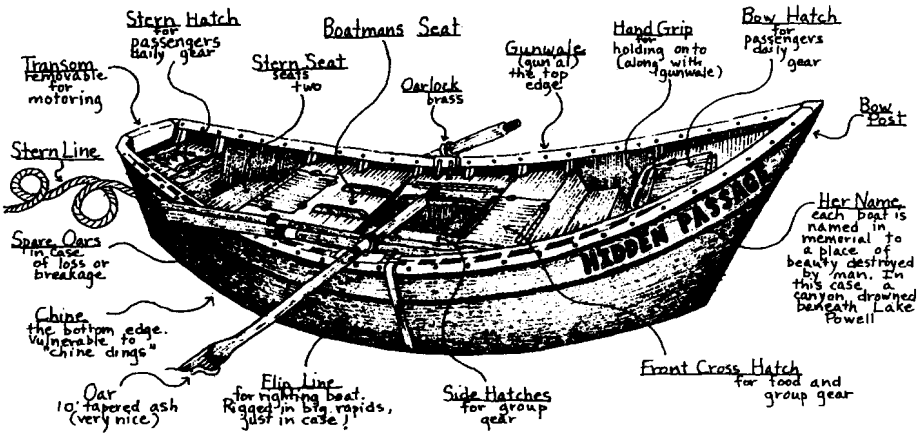

Salmon. We will have the opportunity to stop and relax in hot springs that prospectors visited a century ago. The memory of the "Thunder Mountain Gold Rush" of 1898 will be revisited at an abandoned trading post that we will see. Wildlife including moose and Bighorn sheep may be encountered along the way. Our take out point from the river is near Riggins, Idaho, several hours south of Lewiston, Idaho, where we will be transported and bid our guides farewell.

The AAPG convention is being held in Denver, June 12-15, 1994. For the convenience of those who are going to be in Denver then, we are planning for our excursion to follow (June 17-23) the convention. From Houston, you are almost there and you may want to piggy back this opportunity with your convention trip. Cost for the river trip itself is estimated to be around $875 per person, including a five day fully outfitted dory trip, entertainment, meals, field refreshments, guidebooks, hotel before and after the trip, and taxes. Participants will need to make their own travel arrangements to and from Idaho. Air travel is most economical into Missoula, Montana, and out of Spokane, Washington. If participants coordinate with us, we may be able to make some group arrangements. Let us know ASAP. ground transportation from these locales to and from the river will be arranged once logistics are finalized.

For more info: *Contact Andy Gambill, Hunt Oil Corp. (713) 683-2365*
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Registration Form

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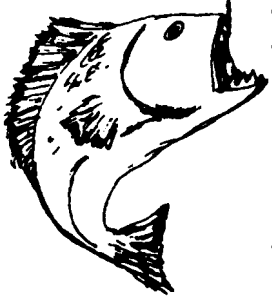

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Continued from page 35

four measurements represent how quickly the hydrogen protons return in line with the magnetic field of the permanent magnet after being "tipped" by the radio signal.

A standard magnetic resonance imaging field log is color coded between the different raw measurements, and provides an outstanding qualitative description of the reservoir's pore and grain size distribution. As the ratio of echo 1/echo 13 increases, the grain and pore spaces become smaller, indication intervals of lower permeability and high irreducible water content. Conversely, as the ratio of echo 1/echo 13 decreases, the grain and pore space become larger, indication intervals of high permeability and low irreducible water content.

One can see the interval from 4,520 to 4,612 feet consists of three coarse-grained intervals and two fine grained intervals. The clean sand from 5,216 to 5,240 feet is clearly a fining downward sequence as the ratio of echo 1/echo 13 increases with depth.

Combined Log

Figure 3 is a display of the magnetic resonance imaging log and conventional log data combined. Added to the display are sidewall core porosities and permeabilities shown as dots on the appropriate curves. Also added is a curve labeled BVW in Track 3. This curve represents total matrix water (movable and bound) seen by the resistivity device. The display provides a very powerful description of the reservoir.

For the first time, answers to fundamental questions managers have always asked of wireline logs, but were never answered, are now available.

For example: "What will the reservoir produce (nothing, water, or hydrocarbon)?" is answered: "Intervals with no free fluid will produce nothing. Reservoirs with free fluid and BVW greater than MBVI will produce water. Reservoirs with free fluid and BVW equal to MBVI will produce hydrocarbons with out a water cut. Intervals included are 4,524, 4,612 and 5,150 - 5,245."

A second question: "Which reservoir contains the most producible hydrocarbon?" is answered: "The reservoir with the most hydrocarbon feet at irreducible conditions-first, 5,195-5,245: second, 4,532-4,612; and third, 5,150-5,170."

The third question: "Which reservoir will yield the highest production rate of hydrocarbon?" is answered: "The reservoir with no movable water with the greatest cumulative number of MD-feet(best permeability-first, 5,195-5,245 (5,215-5,225 absolute best): second 4,532-4,612; and third, 5,150-5,170."

With the added parameters of free fluid, irreducible matrix water and permeability log evaluations that will match production results can become a reality.

It should also be noted that the original oil/water contact in the upper zone in this well bore was 30 feet below the present contact of 4,612 feet. One can see in Figure 3 that very little hydrocarbon was left behind, causing one to realize the recovery efficiency over the interval already produced was very high.

Universal Application

Pennzoil had already used the magnetic resonance imaging log in the Travis Peak and Cotton Valley reservoirs of East Texas. It is also difficult to predict production in these reservoirs from conventional log analysis without the use of the MRIL survey.

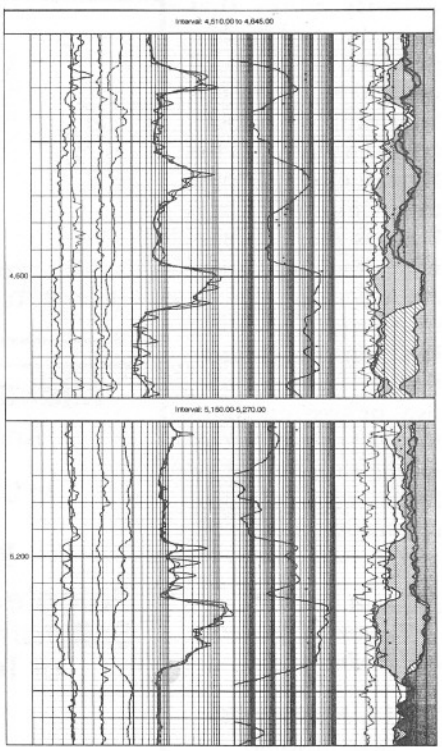

Figure 3

The Travis Peak, in particular, causes grave problems for the log analyst. The sands, whether hydrocarbon productive or water productive, many times display identical log responses on resistivity and porosity logs. This is because the different sands have the same water saturation, but not the same irreducible water saturation.

The key to determining which sands will produce hydrocarbons instead of water is knowing the sands irreducible water contents. The same basic log interpretation problem of differentiating between movable water and irreducible water from wireline logs exists in all formations drilled. The magnetic resonance imaging log measurement provides this critical fundamental measurement of irreducible water volume in any type of formation.

It is no longer necessary to assign random cutoffs of water saturation and porosities, as is typically the case, to determine if a reservoir will produce hydrocarbons or water. The irreducible water, free fluid, and permeability are now available on a foot by foot basis.

Pennzoil, utilizing this new technolo-

gy, has been able to improve its understanding of a prolific oil reservoir. All the free fluid in the questionable low resistivity zones throughout the G-2 sand was determined to be oil. Analysis of the 30 feet below the present oil/water contact over which the original oil in place has been produced indicates a very efficient hydrocarbon sweep, as practically no hydrocarbons were left behind. This newly realized volume of net pay will add an appreciable amount to estimated recoverable reserves.

More and more emphasis is being placed on identifying intervals with low resistivity that contain commercial hydrocarbons. Managers, reservoir engineers, geologists, and petrophysicists are all faced with deciding if zones logged with low resistivity readings are productive. Any zones which calculate some hydrocarbon saturation could be commercial.

Without the magnetic resonance imaging log, all these types of zones would have to be tested to determine if they were commercial of just water productive. The MRIL field log can easily identify zones that have the potential to produce commercial quantities of hydrocarbons with low resistivity readings. This knowledge should mean money in the bank as users of magnetic resonance imaging logs will no longer waste money testing low resistivity zones that are water productive, or pass up zones that will produce commercial quantities of hydrocarbons at low resistivities.

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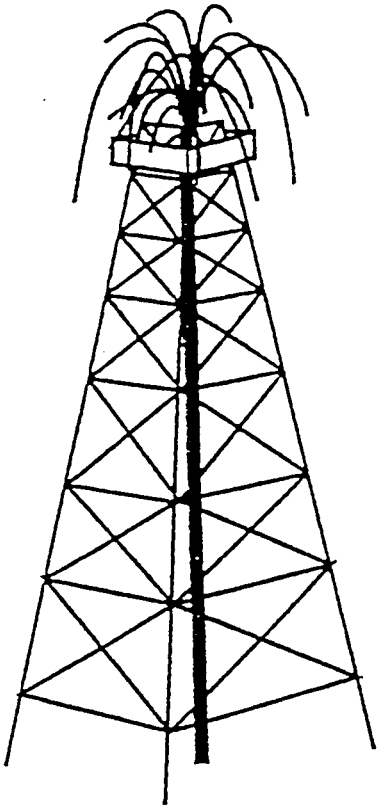

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RELATED RESEARCH

Pattern of Hydrothermal Circulation From Fission-Track Analysis Within The Newark Basin

Michael S. Steckler, Gomaa I. Omar, Garry D. Karner, and Barry P. Kohn

Introduction

The timing, spatial distribution, and migration of crustal-scale fluid flow within extensional environments are poorly understood. The effects of fluid flow within extensional tectonic settings are only now being realized, especially in terms of the thermal history of rift and passive margin basins. Independent geologic observations from the Newark basin attest to the existence and timing of relatively high temperature (100-250 °C) hydrothermal fluids within the basin. FT results from apatites and zircons from the Newark basin and surrounding basement provide information about the pattern of hydrothermal circulation within the Newark basin and the timing and temperature range of the fluids.

Geology Of The Newark Basin

The early Mesozoic extensional system along the eastern seaboard of North America consists of more than 20 exposed basins (Fig. 1) and others covered by coastal plain sediments. These halfgraben basins represent the western limit of the Mesozoic rifting that led to the formation of the Atlantic Ocean. The faulted, tilted, and partially eroded rift strata are termed the Newark Supergroup (Olsen, 1980). The Newark basin is the largest of the exposed Newark Supergroup basins, covering ~7770 km^2 and measuring 220 km along strike (Fig. 1). The basin is filled by Upper Triassic-Lower Jurassic (Carnian to Sinemurian) strata; maximum thickness is estimated to be 6-8 km (Schlische and Olsen, 1990). Mafic igneous rocks within the basin, with a cumulative thickness of >1.5 km, were all rapidly emplaced at 201±1 Ma (Sutter, 1988; Olsen and Fedosh, 1988; Dunning and Hodych, 1990).

The basin forms a wedge-shaped halfgraben cut by east-dipping border faults along its northwestern side (Fig. 1). This side of the basin consists of a mostly right-stepping series of border faults, most of which are reactivated Paleozoic thrust faults (Ratcliffe et al., 1986). The southeastern side of the basin consists mostly of an onlap of synrift basin strata onto the hanging-wall basement (Schlische, 1992). The Newark basin strata generally dip towards the border faults at angles of 5° to 20°. Estimates using the fault and basin geometry suggest only relatively minor extension of the upper crust (5-10 km; Bell et al., 1988).

The youngest strata preserved in the Newark basin are Sinemurian (198-201 m.y.). Breakup of the continental margin and the initiation of seafloor spreading in the central Atlantic Ocean occurred sometime between 175-190 Ma (Klitgord and Schouten, 1986; Benson and Doyle, 1988). The eastern edge of the Newark basin is unconformably onlapped by Lower Cretaceous and younger coastal plain sediments (Fig. 1). Erosion of Newark basin strata must have ceased by the time they were onlapped by the Barremian-age (124-118 Ma) sediments of the Atlantic margin. It is within this time interval (~80 m.y.) that any younger rift or postrift sediments, if they existed, must have been both deposited and eroded.

Fission-Track Results

Thirty-four apatite and ten zircon FT ages have been determined from samples of the synrift strata within the northern Newark basin and surrounding basement (Fig. 1). Generally accepted effective closure temperatures for apatite and zircon are 120 ±20 °C, depending on the cooling rate, (Hurford, 1986 and references therein) and 220±40 °C (e.g., Hurford, 1986; Fitzgerald and Gleadow, 1988; Brandon and Vance, 1992 and references therein), respectively.

In addition, 28 horizontal confined track length distributions (HCTLDs) have been measured on the apatite samples. FTs are initially formed with a narrow range of track lengths and then anneal by shortening as a function of their time-temperature history. The distribution of track lengths reflects the low-temperature thermal history of the host rock and permit more rigorous interpretation of FT ages (Gleadow et al., 1986; Green et al., 1989). The annealing behavior of FTs is also affected by composition (Crowley and Cameron, 1987). FTs in fluorapatite are less stable than in chlorapatite, an effect that is most pronounced in samples that have undergone a high degree of annealing.

Most of the ten zircon samples plotted in Figure 2 have a similar age. The basin and basement samples that form a plateau have a weighted mean age of 180 Ma. These ages postdate the deposition of the youngest preserved strata in the Newark basin and indicate that the strata underwent temperatures high enough to reset zircons after deposition in the basin. The zircon ages also indicate that they cooled below 220 ±40 °C around 180 Ma. Two samples near the border fault were not heated sufficiently to totally reset their ages (318 and 310 Ma, respectively). Roden and Miller (1991) reported similar results for the Newark basin. Two zircon samples yielded ages of 338 ±60 Ma for the Jurassic Towaco Formation near the border fault and 252 ±37 Ma for the Triassic Passaic Formation (Roden and Miller, 1991).

The pattern of apatite ages is very sim-

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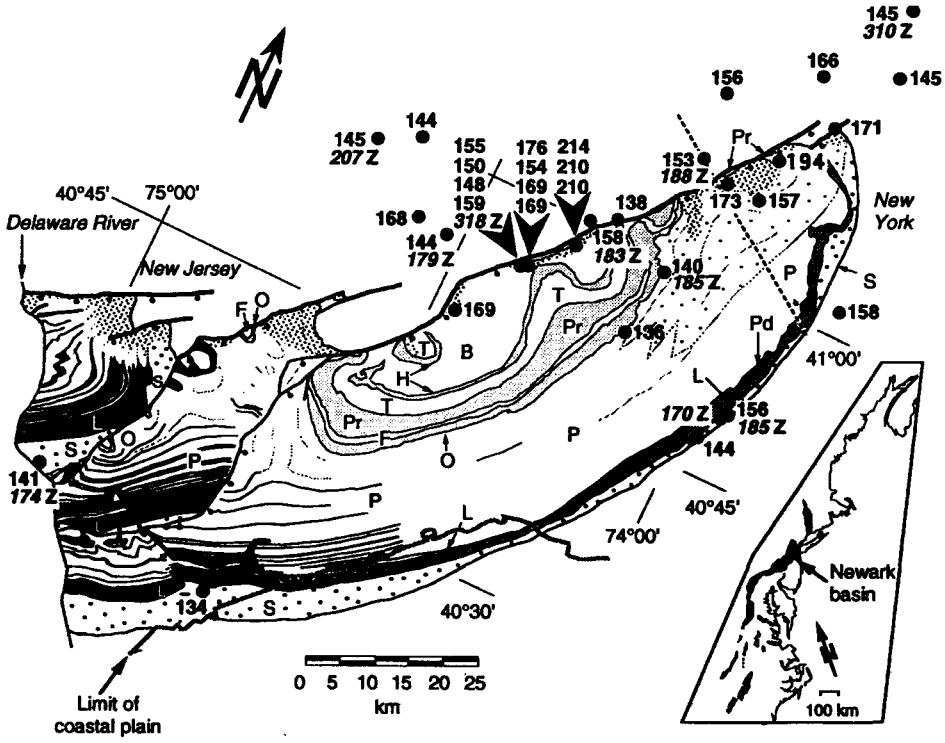

Figure 1

ilar to the zircon results (Fig. 2). The distribution of apatite FT age is flat across both the basin and the surrounding basement except in the vicinity of the border fault. Basement samples have all been reset to ages younger than rifting. The ages range from 138 to 170 Ma with an average of 154 Ma. The HCTLDs have long mean track lengths between 13.20 and 14.14 μm, and are negatively skewed, with no short tracks; these characteristics imply relatively rapid cooling.

The samples from within the Newark basin range in age from 134 to 214 Ma. These fall into two distributions. Away from the border fault, the ages range from 134 to 156 Ma. Again, the HCTLDs have long mean track lengths (13.36-14.25 llm) and are negatively skewed with few short tracks. The young age and lack of highly annealed short tracks indicate that these samples have all been heated and completely reset since deposition within the basin. The weighted mean age of 140 Ma and with the long narrow track-length distributions indicate that these samples cooled rapidly through temperatures of 100 ±10 °C around this time. Due to this resetting, any prior

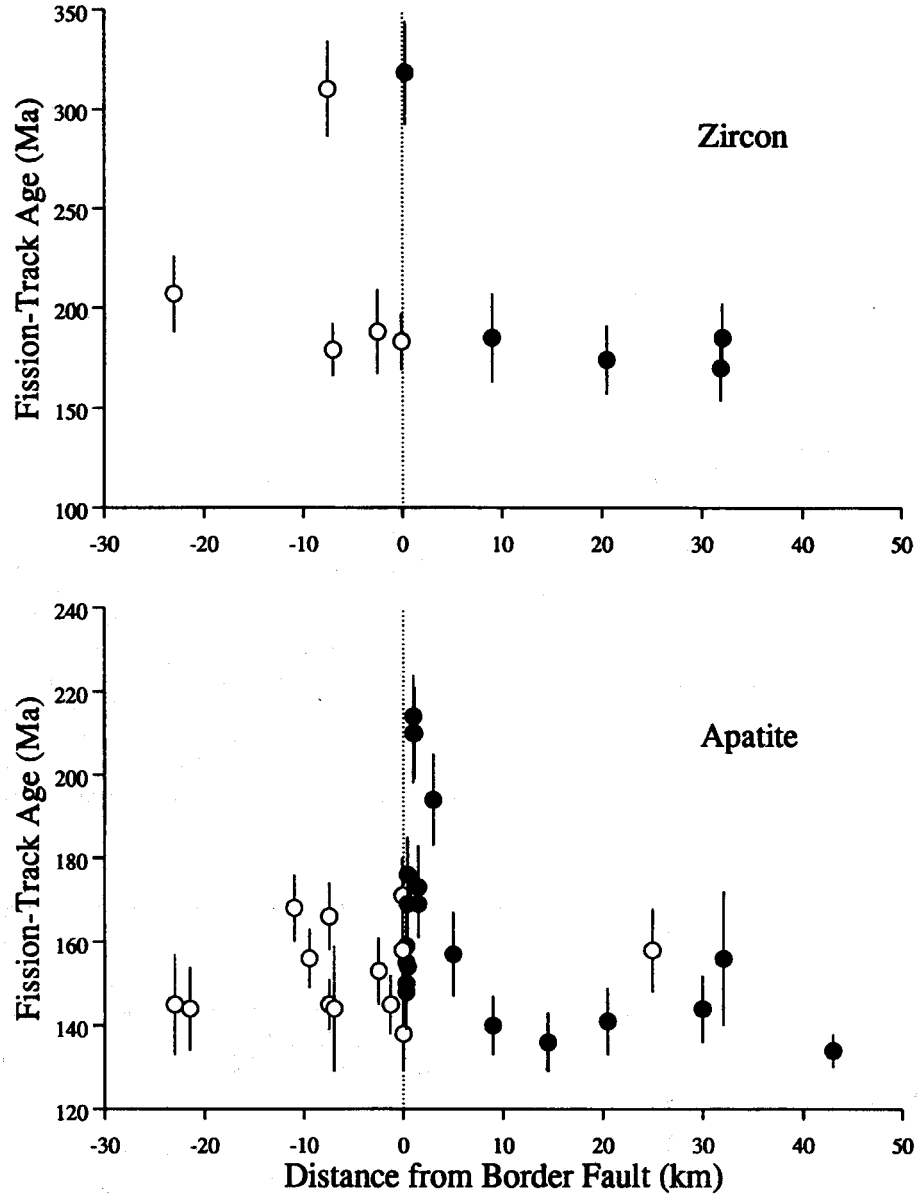

Figure 2

thermal history of the apatite and zircon grains is not preserved.

Near the border fault, the ages and HCTLDs are much more variable. The ages of these samples range from 148 to 214 Ma. At three sites, conglomerate cobbles of differing lithologies were separately dated. Some of the samples from the border-fault region exhibit broader HCTLD distributions or tails of short tracks. Some of these apatites probably retain tracks created prior to their deposition within the Newark basin. Indeed, at one conglomerate site the FT ages exceed the age of sedimentary strata (210-214 Ma vs. upper Boonton Formation, 198 Ma) and at another it is concordant with the depositional age (194 ±11 Ma vs. uppermost Passaic Formation, 201 Ma). After deposition in the basin, these samples were heated sufficiently to shorten existing tracks, but were never heated sufficiently to totally anneal the older tracks. Roden and Miller (1991) obtained a similar pattern, reporting apatite ages from 150-196 Ma within 10 km of the border fault and 126153 Ma at greater distances.

Some of the scatter of ages in the sediment samples near the border fault can be attributed to either retention of older tracks or variation in apatite chemistry. These conglomerates contain cobbles from a variety of sources; they arrived at the basin with a broad range of earlier thermal histories and track densities. Thus incomplete annealing of those tracks would result in greater scatter in ages, but no geological significance to this scatter. Two nearby conglomerate samples yielded ages of 154 to 176 Ma and 150 to 159 Ma. However, the HCTLDs of the conglomerate samples with the older ages exhibit tails of shorter tracks that are absent from the other samples. These tails could be due to incomplete annealing of older tracks, perhaps coupled with chemical differences. In either case, the temperature history of these samples would have differed only slightly. When samples have been in the lower part of the partial annealing zone (100-120 °C) for a long time, small differences in thermal history can result in widely differing ages. We believe that this is the primary origin of the scatter in ages near the border fault. We conclude that this area underwent much less heating (T_{max} ~100-140 °C) than the rest of the basin and surrounding basement.

To summarize, most of the exposed strata in the Newark basin were sufficiently heated after deposition to totally reset both zircon and apatite FT ages. The strata cooled below ~220 °C at 180 Ma and ~100 °C at 140 Ma. This pattern is remarkably consistent over a broad area encompassing both the basin and basement. Sedimentary rocks now exposed near the border fault reveal a more varied and generally cooler thermal history. Zircons are not reset, limiting the maximum temperature to <220 ±40 °C, and apatites show variable degrees of resetting. Some samples were heated to >120 °C, whereas others were never heated above 100-120 °C. The pattern of FT ages may be influenced by syn-rift transverse folds along the border fault (Schlische, 1992), but there are insufficient samples to test this. What is remarkable about the results is the narrowness of the zone adjacent to the border fault that yielded the older ages. In a 5-10 km wide zone, the FT data record over 100 °C change in maximum temperature with minor structural or elevation change.

Evidence Of Hydrothermal Flow

Several lines evidence indicate that extensive hydrothermal circulation occurred during the development of the Newark basin.

Mineralization. Base-metal mineral deposits are related to either Jurassic intrusions (skarn-type deposits) or major structural features within the basin (faults and fracture zones). Fluid inclusion and isotope studies indicate that mineralized veins are associated with 100-250 °C brines from within the basin (Gray, 1988; Robinson and Woodruff, 1988). Model lead ages from galenas in

the coeval Hartford basin fall in the range 150±20 Ma (Robinson and Woodruff, 1988). Hydrothermal minerals such as zeolites are a common precipitate found within fracture networks throughout the basin and adjacent country rock.

Hydrocarbon Maturation and Migration. Bitumen is observed within tension fractures, as inclusions within veins, and as staining within sandstones. These observations indicate that organic maturity was coeval with mineralization, and that hydrocarbons exploited a fracture permeability (Pratt and Burruss, 1988). The FT results are consistent with vitrinite reflectance studies from the Newark basin showing that the Triassic shales are overmature but the Jurassic shales are mature to immature (Pratt and Burruss, 1988; Katz et al., 1989).

Paleomagnetic Data. Paleomagnetic results show two magnetizations, a primary one with mixed polarities (component C) and an overprint (component B) (Witte et al., 1991). Fold-test failure indicates that the B component is a later secondary magnetization whose pole position implies a Jurassic age of magnetization (Witte et al., 1991). Its high blocking temperature (300-660 °C) suggests that it was chemically rather than thermally derived. The B component identifies a thermo-chemical event found throughout the Newark basin. The hematitic cements responsible for carrying component B are likely part of the mineralized precipitates deposited during the migration of relatively hot, hydrothermal fluids. However, uniform normal polarity of the B component indicates that the timing of mineralization must be limited to a single normal-polarity event.

$^{40}Ar/^{39}Ar$ Thermochronometers. Sutter (1988) studied diabase sills of the Newark Supergroup basins and found that although higher-temperature thermochronometers such as hornblende and biotite gave emplacement ages of about 201-202 Ma, K-feldspars separated from granophyres in the diabases yielded younger ages. A K-feldspar from a granophyre in the Palisades sill yielded ages ranging from about 157 to 176 Ma. Sutter (1988) estimated that cooling to temperatures of ~200 °C following emplacement of the sill would have been relatively rapid (≤1 m.y.), and thus interpreted the younger ages as evidence of cooling from a hydrothermal event at ~175 Ma.

Discussion And Conclusions

We interpret the FT results from the Newark basin as indicating the existence and decay of a long-lived hydrothermal convection system in the Newark basin. The spatial distance between locations showing partially reset (border fault) and totally reset (basin and adjacent basement) FT ages is <10 km in a region of little structural relief. Thus, differential exhumation cannot explain the range in FT ages. We interpret the FT data as recording the existence of extreme lateral thermal gradients in a thermal regime dominated by hydrothermal circulation. The lower maximum temperatures near the border fault indicate a region of downwelling. Similar downward percolation of ground-water perturbing temperatures is observed today at the Rhine graben (Person and Garven, 1989). The downward flow is driven by the hydraulic head of the rift-flank topography. We envision a similar situation existing for the Mesozoic Newark basin: an elevated region west of the border fault driving cool water down the alluvial deposits adjacent to the faults (Fig. 3).

The relief at the border fault necessary to drive convective flow could have resulted from a combination of several factors. The absolute elevation of the region surrounding the Newark basin may have been generated by rifting, with

components from the Atlantic passive margin induced thermally (Steckler et al., 1988) or flexurally (Weissel and Karner, 1989), and local footwall uplift adjacent to the Newark basin border fault. There was probably also a substantial remnant topography from the Alleghanian orogeny (Manspeizer et al., 1978). Underfilling of the Newark rift basin by sediments also contributed to the local relief at the border fault. The lake level cyclicity, including anomalous "superwet" cycles, establishes a minimum of a few hundred metres of relief. Comparison to flow at the Rhine graben (Person and Garven, 1989) suggests that at least 1-1.5 km of relief at the Newark basin border fault is required to produce downward flow at the border fault.

The FT data from the interior of the basin show the persistence and decay of the hydrothermal system. Sedimentation was continuous from ~225 Ma to at least ~198 Ma. Strata now at the surface were buried to some depth within the basin. The zircon ages show that these strata cooled below ~220 °C ca. 180 Ma, after the end of recorded rifting in the Newark basin. Cooling and erosion resulted in the closure of the apatite FT systems at ~140 Ma. This age shortly predates the onlap of the basin by a thin veneer of coastal plain sediments at 124-118 Ma, by which time. erosional unroofing of the Newark basin must have been completed. From then on, samples currently at the surface of the Newark basin remained cool (<50 °C). The zircon and apatite ages within the basin and the Cretaceous onlap of the coastal plain are consistent with cooling from >220 °C through apatite closure to surface temperatures at a rate of 3-4.5 °C/m.y.

The cooling of the Newark basin during Jurassic and Early Cretaceous time corresponds to erosion of the basin and flanking highlands. Erosion would both exhume and cool the rocks that are now at the surface and decrease the topographic head driving hydrothermal circulation. By the mid-Early Cretaceous, the highlands were destroyed and the marine coastal plain sediments covered the Newark basin. Most of the thin sedimentary veneer over the Newark basin was removed by the first-order sea-level fall after the Late Cretaceous and recent glaciation.

Estimates for the amount of erosion depend on the geothermal gradient and the temperature perturbation induced by the fluid flow. The older FT ages near the border fault show that downward water flow maintained temperatures in this recharge zone that were more than

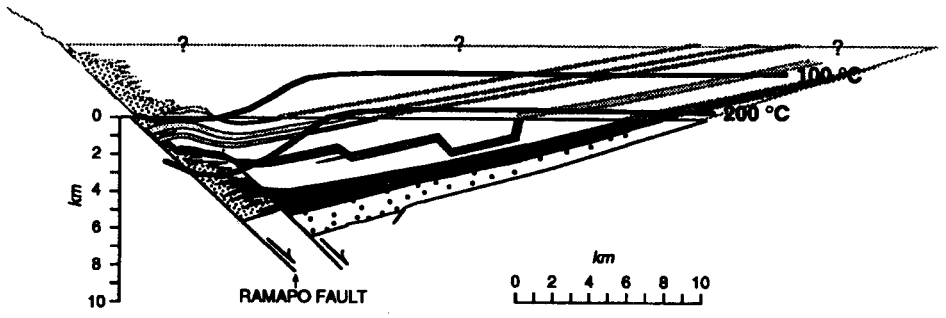

Figure 3

100 °C lower than in the remainder of the basin (Fig. 3). Erosion estimates depend upon relative temperature perturbations in the downwelling and upwelling regions. The larger the temperature perturbation in the upwelling region away from the border fault, the less erosion is required to account for the observations. Estimates for this partitioning and the geotherm suggests a minimum of 3 km of denudation of the Newark basin and surrounding region. Estimated erosion rates lie in the range 45-160 m/m.y. The Newark basin fission-track results suggest that hydrothermal flow at extensional basins is probably much more extensive than has been previously realized.

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OFF THE SHELF

In Limestone Country

by Scott Russell Sanders, Beacon Press, Boston, 1985

Book Reviewed by David M. Orchard

"Walk to your town square or to the lawn of the nearest courthouse, and chances are you'll find a war memorial carved from Indiana limestone....If you live anywhere in the lower forty-eight states, you are probably within walking distance of a library, bank, factory, church, house, or skyscraper built with the Salem Limestone."

So Scott Sanders describes the ubiquity of America's most widely used building stone, the Salem Limestone of Indiana. For more than a century, this stone has been quarried from its outcrop belt for use in monumental and lesser buildings around the country. It has dominated all statistics of stone use. As Sanders says, "There was a time, back in the heyday of the industry before the Depression, when two-thirds of all cut stone in America was coming from this little strip of land, an area so small that you can hike it from side to side or bicycle it from end to end in a day."

Originally published as Stone Country by the Indiana University Press, Sanders' book is partly about the decline of the industry and nostalgia for boom times. It is partly about the profound effect of more than a century of quarrying on the landscape. It is largely about a people and subculture strongly influenced by the area's major industry, stone quarrying.

Of all the extraction industries, the most basic must be removing stone from the ground, not for what it contains or might yield, but rather for the use of that rock for its inherent properties. This Mississippian bioclastic limestone is excellent for quarrying, cutting, carving, and use in buildings. From a formation as much as 90 feet thick, a good quarry will have a sixty-foot section of usable rock uninterrupted by bedding planes. Shell fragments and the foraminifer *Endothyra baileyi* comprise the grains. *Endothyra* gives the rock a pseudo-oolitic appearance, and someone with at least a rudimentary knowledge of carbonate petrography named the town of Oolitic, Indiana, after that characteristic.

As anyone who has worked on microfacies analysis of carbonate rocks knows, even the most uniform formations vary in texture and composition. For the quarriers, subtle changes in texture or color can render a rock unsalable. Stylolites (crows' feet in local terminology) ruin it, and coarse-grained stone is disliked by customers who don't trust its strength and don't like its non-smooth appearance. Solution channels and terra rosa cause further problems.

To find the best stone, therefore, the quarriers must explore. They call in geologists, employ diamond cores and, largely, trust the accumulated wisdom of their practice to choose the right place to open a new quarry. Even with the shallow depth of their search, the results are hit and miss. Failed quarries are commonplace.

Geology and geologists are not always held in the highest esteem. "One quarrier would often drill in formations that underlie the Salem, then complain when he found no good stone. He absolutely refused to believe that sedimentary rock was bedded down in layers. He thought the creamy deposits of Salem could turn up anywhere, like buried treasure. You just had to sniff around for it."

Sanders has learned geology well enough to give a good description of why the Salem limestone is such a prized rock. But he also expresses a layman's sense of wonder when, impressed by its content, he describes the rock as "a cake of corpses." In the course of this book, he visits the site of the earliest known quarry (1827), takes a field trip with the state geologist, talks with quarriers, mill workers, and sculptors, and discusses the social stratification implied by the use of exotic versus local stone for grave markers.

The industry is far beyond its glory years, and Sanders describes the fading of towns originally built for a higher level of local economic activity. But the industry also has an assured minimum level of future demand. With the rock in so many existing buildings, production will long be required for repairs and replacement.

Most of us have taken that walk to the town square and seen this rock in use. Fewer have seen it in outcrop and quarry. This book goes there for you and leaves you with a detailed, empathetic impression of the geology, scenery, people, and life in limestone country.

Aquatic Pollution, an Introductory Text, 2nd ed.

by Edward A. Laws

Book Reviewed by David C. Kopaska – Merkel, Geological Survey of Alabama

This is a college undergraduate textbook, and its stated purpose is to educate both the lay public and policy makers about the scientific aspects of water pollution so that they can make informed decisions about issues related to water pollution. The book is admirably suited to this purpose, and is recommended reading for anyone who wants to know more about what can and should be done, either personally or societally, about various kinds of pollution.

The book is organized as follows. Seventeen chapters cover topics such as Urban Runoff, Plastics in the Sea, and Radioactivity. Each chapter contains a simple explanation of the nature of the problem and most contain one or more case studies. The case studies are discussed in terms of their practical implications and with an eye towards determining what practices are safe/economical under what conditions. I found most of the case studies intensely interesting, and they are one of the best features of the book.

The discussions of various toxins are about as complete as they can be in a book of this scope and length, but in some cases a little more information would be helpful. For example, in the discussion of PCBs, Laws does not mention the controversy in the popular press about whether PCBs are as dangerous to humans as has been reported. Also, he says "PCBs discharged to aquatic systems are presumably either degraded in the water column or buried in the sediments;" apparently unaware of the detailed studies conducted by Sanders (1989) and others, demonstrating that PCBs in the Hudson River are mostly buried in the sediment...and then are remobilized by flood events.

The book has a few other problems of course. There seems to be a little anthropocentrism too, with emphasis on avoiding practices harmful to humans but not those that might harm only wildlife. One of the most irritating things about this book is the high frequency of passive sentence constructions. The book provides insufficient explanation of how some calculations are made; e.g., of toxicity levels used by the EPA. These calculations would probably be explained in more detail in a classroom, but the casual reader does not have this extra assistance.

On the plus side, some topics that have been bandied about in the popular press, such as the methods used to determine whether chemicals are carcinogenic, are clearly explained in relatively few words in this book. The real problems with these studies are rarely mentioned, and probably not understood, by the talking heads who attack the EPA, FDA, and other governmental organizations on TV and on the radio. Every layperson who reads Aquatic Pollution will come away with a much better understanding of why environmental problems are not so easy to solve as one might think.

I only noticed a few factual errors, illustrations are for the most part very easy to interpret and relevant to the text, and I only counted eight typographical errors. Obviously the book was carefully edited. The book is informative, engagingly written, and not all that expensive. I recommend it.

REFERENCE

Sanders, J. E., 1989, PCB-pollution in the Upper Hudson River: from environmental disaster to "environmental gridlock:" Northeastern Environmental Science, v.8,m p. 1-86.

COSTA RICA'S COCOS ISLAND

Cruise from Puntarenas to Costa Rica's beautiful Cocos Island, the largest uninhabited island in the world, with more than 200 cascading waterfalls. Biologists and conservationists will accompany the 60-passenger cruise vessel Temptress. At Cocos you will see a mini-Galapagos, with many species of birds, fish and plants found nowhere else. There will be ample time for birdwatching, nature walks, snorkeling, diving and observing dolphins. Best of all, 90% of your fee will go directly to supplying much-needed equipment and staff to protect the island. Oceanic Society Expeditions is collaborating with a Costa Rican environmental organization to support this important effort.

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USEFUL UTILITIES

GEOQUBE 11
2D TO 3D SEISMIC DATA CONVERSION

GeoQube 11 is a processing sequence which converts a mixed vintage 2D seismic data set into a migrated 3D volume which may be interpreted on an interactive workstation. At the very least, the interpreter will be able to gain 3D workstation benefits on a matched data volume. For example, speed in picking and loop tying and the abilities to time slice and extract random lines. At best there will be a significant reduction in out of the plane artifacts due to 3D migration collapsing diffractors to their point of origin resulting in more accurate structural imaging.

GeoQube 11 is particularly well suited to areas which have been surveyed over a number of years. Often in such instances the grid formed by the total data will be more dense (more finely sampled) than any of the individual surveys. It is also common that such surveys will have been acquired with a variety of azimuths which greatly assists in the estimation of dips.

Where data sets of varying vintages are concerned, the first stage of processing involves matching the phase and character of the different data sets and resolving any apparent positional errors. This stage is an interactive phase where all ties between a certain set and a preselected master set are examined and an optimal operator derived to ratify phase/character misties, the process being analogous to that used to resolve time misties during interpretation. Obviously the effort involved here is proportional to the number of different surveys and to some degree, their quality.

The second stage uses a mathematical approach devised by Pennzoil and licensed by Simon Petroleum Technology. This approach involves a structural reconstruction of data within the polygons defined by the original 2D lines. Basically, surfaces are defined by the 3D volume corresponding to specific horizons and data points are interpolated along these surfaces from nearby lines. Consequently the result is proportional to the input line spacing at the specific locations.

Finally the matched, interpolated 3D volume is 3D migrated and presented in workstation ready form. Quality control plots of in-lines and cross-lines before and after migration are also supplied. Samples of the input 2D lines can also be produced as a final quality check.

GeoQube 11 is not intented to replace acquisition of a new 3D survey with its attendent benefits from finer sampling but it is a cost-effective alternative to conventional 3D, and may be useful in assisting in the design of future surveys.

To obtain a free diskette call Dave Shope or April Robertson at 953-7441

EXPLORATION ACTIVITY REVIEW

By Walter S. Light, Jr.
President, Thunder Exploration, Inc.
Data Furnished by Geomap Co.

National Rig Count: October 29—870; Year Ago—838

International Rig Count: August 1993—935, Year Ago 939

Seismic Crew Count: August 1993—184, Year Ago 210

WEST TEXAS -

SOUTHEAST NEW MEXICO

MW Petroleum Corporation has announced a deeper pool **Silurian** discovery in northwestern **Lea County, New Mexico**. The #1 State "10" had an IP of 443 BOPD, 28 MCFGPD, and 212 BWPD from perforations 10,932'-38'. The well is 2 miles northwest of Devonian production in S.R.R. Field. The trap for the new discovery is structural over the BAR-U Field. The new well is significant because it is the most northerly commercial Siluro-Devonian oil pay in the Tatum basin.

In northwestern **Mitchell County, Texas** Dunigan Operating has completed its #1 Strain with an initial flow from the **Ellenburger** of 57 BOPD, 12 MCFGPD, and 12 BWPD. Nearest Ellenburger production is Westbrook Field located 2.3 miles to the southeast. Westbrook field has produced over 700,000 BO from seven wells. The #1 Strain perforated 10 feet of Ellenburger dolomite (8224' top of pay).

The nearest trend of Ellenburger production is over 25 miles away in Borden County.

Mirage (**Ellenburger**) Field was opened in southeast **Scurry County Texas.** Baytech, Incorporated completed their #1 Richardson for 78 BOPD, 15 MCFGPD, and 27 BWPD from perfs 7673'-90'. There is no other reported Ellenburger production within 5 miles of the new well. With the new control point integrated into Geomap's present interpretation, a small structure is indicated.

Buckeye Energy has announced an **Ellenburger** discovery with its #1 Clements in **Callahan County, Texas.** The well was completed open hole with casing set @ 4015' and 2 3/8" tubing set @ 4020' for an IP of 74 BOPD and 12 MCFGPD. The new discovery is surrounded by Cook Sand (Wolfcamp) production in Callahan Regular Field. Nearest Ellenburger production was from the abandoned Dawson Oil Corporation #3 Travis Chapman 1.25 miles away.

Elsewhere in **Callahan County** Pitcock, Inc. has made a new **Caddo** gas discovery with its #1 R. Salmon. The well was perf'd 2857' to 2875' and had an IPF of 1017 MCFGPD, 2 BC, and 20 BWPD. The new discovery is located 0.75 miles south of Jennie Faye Field (Duffer production). On the Caddo mapping horizon the well appears to be located on the south flank of a Caddo Structure.

In **Eastland County, Texas** a new **Mississippian** gas discovery has been announced by W.G. Arnot, Jr. The #1 Wilson made an open hole completion with 2 3/8" tubing set @ 3048' and 4 1/2" casing set @ 3086'. After acidizing the well flowed with an IP of 823 MCFGPD.

There is no production from any horizon within 2 miles of the new well. Nearest well bore was D&A by Tex-Cal Company in 1974 (#1 D.V. Rodgers Estate) a 3470' Ellenburger test, located 0.75 miles south of the #1 Wilson. Structurally it appears the well may be associated with a local carbonate buildup.

INTERNATIONAL HIGHLIGHTS

NORTH AFRICA

Algeria

Agip has suspended its outpost well **Bir Rebaa SW 2** as an **oil well.** The **BRSW-2** is located in the **Zemoul El Kbar tract (District V, Ghadames Basin)** 4 km east of the BRSW-1 that tested 4,600 BCPD and 13,000 MCFGPD.

Elsewhere in Algeria, **Sonatrach** suspended its **Oufrane Nord 1** wildcat as a successful **gas well** from an unreported **Ordovician** interval. The well is located in the **Bel Rhazi license** approximately 78 km south of **Timimoun (District VII)** and 43 km northwest of Sonatrach's Hassi Sbaa 1 oil discovery. TD was 2,467 m in the Cambrian.

Libya

Veba's B-1-NC84 wildcat tested oil in the **Nubian Sandstones.** The well is located east of Amal Field in the eastern part of the **Sirte Basin.**

Also in Libya, **Agoco** tested an unreported amount of **oil** from its **VV-1-65** wildcat in **Concession 65** in southeast **Sirte Basin.**

Lasmo has spud its **A-1-NC174** wildcat in the **Murzuk Basin, (Onshore Block NC 174).** The **Cambro-Ordovician Sandstones** of the **Memouniat Formation** are the primary objectives.

CENTRAL AND SOUTHERN AFRICA

Cote D'ivoire

United Meridian resumed drilling of its **Panthere 1** off **Grand Lahou** in **Permit CI-11.** Drilling had been suspended for three years.

LATIN AMERICA

Brazil

Petrobras announced a new discovery in the **Cumuruxatiba Basin** with its **1-BAS-104.** The well was drilled to 3,730 m. and is located off Caravelas, southern Bahia, 26 km northwest of the Abrolhos Archipelago National Park.

Petrobras has also announced the test of its **4-RJS-396D** in the **Campos Basin,** 11 km west-southwest of Marlim field's discovery. The well is located in 700 m of water and had an IP of 3,000 BOPD from a presumed **Oligocene** zone between 2,500 and 2,517 m.

Columbia

Triton has completed an outpost its **La Liebre 2** in the **El Pinal Block , Middle Magdalena Basin.** The well tested **Eocene** sandstones of the **La Paz Formation** with flow rates up to 650 BPD of 32.6 API oil. Triton will likely request commercial status for the field.

In the **Los Venados Block, Upper Magdalena Basin, Huilex** has spud its **Reno 1**. The well is located 18 km northeast of Yaguara Field. The likely objectives of this 1,980 m test are the **Upper Cretaceous Monserrate Sandstones** in a subtrust play.

Ecuador

Arco has spud their **Villano 3** appraisal well in **Block 10** in the **Pastaza Basin.** The well will evaluate the **Aptian-Albian Main Hollin Formation** tested in the **Villano 2** at rates of 2,130 BPD of 21 API oil.

Paraguay

Primo Cano Mar-tinez has announced a shallow gas discovery with its **Fortin Gabino Mendoza 1** located in the **Carandaity Basin.** The well tested 2,000 MCFGPD presumably from a **Devonian reservoir.** Another zone tested 5,000 MCFGPD @ 2,700 m.

Venezuela

Corpoven tested its new pool wildcat **SBC-18E** in the **Greater Furrial Trend,** eastern Venezuela. The well is located in the **Santa Barbara Field Area** and flowed a combined 7,050 BOPD with 24 MMCFGPD. Tests were from a 50' interval in the **Oligocene Lower Naricual Sandstone** (3,560 BPD of 29 API) and a shallower 70' interval that flowed an approximate 3,500 BPD of 34 API oil with no water.

AUSTRALIA

Western Australia

Wapet's Australind 1 found a gas column overlying thin oil pay. No test data was released. The well is located in **WA-24-P (Barrow-Dampier sub-basin),** 3.3 km north-northwest of **Saladin 1** that tested 5,950 BOPD and 1500 MCFGPD.

Woodside's Dixon West 1 wildcat in **WA-28-P** on the **Rankin Platform** tested an aggregate of approximately 2,600 BOPD and 1,000 MCFGPD from **Upper Jurassic sandstones.** The well is in 84 m of water 7.5 km south-southeast of Woodside's Rankin 1.

EUROPE

Belgium

The Belgium Council of Natural Resources initiated a **Coalbed methane test** in the **Campine Basin. Peer 1** drilled to a TD of 1,346 m. Almost the entire 480 m **Westphalian** section was cored. The well has been stimulated and is currently de-watering.

Netherlands

NAM has made another **gas discovery** with its **Saaksum 1** wildcat in the **Groningen Concession.** The well is close to Groningen gas field (110 TCF). The well was suspended after encountering gas in the **Permian Rotliegend Slochteren Sandstone.**

Turkey

TPAO suspended its **Cagla 1** wildcat after recovering oil from two different DST's between 1,488 m to 1,510 m and 1,513 to 1,535 m. The well is located in **License 3037,** 8.5 km south-southwest of the Caylarbasi 1 oil discovery. **TPAO** has also suspended its **Ozan Sungurlu 4** outpost after recovering oil from a DST between 2,638 and 2,656 m. The well is located on the northwestern edge of the Ozan Sugulurlu field that produces from **Campanian** to **Turonian Karabogaz Formation.**

Continued on page 57

QUICK LOOK TECHNIQUES

Additive Property of Faults

by Subsurface Consultants & Associates, Inc.
Lafayette, LA 70508

In an area of intersecting faults, the vertical separation (the missing or repeated section) of the individual faults should be additive, or very close to additive, across the intersection where the two faults merge into one. Vertical separation or missing section is discussed in the December 1993 issue of this Bulletin. Figure 1 shows two faults downthrown to the south that merge laterally to the east. The vertical separation for the eastern portion of the fault is equal to the sum of the vertical separations for the two smaller faults.

When checking the additive property, we are not referring to the fault gap or over lap widths being additive, but the vertical separations (the missing or repeated section seen in a well log). The vertical separation is checked by calculating the vertical difference in contour values across the fault in the strike direction of the contours (Figure 1). An easy way to review the additive property of faults is to go clockwise around a fault (see dashed circle on Figure 1) adding the vertical separations for the faults dipping in a clockwise direction and subtracting the vertical separations for the faults dipping in a counter-clockwise direction. If the additive property of intersecting faults is honored correctly, the additions and subtractions should nearly equal after crossing all the faults. Be sure to check this property as close to the intersection as possible. Faults can change in size laterally; therefore, at some distance from the intersection the vertical separations may not be additive. Typically, the closest contours to the intersection are used to check this property.

Figure 2 shows a completed structure map prepared from seismic data with intersectingä faults that do not honor the additive property. This is a direct indication that the map is incorrect. There is a 1500 foot bust on this map. Because of the magnitude of this error, it is likely that the problem is the result of a seismic mistie across one or more faults. The data must be reviewed again and the map redone before any decisions can be made with regard to hydrocarbon potential.

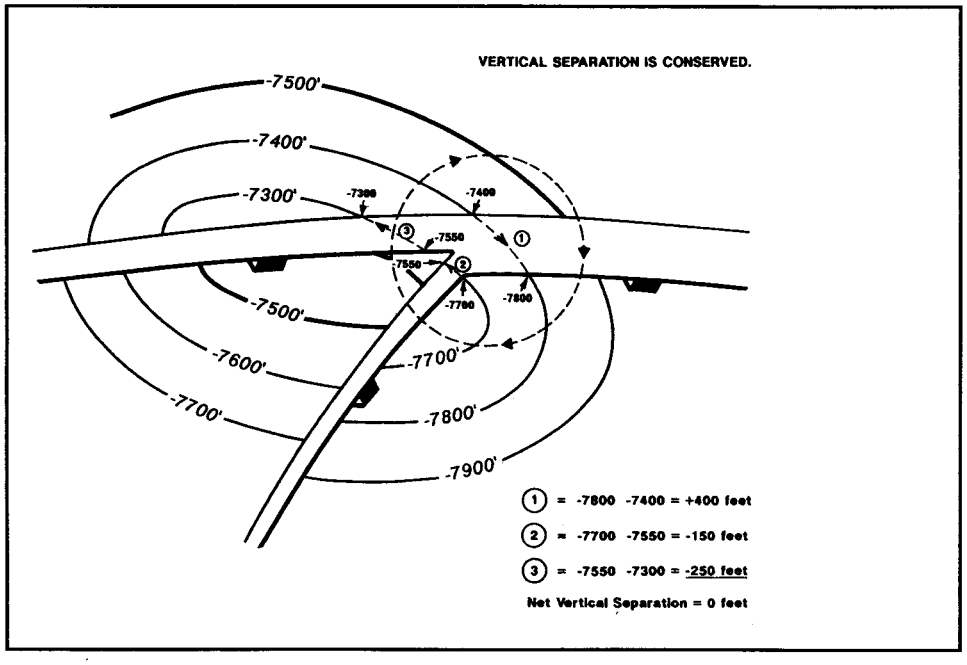

Figure 1

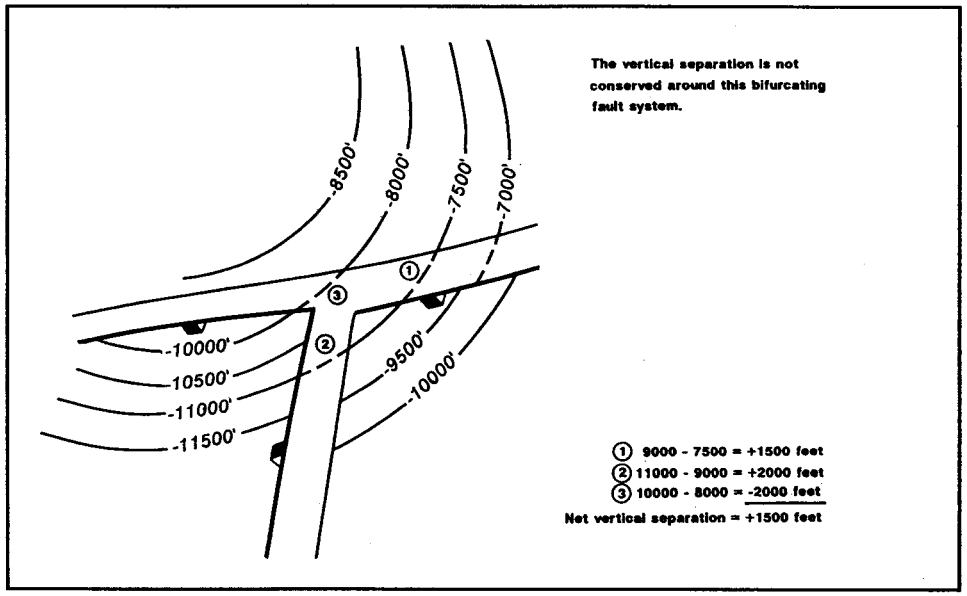

Figure 2

SOCIETY OF WOMEN ENGINEERS

The Society of Women Engineers is pleased to announce our 1994 Spring Scholarship Program. This year we are seeking qualified applicants for thirty-six scholarships varying in amounts from $1,000 to $4,000 and totaling more than $50,000. Enclosed are copies of the official SWE application form which includes instructions for filing. Additional copies of the applications may be obtained from our Headquarters office or can be reproduced at your school.

Please bring this scholarship opportunity to the attention of all qualified women students in your school. Applications, including supportive materials, must be postmarked no later than February 1, 1994.

All applications for SWE Spring Scholarships (described under "Sophomore, Junior, Senior and Graduate Scholarships" in the form on page 56) are judged by a committee of at least five engineers, not connected with an engineering school, who represent different fields of engineering. Recipients will be notified approximately May, 1994, and will receive their awards in September, 1994, for use during the 1994-1995 school year.

Applications for our Summer Scholarship Program (for Freshmen and Re-entry scholarships) will be available in March 1994 and will be forwarded to you at that time.

APPLICATION – TO BE ACCEPTED FOR JUDGING AN APPLICANT MUST SUBMIT ALL REQUIRED ITEMS AS HEREIN ITEMIZED POSTMARKED NOT LATER THAN FEBRUARY 1. ALL OF THESE ITEMS MUST BE SUBMITTED IN ONE PACKAGE OR ENVELOPE. THE APPLICANT IS RESPONSIBLE FOR SEEING THAT ALL THE NECESSARY DATA (LETTERS, TRANSCRIPT, STATEMENT OF "GOOD STANDING" AND COMPLETED APPLICATION FORM) ARE SUBMITTED BY THE DEADLINE IN ONE PACKAGE, AND WILL BE IMMEDIATELY DISQUALIFIED FROM JUDGING WITH NO FURTHER FOLLOW-UP IF THESE INSTRUCTIONS ARE NOT FOLLOWED. REFERENCE LETTERS MAY BE SUBMITTED IN INDIVIDUALLY SEALED ENVELOPES WITHIN THE APPLICATION PACKAGE.

The following specific items are to be submitted

1. **Application Form** — Completed "Society of Women Engineers Scholarship Application" (Attachments may be added to the application blank if there is not enough room in the activities and employment blanks.)
2. **Transcript and Statement of "Good Standing"** — Official copy of applicant's transcript showing grades for the entire enrollment, in current school and prior college or university, and a statement of "good standing" from the Department Head, the Dean or the Registrar
3. **Applicant's Letter** — A letter written by the applicant addressed to the Chairman, Scholarship Award Committee of the Society of Women Engineers. This letter is not to be more than one typewritten page in length and should describe the applicant's feelings and opinions on the following
   a. Why she decided to study engineering and why she chose her particular major
   b. Why she has applied for this scholarship
4. **Reference Letter No. 1** — Letter of reference from the head of the department where the applicant is taking her major or her faculty advisor (Indicate standing in class of applicant relative to other students.)
5. **Reference Letter No. 2** — Letter of reference from another engineering professor (not the Dept. Head) in whose class the applicant has been, or is, enrolled
6. **Reference Letter No. 3** — Letter of reference from one present, or former employer, the reference should preferably be from an employer who is not a relative. (The applicant's employment need not have been connected with engineering.)
7. **Reference Letter No. 4** — Letter of reference from one person who has personally known the applicant for five or more years, one not associated with the applicant's college, not a member or relative of the applicant's family, and not an employer

MAILING INSTRUCTIONS — Mail all items by regular mail postmarked by February 1st to:

Scholarship Award Chairman, Society of Women Engineers
120 Wall Street, 11th floor
New York, New York 10005-3902

Society of Women Engineers
SCHOLARSHIP APPLICATION

PERSONAL DATA PLEASE PRINT (BLACK INK ONLY) OR TYPE

NAME

SCHOOL ADDRESS (CHECK PREFERRED MAILING ADDRESS ☐)

CITY | STATE | ZIP | SCHOOL PHONE

MAIDEN NAME | AGE | DATE OF BIRTH | CITIZENSHIP

HUSBAND'S NAME | OCCUPATION

MOTHER'S NAME | OCCUPATION

FATHER'S NAME | OCCUPATION

NAME OF PARENT OR GUARDIAN

ADDRESS OF PARENT OR GUARDIAN

CITY | STATE | ZIP

HOME ADDRESS (CHECK PREFERRED MAILING ADDRESS ☐)

CITY | STATE | ZIP | HOME PHONE

ANTICIPATED EXPENSES FOR COMING YEAR:

TUITION $_____

TRANSPORTATION _____

ROOM & BOARD _____

BOOKS & SUPPLIES _____

CLOTHING _____

PERSONAL MISC. _____

OTHER _____

TOTAL $_____

SOURCES OF INCOME FOR COMING YEAR:

PARENTS $_____

SCHOLARSHIPS _____

EMPLOYMENT _____

OTHER _____

(DESCRIBE)

TOTAL $_____

HAVE YOU EVER BEEN REFUSED A SCHOLARSHIP FOR YOUR ENGR. EDUCATION? ☐ YES ☐ NO

EDUCATION

PREVIOUS COLLEGE OR UNIVERSITY ATTENDED | DEGREE | YEAR GRAD.

COLLEGE OR UNIVERSITY NOW ATTENDING

LOCATION

MAJOR SUBJECT

DEGREE TITLE | EXP. YR. OF GRAD.

ENROLLED IN:

☐ 5 YR. PROGRAM

☐ 5 YR. CO-OP

☐ _____

NOW IN:

☐ 1ST YEAR

☐ 2ND YEAR

☐ 3RD YEAR (for 4th year co-op)

☐ 4TH YEAR (for 5th year co-op)

SUPPLEMENTARY INFORMATION (USE ADDITIONAL SHEETS IF REQUIRED)

COLLEGE ACTIVITIES: ON CAMPUS	OFF CAMPUS
SCHOLASTIC HONORS (NAME, YEAR RECEIVED)	HONORS (NAME, YEAR RECEIVED)
SOCIETIES & ORGANIZATIONS (NAME, OFFICES HELD, YRS. MEMBER)	SOCIETIES & ORGANIZATIONS (NAME, OFFICES HELD, YRS. MEMBER)
OTHER	OTHER
HIGH SCHOOL ACTIVITIES:	INTERESTS & HOBBIES
HONORS, CLASS & COMMUNITY ACTIVITIES	

PROFESSIONAL DATA SUPPLY A BRIEF RESUME OF YOUR WORK, YOUR DUTIES, STARTING AND TERMINATING DATES, SALARY

DURING COLLEGE	DURING HIGH SCHOOL

OPTIONAL: TO BE CONSIDERED FOR MINORITY SCHOLARSHIPS, PLEASE CHECK IF APPROPRIATE: BLACK ___ HISPANIC ___ NATIVE AMERICAN ___ PACIFIC ISLANDER ___.

I believe all the above information to be true. I hereby apply for a Society of Women Engineers scholarship. It is my understanding that I will be notified by May 1 if I have been selected as the recipient of an award. I further certify that I am not attending school as a member of any branch of the armed services nor am I obligated to serve an enlisted period in any branch of the armed services following graduation.

DATE RECEIVED | BY | SWE NO.

_____ SIGNATURE OF APPLICANT

_____ DATE

Exploration Review, Continued from page 53

FAR EAST

Brunei

Brunei Shell's Bugan 1 is a new gas discovery on the flank of **Iron Duke Field.** No test results have been released on the 3,500 m well.

Indonesia

Asamera has made a gas/condensate discovery on **North Sumatra.** The **Alur Rambong 1** was drilled to a TD of 3,360 m and had flow rates of 28,000 MCFGPD with up to 1000 BPCD from an undisclosed interval. The well is located 3.5 km north-northeast of the Julu Rayeu Field.

Pakistan

OMV of Austria discovered **gas** with its **Miano 1** wildcat. The well flowed 35,500 MCFGPD from **Lower Cretaceous Lower Goru Sands.** It is located in **Block 20** in the **Indus Basin, East Baluchistan.** The disocvery is on trend with both the Mari Gas Field and the Kadanwari Field.

NEAR EAST

Oman

Oxy's Wadi Latham 1 tested 2,439 BPD of 40 API plus 2,200 MCFGPD from a 61 m section of a medium radius **horizontal hole** between 2,048 m and 2,109 m. The productive zone is the **Lower Cretaceous Shuaiba Formation.** The well is located 8 km northeast of **Daleel Field.**

Oxy also completed its **Al Barakah NE-1** wildcat as an **oil well.** The well was drilled to 1,678 m having presumed objectives of the **Shuaiba Formation Limestones.** This well is located 6 km north-northeast of **Al Barakah Field.**

UNITED KINGDOM - NORTH SEA

Amerada tested its **15/21b-50** wildcat located between Rob Roy and Scott fields for a rate of 5,274 BPD of 28.5 API oil.

Amoco's 49/23-D5 Baird Prospect wildcat tested good flows of gas.

Bow Valley's appraisal **16/6a-4,** a farm-in on the **Sedgewick Eocene Structure** tested over 9,000 BOPD from a horizontal interval.

Norway

Saga's 34/7-22 wildcat, just east of **Tordis** tested the **Brent Formation** at a stabilized rate of 7,674 BOPD.

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