

## PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

of the Pacific Section American Association of Petroleum Geologists

February/March 1991 No. 2

#### THE PRESIDENT'S COLUMN

In January, I had the pleasure of attending AAPG Day in Tulsa. It's an opportunity for the Tulsa staff to show their stuff and bring together Officers from Sections and affiliated geologic societies.

Fred Dix, of <u>Explorer</u> bad jokes fame, is the Executive Director and presided over the affair. We started with a tour of the office facilities and met the Directors and Managers of the various departments. They have a staff of about 70 with particularly large groups in convention and accounting departments. Fred also gave us a rundown on membership and projections for the future of AAPG. After the boom of 1982 and the bust of 1985 to 1986, things seem to be settling out to about the pre-boom level. There was also discussion regarding what's going on in geology departments around the country. Enrollment is creeping back up, and a large percentage are there for environmental related studies.

Three groups were in attendance, Officers and representatives from Sections and geologic societies, AAPG Officers and candidates, and Tulsa staff. The most informative function was a session where all of the attendees had a chance to give a summary of local activities. The Pacific Coast was represented by "yours truly" and Tom Dignes from the Northern California Geologic Society. Four of the six national Sections were represented along with twelve affiliated geologic societies. Absent were the Rocky Mountain Section (!) and the Gulf Coast Section. Actually, the latter was represented by the Gulf Coast Association of Geologic Societies and the New Orleans Geologic Society. Hard to imagine a meeting of this caliber without anyone from Denver, although their 1994 national convention is scheduled there. Something else I didn't understand, the Dallas Geologic Society is on the rocks, and by their own words are floundering. The Houston Geologic Society, on the other hand, is blowin' and goin'. Their membership is about 5,300 (entire Pacific Section is 1,000 +/-), their annual budget is \$450,000 and they publish their own bulletin of about 60 to 80 pages. Sounds like one hell of a lot of work, and perhaps not something to emulate.

I found that all of the Sections and geologic societies are experiencing the same transition to environmental affairs that we are. I thought California was ahead in this transition, but the change is just as acute elsewhere. The Dallas Geologic Society has brought in 60 new members recently - all in environmental jobs.

Another common thread is the effort to get primary schools and pupils involved with the geologic sciences. Organized field trips with youth groups, especially Scout Troops, are somewhat effective.

Regarding publications, one delegate noted that in her office, one could hear the bulletins hitting the round file in concert, just not enough local articles of interest. Fred's rejoiner was a predictable, "Then publish!". The <u>Explorer</u>, on the other hand, is successful, economical and popular. The Bulletin keeps getting cut down and is barely a "break-even" publication.

Bud Reid gave us a rundown on national conventions. The schedule is set at least through 2004 - assuming we're all still here. There is a universal problem with conventions - attendees slurping up the coffee and donuts in the spouse's hospitality room. At the Dallas meeting in April there will be a special area set aside called the "Deal Room" where copies, faxes and tables will be available. No indication that java and sinkers will be served.

## AAPG NATIONAL CONVENTION

## 75th Anniversary

"A Look Back - A Look Forward"

April 7 - 10, 1991

Dallas, Texas

Entertainment Highlights

(See Page 9)

Jack Cunningham, President

## San Joaquin

March - No meeting, Pacific Section AAPG Convention, Bakersfield.

April 9 - Ted Flanigan, Consultant, "A Review of Nevada Oil Fields and Future Potential".

May 14 - David C. Callaway, ARCO Oil and Gas, "Sequence Stratigraphy of the San Joaquin Valley".

June 11 - Edwin Horan, Field Study Associates, "Petroleum Potential of Humboldt Basin, California".

July & August - No meeting.

September 13 - Annual Fall Barbecue and Golf Tournament, Stramler Picnic Area.

Suggestions for meeting speakers or topics should be addressed to Larry Knauer at 805/763-6280.

The meetings are held at the American Legion Hall at 2020 "H" Street in Bakersfield. Attitude adjustment starts at 6:00 p.m. and dinner is served at 7:00 p.m. For more information and reservations please contact Laura Bazeley at 805/326-1112.

## Coast

March 26 - Erle Kauffman, AAPG Distinguished Lecturer, will present "250 Million Years of Mass Extinctions -Dinosaurs to Man". Please note that this is the fourth Tuesday of the month.

April 16 - G. C. "Butch" Brown, Consultant, "Turbidites, A Primer".

May 21 - To be announced.

Meetings are held the third Tuesday of every month. Meeting time is at 6:00 p.m., dinner at 7:00 p.m. at the American Legion Hall in Ventura. The address is 83 South Palm. For reservations please contact Marty Meyer at 805/494-2210.

THERESA GEIJER, Secretary for the Coast Geological Society, was transferred to Texaco downstream functions in Universal City and has elected to resign her duties.

**DAVE SALTAR**, retired, Chevron, has assumed the responsibility of Secretary for the remainder of the current Officer term for the Coast Geological Society.

Los Angeles

The meetings will be held alternate months at noon at UNOCAL Center, California Room, 1201 West Fifth Street, Los Angeles.

For reservations or information, call Randall Ferguson at 714/842-6331 or Ken March at 213/436-9211 - #357.

## Northwest

March 8 - Walt Youngquist, Consultant, "Petroleum Resources and the Destiny of Nations", to be held at the State Lands Office, Salem, Oregon.

**April 12** - Ted Flanigan, Consultant, "A Review of Nevada Oil Fields and Future Potential", to be held at the Red Lion Inn, Portland, Oregon.

May 10 - Rick Fritz, Masera Corporation, "Horizontal Drilling: An Overview", to be held at University Tower, Seattle, Washington.

June 21 & 22 - To be announced, "Geothermal Exploration in Central Oregon: Past, Present and Future", to be held at The Riverhouse, Bend, Oregon.

For suggestions or questions, please contact Lanny Fisk at 503/382-0825, Barbara Portwood at 503/287-2762, or any other member of the NWPA Program Committee: Phil Brogan, Harry Jamison, Paul Dudley or Nancy Ketrenos.

## Northern

Our Secretary, Norm Norton, has accepted a transfer to Houston. We are sorry to see him go, but wish him well in his new job assignment. Mary Rose Cassa will be taking over his duties and will continue to handle the duties of Treasurer. The Executive Committee wishes to thank both Norm and Mary for their efforts on behalf of NCGS.

In addition, the NCGS is proud to annouce the availability of a \$1,000 grant to support student research on northern California geology. Interested students should send a description of the project, an itemized list of anticipated expenses, and a letter of support from the faculty advisor. All requests and supporting documentation must be received by March 12, 1991.

Please contact Dr. J. C. Phelps, NCGS Grant Committee, Chevron Overseas Petroleum, Inc., Post Office Box 5046, San Ramon, California 94583-0946.

#### SACRAMENTO PETROLEUM ASSOCIATION

Meetings are held at noon at Neptune's Table Restaurant. For reservations please contact Rich Boyd at 916/929-4141.

#### COMING EVENTS

- March 20 to 22 SPE 1991 Western Regional Meeting, Long Beach, "Technology - The Balance for Oil & Environment". For more information or to register, call the SPE Meetings Department at 800/527-6863.
- April 4 & 5 Fifth Annual Spring Symposium on Natural Gas, San Diego. Sponsored by <u>National</u> <u>Gas Week</u>. Please contact Tonia Tompkins, Conference Coordinator at 800/368-5803 (see Page 3 for further details).
- April 7 to 10 National AAPG Meeting, Dailas.
- May 6 to 9 Offshore Technology Conference, Houston.
- June 3 to 7 Computer Modeling Group Symposium on Reservoir Simulation, Calgary.
- June 7 to 9 "Geology of White River Valley, Grant Range, Eastern Railroad Valley and Western Egan Range, White Pine County, Nevada", Nevada Petroleum Society Field Trip. Please contact Earl Abbott or Neal Brecheisen of the NPS, Post Office Box 11526, Reno, Nevada 89510 or phone 702/827-2324.
- June 11 to 13 EPA Forum on Innovative Hazardous Waste Treatment Technologies, Dallas.
- June 16 to 19 SPWLA 32nd Annual Logging Symposium, Midland, Texas.
- August 15 to 18 SEPM Mid-year Meeting, Portland, Oregon.
- September 11 to 13 Pacific Coast Gas Association 98th Annual Meeting, Seattle, Washington.
- September 29 to October 2 -International AAPG Conference, London.
- October 6 to 9 SPE Annual Technical Conference and Exhibition, Dallas.
- November 10 to 14 Society of Exploration Geophysicists 61st Annual International Meeting, Houston.
- November 17 to 19 API Annual Meeting, Houston.
- April 29 to May 1, 1992 Pacific Section AAPG Convention, Sacramento, Rich Boyd, Chairman (Capitol Oil).

#### 1992 AAPG SECTIONAL MEETING

Rich Boyd, 1992 Convention Chairman for the AAPG Sectional Meeting in Sacramento, is looking for Committee Chairmen, as well as other volunteers.

Want to help? Please call Rich at 916/929-4142.

#### 

#### **RECENT MOVES**

ALEXANDER DAVIDSON has moved from Houston to Bellingham, Washington.

JOHN R. GILBERT has been transferred

JAN GILLESPIE has recently moved to

Chevron.

in hydrogeology.

Barbara to Edison.

to Houston from San Ramon with

Bakersfield from Laramie, Wyoming, Jan

is a professor of geology at Cal State

Bakersfield and will be teaching a course

Resources has moved from Santa

#### **NEW MEMBERS**

#### SOUTHERN CALIFORNIA

GERALD F. GENG, Thousand Oaks.

HOWARD R. LEVEL, Ventura.

- STEVEN J. UCHYTIL, ARCO Oil and Gas Company, Bakersfield.
- J. FRED BAIR, Chevron U.S.A. Inc., Bakersfield.
- GARY L. SMEDLEY, Chevron U.S.A. Inc., Bakersfield.
- JOHN M. GHIST, ARCO Oil and Gas Company, Bakersfield.
- **ROBERT A. JACKSON**, ARCO Oil and Gas Company, Bakersfield.
- **KEVIN MAYES**, Bechtel Petroleum, Tupman.
- KENNETH S. WERNER, UNOCAL Corporation, Bakersfield.
- EARL F. LaPENSEE, Los Angeles.
- CHARLES H. ACORD, UNOCAL Corporation, Bakersfield.

#### LETTER TO THE EDITOR

#### Dear Editors:

I am writing to comment on your "one-liner"" in the January, 1991 edition of the Pacific Petroleum Geologist Newsletter. The major oil companies take enough grief from the press as it is. Stating that Chevron and BP are postponing safety improvements without further clarification is irresponsible reporting. Safety improvements to what? Why were they postponed? As a Chevron employee, I can tell you that safety in the workplace is one of Chevron's primary objectives. I expect BP has the same objective. I am very disappointed in the Newsletter.

Frank Koch

Dear Mr. Koch:

The "one-liner" regarding safety should not have been printed.

We regret the oversight. Thank you for bringing it to our attention.

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#### NATIONAL GAS SYMPOSIUM

The Fifth Annual Spring Symposium on Natural Gas, sponsored by <u>National</u> <u>Gas Week</u>, will be held in San Diego on April 4 and 5, 1991.

The program will include discussions and review of environmental legislation and regulation affecting gas operations, including operations in wetlands; a look at the California market; comments on the importance of including energy issues in the U.S.-Mexico free trade talks; debate over comparability of service on pipelines between pipeline sales customers and independent shippers; a review of anticipated gas demand; and the gas supply that will be needed to meet that demand.

Further information and details on registration, including the symposium program, are available by calling the Conference Coordinator, Tonia Tompkins at 800/368-5803 or 202/662-0711. Please fax written inquiries to 202/783-5918.

#### SACRAMENTO BASIN SYMPOSIUM

The Sacramento Petroleum Association has announced that it will sponsor a symposium, "The Structural Geology of the Sacramento Basin", at the 1992 AAPG-SEPM-SEG Pacific Section Convention in Sacramento. Papers may be presented either orally or in poster format, and a volume of written papers will accompany the symposium.

If interested in participating, please contact Victor Cherven at 916/677-0477 or William Edmonson at 805/322-0337.

#### DINOSAUR QUARRY FIELD TRIP

The Grand Junction Geological Society, in cooperation with the Museum of Western Colorado and the Colorado Plateau Section of the AIME, are having a field trip on June 6, 7 and 8, 1991. The three day field trip will visit world famous dinosaur quarries and trackway sites in the Grand Junction, Colorado, and Moab, Price and Vernal, Utah areas.

For information, please contact Bill Chenoweth, 707 Brassie Drive, Grand Junction, Colorado 81506. Bill's telephone number is 303/242-9062.

#### JEFFREY KENNEDY has been transferred from Los Angeles to Camarillo with the Minerals Management Service.

KENNETH H. HUNTER III of Hunter

- **ROBERT H. KIRBY** has transferred from Saudi Arabia to Bakersfield with Chevron.
- JOHN R. LJUNG has moved from Valencia to San Luis Obispo.
- ANN M. MARKSTROM has moved from Bakersfield to Pickney, Michigan.
- **THANE H. McCULLOH** has transferred from Mobil Research and Development Corporation in Dallas to Mobil Exploration and Producing U. S., Inc. in Bakersfield.
- MARILYN G. MERRITT has moved from Camarillo to Bakersfield.
- **CRAIG K. OGAWA** has been transferred to Camarillo from Los Angeles with the Minerals Management Service.
- HANS F. SCHWING has transferred from UNOCAL in Bakersfield to UNOCAL International in Los Angeles.
- MARK A. THOMPSON has moved from Bakersfield to Cambria.
- JOHN T. WILLIAMS has moved from Sky Valley to Valencia.
- **STEVEN A. WOLFSON** has moved from Los Angeles to Camarillo with the Minerals Management Service.

THE MINERALS MANAGEMENT SERVICE, U. S. DEPARTMENT OF THE INTERIOR, has moved from downtown Los Angeles to new offices at 770 Paseo Camarillo, Camarillo, California 93010.

#### NORTHWEST PETROLEUM ASSOCIATION

#### **NEW OFFICERS**

#### **President**

Barbara B. Portwood Independent Consultant, Portland, Oregon

Vice President & President-elect

Lanny H. Fish President, Norwestco, Bend, Oregon

#### Secretary

Richard G. Bowen Publisher, <u>Northwest Oil Report</u> Portland, Oregon

#### <u>Treasurer</u>

William Connelly Exploration Manager, Nerco Oil & Gas Vancouver, Washington

#### **Directors**

#### Peter Hales Exploration Manager, Weyerhaueser Company Tacoma, Washington

Harrison C. Jamison Consultant, Sunriver, Oregon

Robert Deacon Consultant, Wright-Deacon & Associates Portland, Oregon

#### Robert Fujimoto Geologist, U. S. Forest Service Portland, Oregon

#### **Dennis Olmstead**

Petroleum Engineer, Oregon Department of Geology & Mineral Industries Portland, Oregon



#### NEWSLETTER ANNOUNCEMENT

After three years of editing the newsletter for the Pacific Section, Laura Bazeley will step down as Editor. We want to thank Laura for the many hours that she has donated to this publication and for her successful efforts in continuing to make it an important source of news and information for the geological societies of the Pacific Section.

Nancy Houghton will be our new Editor. Nancy moved to Bakersfield from Dallas, Texas approximately two years ago. While in Dallas, she worked as a geologist with Core Laboratories. Nancy now works for Chevron U.S.A. She can be reached at 805/395-6351 for newsletter-related information or to submit news items for publication.

#### ASSOCIATION OF ENGINEERING GEOLOGISTS 1991 ANNUAL FIELD TRIP

Bob Larson, Chairman of the Field Trip Committee, has announced that this year's field trip is tentatively scheduled for August 14, 1991. Tom Blake will lead the trip, which will visit the general area of Santa Susana Mountains, Simi Valley, Camarillo and the eastern Oxnard Plain. The Simi-Santa Rosa fault will be highlighted. Papers and suggestions for field trip stops are needed in order to make this a successful trip, so please volunteer. Papers on all aspects of engineering geology, hydrogeology, as well as general geology are welcome. Please contact Tom Blake at (805) 650-7000 or Rob Larson at (818) 458-4923. The deadline for submittal of papers is June 1, 1991.

As the date of the field trip approaches, Bob Larson will also need about twenty volunteers willing to help him put together the field trip guidebook.

#### UNION PACIFIC RESOURCES FUNDS ASSOCIATION FOR WOMEN GEOSCIENTISTS (AWG) FOUNDATION

The Association for Women Geoscientists is pleased to announce that funding is available for the Union Pacific Resources - AWG Distinguished Lectures. Union Pacific Resources Company has given the AWG Foundation a \$2,500 grant for 1991 to underwrite travel for women geoscientists participating as speakers.

Grants of up to \$300 for direct travel costs will be available on a first come, first serve basis to non-profit, non-government institutions or organizations seeking speakers from the AWG Speakers Bureau. The Speakers Bureau provides a list of over 150 nationally recognized women geoscientists with a great choice and range of speakers' topic to those seeking speakers on geoscience topics.

For information on obtaining a list of speakers and a grant for speaker's travel, please write: Speaker's Bureau, Association for Women Geoscientist's Foundation, c/o Resource Center for Associations, 10200 West 44th Avenue #304, Wheat Ridge, Colorado 80033, 303/422-8527.

#### **BLM-EESI GEOLOGIC FIELD TRIPS**

The following field trips are being sponsored by the Bureau of Land Management and the Earth Environmental Sciences Initiative.

#### March 16, 1991 San Andreas Fault: <u>Gorman to Wallace Creek</u>

This trip explores the San Andreas Fault starting at it's intersection with the Garlock Fault. Classic fault localities are seen, including the main scarp of the 1857 Ft. Tejon earthquake and the offset drainage at Wallace Creek.

#### April 13 & 14, 1991 Highway 49: Sierra Gold Belt

This trip begins in Mariposa and goes through gold camps along Highway 49, ending at Sattley in Sierra County. The trip includes demonstrations of placer mining and gold panning.

#### May 4 & 5, 1991 San Andreas Fault: McKittrick, <u>Parkfield & Pinnacles</u>

This trip begins in McKittrick. The McKittrick brea pits/oil seeps are visited on our way over the Temblors to the Carrizo Plain and the San Andreas Fault. We follow the fault through Parkfield, the "Earthquake Capital of the World", then we continue along the fault to Pinnacles National Monument. We will hike completely around the Pinnacles.

#### June 1, 1991 Kern Canyon-Walker Pass

This trip begins in Bakersfield and is centered on the mining activities along the Kern River. Archaeology sites in the Walker Pass area are visited and a placer mining demonstration is given in the Keysville Recreation Area new Lake Isabella.

#### August 3, 1991 <u>Piute Mountains-Walker Basin</u>

The Havilla, Lorraine and Kelso Valley mining districts are visited on this trip. Mining and milling demonstrations are given at Havilla, and several underground mines are explored. Flashlights and high clearance vehicles are needed by all participants.

#### September 21, 1991 San Joaquin Valley Eastside Stratigraphy: Kern\_Gorge to Pastoria Fan

The classic exposures of rock units on the eastern side of the San Joaquin Valley are investigated. Several fossil collecting areas and oil production facilities are visited.

## Restech California

For more information, please call **BUZZ DELANO** 

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#### November 2, 1991 San Andreas Fault: <u>Gorman to Cajon Pass</u>

This segment of the San Andreas Fault has several clastic study areas. In addition, we visit Devil's Punch Bowl and the Tropicana Gold Mine.

#### December 7, 1991 San Joaquin Valley Eastside <u>Stratigraphy: Kern River Area</u>

The classic exposures of rock units on the eastern side of the San Joaquin Valley are investigated. Several fossil collecting areas, oil production facilities and major faults are visited.

#### Junior Mining Inspector Program

The Junior Mining Inspector Program is for youths from eighth to twelfth grades and their parents and/or guardians. Participants accompany the District Mineral Examiner in his inspections of mining projects throughout central California. These one-day educational programs are being offered on the following dates: February 9, April 20, May 11, July 13, August 10, September 14, October 5, and November 9.

#### **Reservations and Information**

The field trips are limited to 25 vehicles. The Junior Mining Inspector Program trips are limited to six persons. We encourage each driver to have a CB radio in their vehicle so that information can be given on the radio between stops. Reservations are on a first-come first-served basis. There are no registration fees for any of these trips, but donations to offset the cost of publication of the field guidebooks are welcome.

To reserve a place on any of these BLM-EESI field trips, please contact Dr. Gregg Wilkerson or Anne Falcon at 805/861-4210.

## PACIFIC SECTION AAPG FIELD SUMMARIES TRACY GAS FIELD - NEW SHALLOW POOL DISCOVERY

#### by Robert Sterling & Rodney Nahama

The Tracy Gas Field is located in Section 15, T.2S., R.5E., M. D. B. & M. within the present city limits of Tracy, California in San Joaquin County. The field, lying between the cities of Stockton and Livermore in the southern-most Sacramento Valley, was the first gas field discovered in Northern California. The discovery well, drilled by Amerada Hess in 1934, was drilled on the basis of early 100% seismic data, making this one of the first seismic success stories in California as well. The original zone was the Cretaceous Tracy sand at approximately 4,000 feet. The initial well (F.D.L. #1) tested for over 30,000 MCF of gas per day and was drilled into the Lathrop Formation at a total depth of 9,600 feet. The Amerada F.D.L. #2 was actually the first well to go on production at a rate of 35,000 MCF per day with a flowing tubing pressure of 1,400 on a 1.5 inch choke. Four additional wells were completed, making a total of six wells producing in the field. A series of wells were drilled in the 1960's to try to produce attic gas from the Tracy with no success. The Tracy sand produced over 13.5 BCF through 1964, when all of the wells were abandoned.

Gas production from the fifth Blewett was found by MCO in 1977 in the MCO Rossi-Stewart #1 in Section 10. In 1980, Husky drilled the Rossi #1 in Section 10 and found shallow gas in the Miocene that was completed at a rate of 1,500 MCFD. After 225,000 MCF of production, that well was abandoned after encountering mechanical problems.

In 1989, Nahama & Weagant Energy Company (NWEC) purchased seismic data from Shell that was shot in 1980 and covered the Tracy Gas Field. After Western Geophysical reprocessed these lines, NWEC noticed a very obvious bright spot at 1.0 second on



several lines that also exhibited positive Amplitude Offset Versus (AVO) response that seemed to be associated with the shallow gas found in the Husky Rossi #1 well. Α synthetic seismogram confirmed the correlation with the Rossi #1 well. This bright spot was seen on three seismic lines and appeared to be quite extensive.

Upon reviewing both the shot point base supplied bv Shell and other trade maps, two appeared wells to be located within the area that the bright spots covered. The J. M. Young Cordoza #1 was located in the north half of the northwest of quarter Section 15 and the Amerada F.D.L. #4 was located on the west **quarter** corner of Section 15 and right on the N-S seismic control. Reviewing the histories of these two wells showed that neither had established production



from the Miocene interval that had produced in the Husky Rossi #1. However, some very important things were noticed. First, after carefully reviewing the

location notes and a lease map of the area, it was determined that the Cordoza misplotted by almost was #1 well one-half mile and that it was actually located in the southwest quarter of Section 15. The Amerada F.D.L. #4 was properly located and upon further study of the old electric log, it was suspected that because of high resistivities, that well had encountered almost 100 feet of gas sand in the Miocene that Amerada had never perforated.

With these issues resolved, NWEC went ahead and drilled the Tracy #1-15 directionally to test the seismic anomaly 1,550 feet south of the Husky Rossi #1 well, encountering fifty feet of gas sand in the Miocene sand. The Tracy #2-15 well was then directionally drilled from the same pad to bottom as near to the Amerada F.D.L. #4 as possible, encountering 88 net feet of gas sand. The Miocene in both wells tested at rates around 2,500 MCFD at 1,350# FTP and a shut-in TP of 1,410#. Bottom hole pressure was 1,535# static. The wells were put on production in June, 1990 at a combined rate of 3,000 MCFD. As of this writing, the lease has produced 577,240 MCF and is still producing at the Page 7 1991 No. 2

rate of 3,000 MCFD with a FTP of 1,295#. It is assumed that the reservoir is water drive.

In December, 1990, NWEC drilled the Tracy #3-15 directionally to bottom 1,500 feet east of the Tracy #2-15 bottom hole location. The well was drilled to confirm the size and trapping mechanism of the reservoir. Mapping had forecast a 25 to 30 feet pay section and the well actually encountered 68 feet of net pay. Testing indicated that the zone definitely is pressure connected to the other two wells, confirming the aerial extent of the gas sand. At this writing, the #3-15 is awaiting hook-up.

The Tracy Gas Field is located on a structure of the upthrown side of the Vernalis Thrust Fault. The Vernalis Fault

trends N30°W and makes almost a 70 degree turn to the west at the Tracy Gas Field, ultimately intersecting the Stockton Arch Fault four miles west of the Tracy. The



Vernalis Fault has over 1,400 feet of vertical movement in the field area. The structure exhibits almost 350 feet of structural closure at the Tracy sand, though the original gas column in the Tracy was only 130 feet in maximum thickness. Even though structural closure is exhibited in the deeper Cretaceous sands including Winters and Lathrop, there is presently no accumulation on the structure in those formations. On the downthrown side of the fault north of the field there is a small accumulation in the fifth Blewett sand that has proven so far to be insignificant.

The Basal Miocene sand was deposited unconformably on Cretaceous age rocks (Blewett) in this area. The productive sand is a medium to coarse grained quartz sand that appears to be shallow marine to fluvial in origin and was deposited on the northwest flank of the Tracy structure. The regional distribution of this sand suggests that it was deposited as a series of shallow marine discontinuous sand bars. There is no obvious barrier between the gas bearing wells and the non-gas bearing wells in the field. The productive sand apparently pinches out to the east and south, and another Miocene sand is present in the other wells in the field.

The Tracy sand produced 13,775,969 MCF of 929 BTU gas from the Amerada wells. The Miocene closure covers approximately 300 acres with a maximum thickness of 95 feet of net gas sand. The gas is 906 BTU. The lack of gas accumulation in the deeper formations and the partial fill-up of the Tracy sand the structuring occurred suggests that in Plio-Pleistocene time. Deeper potential may exist on the downthrown side of the Vernalis Fault, though many wells have been drilled to test these ideas. Further work needs to be done to evaluate the downthrown potential.

The success demonstrated at Tracy utilizing old well data, old seismic data reprocessed for AVO, and careful attention to detail should not be a unique phenomenon in the Sacramento Valley. The opportunity for additional reserves in old fields from innovative interpretation should be a part of any integrated exploration program.

#### **REFERENCES**

Hunter, G. W. (1957), Tracy Gas Field, California Division of Oil and Gas, Summary of Operations, California Oil Fields, Vol. 43, No. 1

#### EDITOR'S NOTE

An expanded version of this paper was presented in March, 1991 at the Joint Pacific Section AAPG-SEPM-SEG Convention in Bakersfield, California. Special thanks are extended to Nahama & Weagant Energy Company for their prompt approval in allowing the publication of this article.

### **HONORS AND AWARDS**

#### SIDNEY POWERS MEMORIAL AWARD

Some geologists gain fame looking for oil in remoted jungles of the world. Some find it in their own backyard. For JOHN E. KILKENNY, his trek for hydrocarbons took him through the sprawling urban jungle of booming Los Angeles and literally into people's backyards.

He's not complaining. This year's Sidney Powers Memorial Award medalist is a third generation Californian who proudly admits love for his home state. He's spent almost all of his distinguished geological career in California, where he experienced not only professional success but has also been a major force behind the activities of the Pacific Section, as well as the AAPG.

Kilkenny, well-known for his modest fashion, is perhaps the only person surprised by his selection for the Association's highest honor.

"I couldn't believe it when Jim Gibbs called and told me - I thought there were those more qualified than I", he recently told the <u>Explorer</u>. I've looked over the list of previous recipients, and I'm not sure I belong".

The facts suggest otherwise.

Kilkenny began his career in 1935, when he graduated from the University of California at Berkeley with a degree in geology, and his first years were spent with various companies. He started with the Texas Company, but one year later joined Superior Oil as a geologist and scout. In 1938, he moved to Olson's Scouting Service, and two years later became a geologist with the Pure Oil Company. From 1945 to 1951, Kilkenny was district geologist and then chief geologist for Chanslor-Canfield Midway Oil Company.

In 1951, the made the most important move of his career, joining Union Oil Company of California (now Unocal Corporation) as senior staff geologist.

Kilkenny moved up through the ranks to chief geologist, Pacific Coast, domestic geologic coordinator, geological coordinator for the geothermal division, and finally vice president of Union's Phillipine Geothermal Inc. He retired from the company in 1977.

Since retirement in 1977, Kilkenny has worked as a geological consultant and has been extremely active in AAPG and the Pacific Section.

He was Vice President of AAPG in 1968-69 and President in 1975-76. He was awarded honorary membership in 1972; served as a distinguished lecturer in 1974; was President of the Foundation Trustee Associates in 1981; and has been involved with numerous convention committees. He also was President of the Pacific Section in 1963 and was awarded honorary membership of that organization in 1974.

In addition to many published papers, he was one of the editors for AAPG Memoir 15, "Future Oil Provinces of the U.S., Their Geology and Potential". Also, he assisted with the National Petroleum Council's "U.S. Energy Outlook Geothermal Energy Prospects, 1971 to 1985".

Excerpted from Kathy Shirley's article in the Explorer on John E. Kilkenny

#### HONORARY MEMBERSHIP

**ROBERT LINDBLOM**, a long-time Pacific Section AAPG member and Past President, has been awarded a life-time honorary membership in the Pacific Section AAPG for his dedicated service to both the Section and the National organization. Congratulations, Bob!

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# Hot entertainment in "Big d" !!

It is the first week of April, 1991, and you are at the baggage claim area at either at Dallas-Fort Worth (DFW) Airport or Love Field in Dallas, Texas. While waiting for your luggage to arrive in one or more pieces, you look around and see the banner "AAPG MEMBERS -WELCOME". Thoughts of - "Why am I here?" come to mind. You remember that you want to attend five or six of the talks that pertain to the trend you are working and to see ten or so of the poster sessions. What about the fun factor? You now remember the spectacular entertainment program put on by the Dallas Geological Society.

On Sunday, April 7, you can either play golf in the "Diamond in the Rough" tournament or tennis in the "Ace of Diamonds" tournament both at the Hyatt Bear Creek Golf and Racquet Club at DFW Airport. The co-sponsor for these tournaments is Atlas Wireline Services. The buses will leave from the Fairmont Hotel at 7 a.m. and return around 2:30 p.m.

For night time entertainment on Sunday, April 7, you can attend the "Diamond Jim's" Sunday Night Celebration at Dallas Alley, in the historic West End of downtown Dallas. Buses will leave from the Convention Center and make a hotel loop starting at 6:30 p.m. with the dinner, dancing and play time starting at 7:00 p.m. Food and entertainment will be at Alley Cats and Bobby Sox (West End) until 11:00 p.m. Return buses will run from 8:00 p.m. until 11:15 p.m., picking you up at the West End and returning you to your downtown hotel. Halliburton Logging Service, Inc. is the co-sponsor of this event.

On Monday night, April 8, I am planning to eat barbeque, honky tonk and watch a bull riding exhibition at the "Rough Cut" Country Evening at Billy Bob's Texas, located in the old Fort Worth Stockyard District. The buses will leave the Fairmont Hotel at 6:00 p.m. and 6:15 p.m. for the trip to Fort Worth and then will begin leaving for the trip back at 10:00 p.m. Again, the buses will shuttle back to the downtown hotels. Oryx Energy Company is the co-sponsor for the night at Billy Bob's.

Also on the night of Monday, April 8, there will be the DGS Diamond Jubilee Dinner at the Dallas Petroleum Club, located in the Texas Commerce Tower, downtown Dallas. This evening of dinner, dancing and a surprise is for our distinguished AAPG collegues with membership of 35 years or more. The bus shuttle service will start leaving the Fairmont at 6:00 p.m. with pickup from the Petroleum Club starting at 9:30 p.m. through 10:30 p.m. It will make drop offs at downtown hotels. Enserch Exploration, Inc. is the co-sponsor for the dinner. A decision must be made about Tuesday night, April 9. For the price of \$25, I can either attend a "Diamond Studded Evening" at "The Mort" or the "Multi-Faceted" Night at the Improv for \$28.

The event at the Morton Meyerson Symphony Hall in downtown Dallas will be a great time to socialize beginning with a lavish cocktail reception complete with hors d'oeuvres, wine, champagne, cheese, fruit and a cash bar. This reception will start at 7:00 p.m. and the concert hall doors will open at 8:15 p.m. The 85 piece Symphony Orchestra will present an upbeat pops repertoire. Dress can be either casual or coat and tie. A bus shuttle service for the downtown hotels will start the pickup circuit at 6:30 p.m. and will depart from The Mort starting at 10:00 p.m. This fabulous event is made possible through the generosity of our co-sponsors, Mobil Research and Development Corporation and Mobil Exploration and Producing Services, Inc.

The evening at The Mort will be a lot of fun, but for those who favor a different sort of entertainment, you can attend dinner and a show at the Improvisation, America's Original Comedy Showcase and Restaurant. The Improv is located in the Corner Shopping Center at Walnut Hill Lane and North Central Expressway. Buses will depart at 6:30 p.m. and 6:45 p.m. from the Fairmont. The return buses will start departing from the Improv at 10:00 p.m. The co-sponsor of this event is ARCO Oil and Gas Company with Schlumberger Well Services as co-sponsor for the event's transportation.

The Entertainment Committee had four specific goals when putting together this spectacular program. Each event needed to 1) give the attendees ample time to socialize and have fun, 2) provide generous amounts of food and great "Texas Hospitality", 3) keep the price low and affordable to all, and 4) reflect the high quality of our Association. The Dallas Geological Society, as the sponsor of the Diamond Jubilee social events, wants each of the convention participants to enjoy themselves and have a great time at this 75th anniversary celebration of the AAPG. Ya'll come and have fun!

We would like to extend a special thank you to all of our terrific co-sponsors, without whose help and generosity none of the events would have been possible.

Finally, please don't forget that as an attendee to any of the events, you <u>must</u> have your name badge and ticket for that event.

#### Page 10 1991 No. 2

#### **RECOMMENDED READING**

#### NATIONAL GEOGRAPHIC MAGAZINE

Vol. 177, No. 5, May, 1990

Africa's Great Rift, by C. Stager, Photographs by C. Johns

Earthquake: Prelude to the Big One?, by T.Y. Canby

#### GEOLOGICAL SOCIETY OF AMERICA BULLETIN

Vol. 102, No. 3, March, 1990

Origin of Kink Bands in the Golconda Allochthon, Toiyabe Range, Nevada, by H. A. Babaie and R. C. Speed

Pattern and Origin of Stepped-bed Morphology in High-gradient Streams, Western Cascades, Oregon, by G. E. Grant, F. J. Swanson and M.G.Wolman

Vol. 102, No. 7, July, 1990

Lithology and Biostratigraphy of Franciscan-like Chert and Associated Rocks in West-central Baja, California, Mexico, by R. Sedlock and Y. Isozaki

A Submarine-fan Valley-levee Complex in the Upper Cretaceous Rosario Formation: Implication for Turbidite Facies Models, by W. Morris and C. Busy-Spera

Criteria Helpful in Recognizing Shear-zone and Diapiric Melanges: Examples from the Hoh Accretionary Complex, Olympic Peninsula, Washington, by D. L. Orange

Zircon U-Th-Pb and Whole-rock Rb-Sr Patterns of Lower Mesozoic Igneous Rocks in the Santa Rita Mountains, Southeast Arizona: Implications for Mesozoic Magmatism and Tectonics in the Southern Cordillera, by Y. Asmeron, R. E. Zartman, P. E. Damon and M. Shafigullah

Late Quaternary History of Colluvial Deposition and Erosion in Hollows, Central California Coast Ranges, by S. L. Reneau, W. E. Dietrich, D.J. Donahue, A. J. T. Juli and M. Rubin

Remagnetization and Northward Translation of Mesozoic Red Chert from Edros Island and the San Benito Islands, Baja, California, Mexico, by J.T. Hagstrum and R. L. Sedlock

Structural Geology of the Upper Plate of the Bullfrot Hills Detachment Fault System, Southern Nevada, by F. Maldonado

Section

Post Office Box 1072

NEWSLETTER

Pacific

Bakersfield.

#### GEOLOGY

Vol. 18, No. 3, March, 1990

Ancient Continental Margin Assemblage in the Northern Coast Mountains, Southeast Alaska and Northwest Canada, by G. E. Gehrels, W. C. McClelland, S. D. Samson, P. J. Patchett and J. L. Jackson

Magnesium-salinity Relation in the Saline Lake Ostracode Cyprideis American, by J. W. Teeter and T. J. Quick

Rapid Uplift and Crustal Growth in Extensional Environments: An Isotopic Study from the Death Valley Region, California, by Y. Asmerom, J. K. Snow, D. K. Holm, S. B. Jacobsen, B. P. Wernicke and D. R. Lux

Soil-forming Intervals Caused by Eolian Sediment Pulses in the Lahontan Basin, Northwestern Nevada, by O. A. Chadwick and J. O. Davis

Intra-arc Strike-slip Fault Exposed at Batholithic Levels in the Southern Sierra Nevada, California, by C. J. Busby-Spera and J. B. Saleeby

Rare Earth Elements as Indicators of Different Marine Depositional Environments in Chert and Shale, by R. W. Murray, M. R. Buchholtz, T. Brink, D. L. Jones, D. C. Gerlach and G. P. Russ III

Regionally Extensive Mid-cretaceous West-vergent Thrust System in the Northwestern Cordillera: Implications for Continent-margin Tectonism, by C. M. Rubin, J. B. Saleeby, D. S. Cowan, M. T. Brandon and M. F. McGroder

#### JOURNAL OF GEOPHYSICAL RESEARCH

Vol. 91, No. B12, November 10, 1986

Earthquakes, Quaternary Faults and Seismic Hazards in California, by S. G. Wesnousky, Seismic Lab, CalTech, pp. 12587 - 12631

#### **CALIFORNIA GEOLOGY**

Vol. 43, No. 5, May, 1990

Landslide and Flood Potential Along Cache Creek Lake, Colusa and Yolo Counties, California, by M. W. Manson

Vol. 43, No. 1, January, 1990

Loma Prieta Earthquake, October 17, 1989, Santa Cruz County, California, by S. McNutt Effects of the Loma Prieta Earthquake, October 17, 1989, by D. R. Montgomery

> Lucy Birdsall (Deceased)

PACIFIC SECTION AMERICAN ASSOCIATION OF PETROLEUM GEOLOGISTS OFFICERS 1990 - 1991

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San Joaquin LAURA BAZELEY
(805) 326-1112
Recommended Reading RUSS ROBINSON
(805) 664-2324
NEW SLEINER OF THE PACING Section - American

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## PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

of the Pacific Section American Association of Petroleum Geologists

April / May 1991 No. 3

## ELECTION ISSUE

#### THE PRESIDENT'S COLUMN

Congratulations to Dan Schwartz and his Committee for the fine 1991 Convention. I'm pleased to report that although total registration was somewhat less than anticipated, the cash flow is very satisfactory. Aside from the great papers, trips and short courses, the entertainment was super. Unfortunately, the best show was seen by only a few - Paul Hacker's confrontation with Parks and Recreation, and the Fire Department. The show featured black-outs, geysers and Paul being skewered by the County. Too bad it wasn't videotaped - a hands-down winner on *Funniest Home Videos*, ranking right up there with the famous toreador epic featuring Don Padick - "No Horns At All".

Previous columns have introduced the concept of a reformed Pacific Section. Now you get the rest of the story in the following by Tom Wright, Chairman of the Planning and Organization Committee. Tom's ideas and concepts have been fully coordinated with the Executive Committee and over the past year and are being brought forth at this time for your response. And now, here's Tom!

Jack Cunningham, President

#### PACIFIC SECTION AAPG: THE DECADE AHEAD

What will the Pacific Section look like when the year 2000 arrives? Will it continue to play an important role among West Coast geologists despite the major changes already underway in our profession? Can we navigate safely into the future or will we sail off the edge of the world?

The past decade of boom and bust in the oil industry has brought great changes both in the Section's membership and in our local societies. The previous 1959 - 1973 downturn separates our membership into two cohorts. In Pacific Section's four state region, about 25% of AAPG members are in the older generation. Of these, more than 60% who list themselves as retired, consultant or independent will continue to live in the region and support the Section. By the end of the 1990's their ranks will have dwindled and few will be more than "elder statesmen" in Section and society activities. As of last year, the younger generation makes up about 63% of AAPG members in the Pacific Coast region. One-third of these work for major companies and some have since been transferred East. At least 10% now work as

#### 1992 PACIFIC SECTION AAPG-SEPM-SEG MEETING

"Creative Approaches to Environmentally Sound Exploration"

## CALL FOR PAPERS

#### Structural Geology Papers

Regional / General Extensional Structures Compressional Structures Non-Tectonic Structures Entrusive & Volcanic Features

#### **Geophysical Papers**

A.V.O. Analysis Seismic Stratigraphy 3-D Exploration & Development Case Histories Workstation / Personal Computers Gravity & Magnetics Environmental Geophysics Earthquake Studies

Please contact Vic Cherven (916/677-0477) or Bill Edmonson (805/322-0327) if you are interested in participating in the *Structural Geology Paper's Division*.

If you are interested in the *Geophysical Paper's Division*, please contact either Steve Ward (916/486-2643) or Dale Gray (916/369-1444).

## San Joaquin

**April 9** - Ted Flanigan, Consultant, "A Review of Nevada Oil Fields and Future Potential".

May 14 - David C. Callaway, ARCO Oil and Gas, "Sequence Stratigraphy of the San Joaquin Valley".

June 11 - Edwin Horan, Field Study Associates, "Petroleum Potential of Humboldt Basin, California".

July & August - No meeting.

September 13 - Annual Fall Barbecue and Golf Tournament, Stramler Picnic Area.

Suggestions for meeting speakers or topics should be addressed to Larry Knauer at 805/763-6280.

The meetings are held at the American Legion Hall at 2020 "H" Street in Bakersfield. Attitude adjustment starts at 6:00 p.m. and dinner is served at 7:00 p.m. For more information and reservations please contact Laura Bazeley at 805/326-1112.

## Coast

April 16 - G. C. "Butch" Brown, Consultant, "Turbidites, A Primer".

May 21 - P. G. Lillis, U.S.G.S., "Controls on Variations of Crude Oil Quality, Santa Maria Basin".

Meetings are held the third Tuesday of every month. Meeting time is at 6:00 p.m., dinner at 7:00 p.m. at the American Legion Hall in Ventura. The address is 83 South Palm. For reservations please contact Marty Meyer at 805/494-2210.

Los Angeles

The meetings will be held alternate months at noon at UNOCAL Center, California Room, 1201 West Fifth Street, Los Angeles.

For reservations or information, call Randall Ferguson at 714/842-6331 or Ken March at 213/436-9211 - #357.

## Northwest

**April 12** - Ted Flanigan, Consultant, "A Review of Nevada Oil Fields and Future Potential", to be held at the Red Lion Inn, Portland, Oregon.

May 10 - Rick Fritz, Masera Corporation, "Horizontal Drilling: An Overview", to be held at University Tower, Seattle, Washington.

June 21 & 22 - To be announced, "Geothermal Exploration in Central Oregon: Past, Present and Future", to be held at The Riverhouse, Bend, Oregon.

For suggestions or questions, please contact Lanny Fisk at 503/382-0825, Barbara Portwood at 503/287-2762, or any other member of the NWPA Program Committee: Phil Brogan, Harry Jamison, Paul Dudley or Nancy Ketrenos.

#### SAN JOAQUIN WELL LOGGING SOCIETY

April 17 - David G. Kersey, Core Laboratories, "Unconsolidated Reservoir Evaluation: New Advances in Accurate, Precise Determination of Porosity and Permeability".

This meeting will be held at Bill Lee's Bamboo Chopsticks Restaurant, Bakersfield at 11:30 a.m. For further information, please contact Dan Fargo at 805/392-8600.

#### SACRAMENTO PETROLEUM ASSOCIATION

**April 24** - R. Sterling, Nahama & Weagant Energy, "Tracy Gas Field, New Shallow Production".

Meetings are held at noon at Neptune's Table Restaurant, 5990 South Land Park Drive. For reservations please contact Rich Boyd at 916/929-4141.

#### MINERALS MANAGEMENT SERVICE MEETING

The Minerals Management Service will hold its Sixth Information Transfer Meeting for the Pacific Outer Continental Shelf Region on May 29 through 31, 1991 at the Red Lion Inn, Santa Barbara, California.

For further information, please contact Kathryn L. Mitchell at 714/646-1601.

#### **COMING EVENTS**

- April 7 to 10 National AAPG Meeting, Dallas.
- May 6 to 9 Offshore Technology Conference, Houston.
- May 29 to 31 Minerals Management Service Pacific Outer Continental Shelf Region, Sixth Information Transfer Meeting, Santa Barbara. Please see further information on Page 2.
- June 2 to 5 " Sequence Stratigraphy as an Exploration Tool: Concepts and Practices in the Gulf Coast", presented by the Gulf Coast Section of the Society of Economic Paleontologists and Mineralogists Foundation, Eleventh Annual Research Conference. Please see Page 9 for more information.
- June 3 to 7 Computer Modeling Group Symposium on Reservoir Simulation, Calgary.
- June 7 to 9 "Geology of White River Valley, Grant Range, Eastern Railroad Valley and Western Egan Range, White Pine County, Nevada", Nevada Petroleum Society Field Trip. Please contact Earl Abbott or Neal Brecheisen of the NPS, Post Office Box 11526, Reno, Nevada 89510 or phone 702/827-2324.
- June 11 to 13 EPA Forum on Innovative Hazardous Waste Treatment Technologies, Dallas.
- June 16 to 19 SPWLA 32nd Annual Logging Symposium, Midland, Texas.
- August 15 to 18 SEPM Mid-year Meeting, Portland, Oregon.
- September 11 to 13 Pacific Coast Gas Association 98th Annual Meeting, Seattle, Washington.
- September 28 and 29 SEPM Fall Field Trip to Owens Valley in the Vicinity of Lone Pine and Darwin Canyon. Please see Page 8 for more information.
- September 29 to October 2 -International AAPG Conference, London.
- October 6 to 9 SPE Annual Technical Conference and Exhibition, Dallas.
- November 10 to 14 Society of Exploration Geophysicists 61st Annual International Meeting, Houston.
- November 17 to 19 API Annual Meeting, Houston.
- April 29 to May 1, 1992 Pacific Section AAPG Convention, Sacramento, Rich Boyd, Chairman (Capitol Oil).

#### RECENT MOVES

GEOFREY NICHOLSON formerly with Bechtel in Tupman, has moved to Saudi Arabia with Aramco.

#### NEW MEMBERS

#### SOUTHERN CALIFORNIA

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- NEAL D. LIVINGSTON, UNOCAL, Bakersfield.
- SUSAN M. PERRELL, ARCO Four Corners Pipeline, Long Beach.
- DAVID L. PERRY, Calabasas.
- MICHAEL T. GAONA, Chevron U.S.A., Inc., Bakersfield.
- GERALD NALWEAIK, OXY USA Inc., Bakersfield.
- ROGER SLAYMAN, K-C Geotechnical, Santa Barbara.
- M. JOHN NEALE, Chevron U.S.A., Inc., Bakersfield.
- STEPHAN A. BORK, Dames & Moore, Bakersfield.
- ROGER K. HAHN, Chevron U.S.A., Inc., Bakersfield.
- MATT W. HUTSON, Dames & Moore, Bakersfield.
- KENNETH M. PIEL, UNOCAL, Bakersfield.
- **PAUL MAZALAN**, Chevron U.S.A., Inc., Bakersfield.
- CAROL CLAYTON, Mobil Oil Corporation, Bakersfield.
- DEBRA A. BROOKS, North Hollywood.
- JOHN L. LUFKIN, Roy F. Weston, Inc., Woodland Hills.
- JAMES T. GROSS, United Water Conservation District, Santa Paula.
- TIMOTHY J. SHEEHY, EXLOG, Ventura.
- JON R. MORRIS, Grant-Norpac, Bakersfield.
- **ROBERT A. PINOTTI**, Great Valley Petroleum, Davis.

#### NORTHERN CALIFORNIA

ERICK ORTEGA, Woodward-Clyde Consultants, San Jose.

#### **OTHER STATES**

- MARY PAVLIK, Phillips Petroleum, Houston.
- AIMEE E. WIEG, Shell Western E & P, Houston.

#### PACIFIC SECTION AAPG: THE DECADE AHEAD (continued)

hydrogeologists or in other environmental jobs. With West Coast exploration opportunities constrained by restrictions both offshore and onshore, these trends of emigration and career change seem unlikely to be reversed.

Organizations affiliated with the Pacific Section AAPG are already moving to serve their hydrogeologist members. Our local societies in northern California, Bakersfield and the Ventura area are offering frequent programs on hydrogeological topics. National AAPG has just proposed a Division of Environmental Geology for implementation in 1992. Full membership in that division would be open to geologists who do not belong to AAPG itself. National AAPG and our local societies want not only to serve those present members who have changed their career orientation, but also to attract all geologists whose practice involves the movement of fluids through rock or soil, or other aspects of environmental geology, especially as these relate to the petroleum industry.

As the link between local societies and National AAPG, the Pacific Section needs to consider whether there are organizational changes that might better enable us to broaden our technical scope to include hydrogeology and other aspects of environmental geology. Informally we have already begun that process. Our last two annual conventions, at Palm Springs in 1989 and at Bakersfield this year, have included full day sessions on environmental geology or hydrogeology. A symposium volume from the Palm Springs session, "Environmental Concerns in the Petroleum Industry", has sold well. Our 1993 Annual Meeting in Orange County, co-hosted by the Los Angeles Basin Geological Society and the South Coast Geological Society, will include a hydrogeological symposium and a regional symposium that will extend beyond the usual agenda of petroleum geology into seismotectonics and crustal processes as these relate both to basin development and earthquake hazards. The Pacific Section's scope is already expanding beyond our traditional specialization. Should we not consider opening our organizational framework to attract geologists in other fields, and the non-affiliated local societies to which they belong?

Pacific Section AAPG's Planning and Organization Committee is evaluating a possible reorganization of the Section into the Pacific Coast Association of Geological Societies (PCAGS). It would seek to include not only the seven geological societies now affiliated with Pacific Section AAPG but also South Coast and five or more other non-affiliated societies. By and large, members of these geological societies practice applied geology for industry and government, and share interest in aspects of the local geology. As an umbrella organization, PCAGS would serve the same functions as the present Pacific Section AAPG: (1) sponsorship of an annual technical convention, short courses, field trips and publications on geological subjects of interest in this region; (2) publication of a newsletter reporting these activities and those of affiliated local societies and other topics of professional interest to local geologists; and (3) communication between local societies on the Pacific Coast.

Expansion into PCAGS would not "invade the turf" of existing professional organizations on the West Coast. GSA's Cordilleran Section serves chiefly to organize an annual convention with an emphasis on basic research. The Society of Ground Water Scientists and Engineers (National Water Well Association) offers short courses on the West Coast, but has no local or regional meetings or affiliations. The Association of Engineering Geologists has local chapters, but those programs and their annual meetings seldom deal with contaminant hydrogeology or other aspects of environmental geology. For forty years and more, AAPG has served its members well through a tiered structure loosely tying local societies to regional sections and a strong national organization. This structure has enabled a great many geologists to enlarge their horizons and advance in their professional activities. A similar linkage of local societies with PCAGS and perhaps, AAPG's Division of Environmental Geology would afford such opportunities to a broader spectrum of applied geologists. Might that be the shape of a vigorous, re-structured Pacific Section AAPG in the year 2000, and well beyond?

In the near future, Pacific Section members will be asked to respond to these ideas in a questionnaire to be distributed with the annual ballot for election of Officers.

#### Page 3 1991 No. 3

## Page 4 1991 No. 3 CANDIDATES FOR OFFICE - PACIFIC SECTION AAPG









#### PAUL D. HACKER, Candidate for President Elect

#### **Present Position:**

Consulting Geologist

Education:

1979, California State University, Northridge, B.A. Geography; 1982, California Lutheran University, Thousand Oaks, B.S. Geology

**Employment:** 

1974 - 1980: Don Padick Geological Well Logging Services, California; 1980 - 1982: Argo Petroleum, Ventura, Geologist; 1982 - 1984: Bravo Oil Company, Bakersfield, Exploration Geologist; 1984 - 1985: Santa Fe Energy, Bakersfield, Exploration Geologist; 1985 - Present: Consulting Geologist

#### **Professional Activities:**

National AAPG, Pacific Section AAPG, SJGS, Treasurer, Coast Geological Society, 1981 - 1982; Secretary, PS/AAPG, 1984 - 1985; Co-editor, Symposium Volume #1, PS/AAPG, 1984; Program Committee, Pacific Section Convention, 1986; Field Trip Committee, Pacific Section Convention, 1987; Treasurer, PS/AAPG, 1987 - 1989; Finance Committee Chairman, PS/AAPG 1989 - 1991.

#### FRANK B. CRESSY, JR., Candidate for President Elect

#### Present Position:

Consulting Geologist

#### Education:

1971, University of California, Riverside, B.S. Geology; 1974, Oregon State University, M.S. Geology

#### **Employment:**

1973 - 1981: Texaco, Inc., Various Positions from Exploration Geology to District Geologist, Los Angeles; 1981 - 1985: Quintana Petroleum Corporation, Bakersfield and Denver, Exploration Manager and Geological Coordinator, 1985 - Present: Consulting Geologist **Professional Activities:** 

California Registered Geologist; National AAPG, Pacific Section AAPG, Pacific Section SEPM, San Joaquin Well Logging Society; Information Chairman, Pacific Section Convention, 1979; Secretary, San Joaquin Geological Society, 1982 - 1983; San Joaquin Geological Society Delegate to National AAPG, 1988 - 1991; Vice President, Pacific Section AAPG, 1990 - 1991.

#### **RICK BOWERSOX, Candidate for Vice President**

#### **Present Position:**

Geologist, Bakersfield Energy Resources, Inc., Bakersfield Education:

1973, San Diego State, B.S. Geology; 1974, San Diego State University, M.S. Geology Employment:

1975 - 1978: Getty Oil Company, Bakersfield, Geologist; 1978 - 1983: Getty Oil Company,, San Joaquin & Taft Districts, Lead Geologist; 1983 - 1984: Getty Oil Company, District Geologist; 1984 - 1985: Texaco, Inc., District Geologist; 1985 - 1990: Mission Resources, Bakersfield, Geological Manager; 1990 - Present: Bakersfield Energy Resources, Inc., Geologist **Professional Activities:** 

Pacific Section AAPG/SJGS, AAPG, SPWLA, AIPG, CSPG; California Registered Geologist & Environmental Assessor; Field Trip Committee, Pacific Section AAPG Convention, 1977; General Chairman, Pacific Section AAPG Convention, Bakersfield, 1986; Delegate, SJGS to AAPG, 1987 -1988; Session Chairman, AAPG Convention, Los Angeles, 1987; Secretary, Pacific Section AAPG, 1989 - 1990; Business Coordinator, Pacific Section AAPG Convention, Bakersfield, 1991.

#### WILLIAM J. ANDERSON, Candidate for Vice President

#### **Present Position:**

President, Epoch Well Logging, Inc. & Vice President, International Logging Epoch, Inc. Education:

1980, California State University, Northridge, B.A. Earth Science

#### **Employment:**

1979: Co-founded, Epoch Well Logging, Bakersfield; 1982: Established Ventura Office, Epoch Well Logging; 1979 - Present: President, Epoch Well Logging, Inc.; 1990 - Present: Vice President, International Logging Epoch, Inc.

#### **Professional Activities:**

National AAPG, Society of Petroleum Engineers, Ventura Chapter of SPWLA, Coast Geologic Society; Treasurer, Coast Geologic Society, 1986; President, Coast Geologic Society, 1988.

## CANDIDATES FOR OFFICE - PACIFIC SECTION AAPG









#### TIMOTHY L. KIRST, Candidate for Secretary

#### Present Position:

Senior Staff Production Geologist, Mobil Exploration & Producing U.S., Inc.

#### Education: 1974 Univer

1974, University of Wisconsin, Madison, B. S. Geology; 1977, Louisiana State University, Baton Rouge, M. S. Geology

#### Employment:

1977 - 1981: Chevron U.S.A. Inc., New Orleans, Exploration and Production Geologist; 1981 -Present: Mobil Exploration & Producing U.S., Inc., Denver and Bakersfield, Exploration and Production Geologist

#### **Professional Activities:**

AAPG, Pacific Section AAPG, San Joaquin Geological Society; Site Discussion Leader, AAPG San Joaquin Field Trips.

#### W. C. RUSTY RIESE, Candidate for Secretary

#### **Present Position:**

District Geologist, ARCO Oil and Gas Company

Education:

1973, New Mexico Institute of Mining and Technology, B. S. Geology; 1977 and 1980, University of New Nexico, M. S. and Ph.D. Geology

#### Employment:

1974 - 1981: Gulf Mineral Resources Company, Junior Geologist, Project Geologist, Albuquerque; 1981 - 1984: Anaconda Minerals Company, Project Geochemist, Administrative Coordinator, Denver; 1984 - 1989: ARCO Oil and Gas Company, Senior Geologist, Area Geologist, Houston; 1989 - Present: ARCO Oil and Gas Company, District Geologist Professional Activities:

#### **Professional Activities:**

AAPG, Pacific Section AAPG, AIPG, AExGch, IAGOD, IAGC, SGAMD, Sigma Xi, Fellow GSA, SEcG; Judge, San Francisco AAPG National Convention, 1990; Pacific Section Committee, AAPG, 1991; Adjunct or Affiliate Faculty Rice University, Oregon State University, Humboldt State University, California State University.

#### ALLAN SHAREGHI, Candidate for Treasurer

#### **Present Position:**

Geologist, Minerals Management Service

Education:

1979, Memphis State University, B.S. Geology; 1981, Memphis State University, M.S. Geology Employment:

1981 - 1983: Cities Service Oil & Gas, Geologist, Houston; 1983 - 1984: Reservoirs Inc., Geologist, Houston; 1984 - Present: MMS, Pacific Field Operations Group, Camarillo, Geologist/Geophysicist

#### **Professional Activities:**

AAPG, Pacific Section AAPG, LABGS Treasurer in 1987; Vice President/Program Chairman LABGS in 1988; President of LABGS in 1989; Ice Breaker Chairman, Pacific Section AAPG Meeting, Palm Springs, California in 1989.

#### MURIEL R. NORTON, Candidate for Treasurer

#### Present Position:

Vice President, Geoquip Corporation

#### Education:

1983, California Lutheran University, B.A. Geology

#### Employment:

1962 - 1966: BP (Alaska) Inc., Calgary and Palos Verdes Estates, Librarian and Geologic Technician; 1976 - 1985: McClelland Engineers, Inc., Ventura, Geophysical Interpreter; 1985 - 1987: Consultant; 1987 - President; Geoquip Corporation, Ventura, Vice President **Professional Activities:** 

Coast Geologic Society, Pacific Section AAPG; Secretary, Coast Geological Society, 1988 - 1989; Printing Chairman, Annual Pacific Section Convention, 1988.

## PACIFIC SECTION AAPG FIELD SUMMARIES

#### **BLACKBURN FIELD, NEVADA**

by M. R. Cole and D. C. Johannesen

#### **STATISTICS**

#### **Discovery Well**

Amoco Blackburn No. 3 Section 8, T.27N., R.52E., Eureka County, Nevada T. D. 7,951 feet

#### **Discovery Date**

May, 1982

#### Initial Production

346 BOPD and 767 BWPD

#### **Productive Formations**

Oligocene Indian Well Formation Mississippian Chainman Shale Devonian Nevada Formation



#### <u>Trap</u>

Structural, Rotated Fault Block

Average Pay Depth

7,100 feet

**Total Productive Wells** 

Four (4)

Cumulative Production as of June, 1990

2,031,045 bbls.

#### **STRUCTURE**

The structure of this field is dominated by a rotated east-dipping synthetic fault block associated with the main eastern basin-bounding fault of Pine Valley. The complex geologic history of the region and poor seismic resolution has made accurate interpretation of the structure difficult.

The Basin Boundary Fault is a down-to-the-west normal fault that is separated from the Sulphur Spring Range front to the east by a pediment. The normal fault is apparent on seismic lines north of the field area where both Paleozoic and Tertiary rocks can be seen dipping into the fault. The area south of the field is complicated by the presence of many normal faults and a quartz monzonite body. Quartz monzonite in the Amoco Blackburn No. 5 well can be explained by the basin bounding fault cutting between Chainman shale and quartz monzonite. Alternatively, the quartz monzonite may form an intrusive contact with the Chainman and therefore, the fault would be below the TD of the No. 5 well. The Central Graben Fault, the northern Boundary Fault and the Southern Boundary Faults form the West, North and South closures respectively. The lack of upper plant Roberts Mountain Thrust rocks at Blackburn can be attributed to erosion of the structure before it was dropped into its present position.

#### **STRATIGRAPHY**

The Blackburn Field produces oil from the Devonian Nevada Formation, Mississippian Chainman shale, and the Oligocene Indian well Formation. Several Blackburn wells penetrated the Nevada Formation, including Nos. 3, 4, 10, 12, 14, 15 and 16. Regionally, the Nevada Formation, as much as 3,200 feet thick; rests disconformably on the Devonian-Silurian Lone Mountain Dolomite and consists of three members. The Beacon Peak member consists of thin to thick bedded gray to brown dolomite with characteristic thin red stylolites and a grainy appearing texture. The upper portion of the member grades into the Oxyoke Canyon member which consists of quartzite and sandstone with varying amounts of dolomite.



Prominent sandstone or quartzite beds were drilled in the Amoco Blackburn well No. 3 starting at 7,760 feet and probably represent the Oxyoke Canyon member. These beds consist of fine to medium grained, white to clear, rounded to subrounded quartz with slightly calcareous to dolomitic cement. Sandy dolomite beds noted on the mudlog from Blackburn No. 12 and most of the dolomite section encountered in the

Amoco Blackburn No. 4 well also probably belong to the Oxyoke Canyon member. Core data from the Blackburn wells show the uppermost Telegraph Canyon member to be a gray to gray brown, hard, massive, microcrystalline dolomite. The core contains small vugs and is fractured and brecciated with occasional to abundant calcareous fracture fillings. Rare fossil fragments were observed in thin sections in a core from the Amoco Blackburn No. 4 well (7,599 feet). Stylolites can be seen within thin sections and megascopically in the core.

The Late Mississippian Chainman shale unconformably overlies the Devonian Nevada Formation at Blackburn and consists of shale, sandstone, pebbly mudstone and conglomerate. The thickest sections of Chainman encountered were approximately 650 feet at the No. 3 well and 605 feet at the No. 10 well. Thinner sections in the No. 4 (226 feet), No. 5 (172 feet), No. 12 (516 feet), No. 14 (431 feet), and No. 16 (161 feet) wells are probably a result of faulting and erosion due to the overlying unconformity separating the Chainman shale and Indian Well Formation. The absence of any Chainman in the No. 15 well is probably due to faulting. A core from the Amoco Blackburn No. 5 (7,525 - 7,534 feet) recovered 5 feet of black to gray, very fine to coarse grained sandstone. Coarser grains consist primarily of well rounded quartz, subrounded chert and subangular black siltstone. The fine grains are mostly rounded to subrounded, white to clear quartz. Pyrite is common in the matrix and along many vertical and horizontal fractures. Core No. 3 from the Amoco Blackburn No. 12 well recovered 6 feet of black to dark brown argillaceous siltstone. Sidewall cores recovered from the Chainman in the Amoco Blackburn No. 10 included sandstone and siltstone with brown oil stains. Sedimentary structures include convolute bedding and parallel laminae.

A complex variety of tuff, welded tuff, and tuffaceous sediments constitute the Oligocene Indian Well Formation at Blackburn. The formation can be divided into an upper and lower unit, based on mudlog descriptions and core data. The lower unit consists of light colored tuffs grading upward to tuffaceous sediments. A core from the Amoco Blackburn No. 4 (7,218 - 7,240 feet) recovered 21 feet of tuff near the base of the Indian Well Formation. This core is described as a light gray, moderately welded tuff, having an aphanitic, soft, waxy, matrix made up of secondary clay. Phenocrysts consist of five percent fine to coarse grained biotite, some anhedral, clear quartz, a trace of subrounded, gray lithic pebbles, some disseminated pyrite and patchy calcite. Tuffaceous sands and limestones are common toward the top of the lower unit. The upper unit includes greenish-gray tuffaceous sediments with interlayered varicolored ash-flow tuffs. A core from the Amoco Blackburn No. 3 (5,620 - 5,629 feet) shows both green tuffaceous sediments and an overlying brown lithic tuff.

#### RESERVOIR

The Blackburn Field has three pay zones, including the Devonian Nevada Formation, the Mississippian Chainman shale and the Oligocene Indian Well Formation. The reservoir is water-driven and the oil-water contact was cored at



7,215 feet (-1,895 subsea) in the Amoco Blackburn No. 3 well below 97 feet of productive Nevada Formation dolomite. The oil-water contact is similar at a subsea depth in well Nos. 10, 14 and 16.

The original reservoir pressure for the dolomite in the Blackburn No. 3 discovery well was 3,223 psi as measured from a DST at a depth of 7,140 to 7,199 feet. The pressure gradient is 0.45 psi per foot. Pressure measurements for the Blackburn Field are similar to those in the Eagle Springs Field, approximately 120 miles south of Blackburn. Here, the original reservoir pressure was about 3,000 psi at a depth of 6,400 feet. Current available pressure data from Blackburn shows very little lowering of reservoir pressure since the No. 3 well was drilled in 1982.

The bottom-hole temperature for the No. 3 well was 241°F at a depth of 7,951 feet. Using data recorded during logging, the temperature gradient is 2.1°F per 100 feet. This gradient compares closely to the 2.0°F per 100 feet found at the Eagle Springs Field.

The crude oil at Blackburn ranges between 26° and 28° gravity. The viscosity was measured at 3.48 centipoise at 208° F from a sample produced from the Indian Well Formation. Sulfur content varies from less than 0.5 percent from the Paleozoic to 0.43 to 1.45 percent from the Indian Well Formation.

Water produced from the oil zone in the Nevada Formation (7,210 - 7,140 feet) in the Blackburn No. 3 well had the following characteristics given in parts per million: 619 Na, 56 Ca, 23 Mg, 0 K, 536 Cl, 226  $SO_4$ , 0  $CO_3$ , 722  $HCO_3$  and

2,182 total dissolved solids. The sample had a pH of 6.3, a specific gravity of 1.003 and a resistivity of 3.6 ohms at 70° F. Water produced from the Indian Well Formation (5,776 - 6,318 feet) had the following characteristics: 1,021 Na, 69 Ca, 5 Mg, trace K, 1,215 Cl, 208 SO<sub>4</sub>, 0 CO<sub>3</sub>, 598 HCO<sub>3</sub> and 3,116 total dissolved solids. The sample had a pH of 7.7, a specific gravity of 1.002 and a resistivity of 1.84 ohms at 70° F. Produced water is currently being disposed by injection in the No. 12 well.

#### **REFERENCES**

A more complete discussion of the field and references may be found in the following:

Johannesen, D. C. and Cole, M. R., 1990, Blackburn Oil Field, Eureka County, Nevada, *in* Flanigan, D. M. H., Garside, L. J., and Hansen, M., Oil Fields and Geology of the Pine Valley, Eureka County Area, Nevada, Nevada Petroleum Society 1990 Fieldtrip Guidebook, pp. 39 - 53.



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#### PACIFIC SECTION SEPM & COAST GEOLOGICAL SOCIETY

#### FALL FIELD TRIP

#### SEPTEMBER 28 & 29, 1991

The Pacific Section SEPM and Coast Geological Society will be co-sponsoring a geological field trip to examine Paleozoic shelf-to-basin transition rocks in the Owens Valley area. The trip, led by Cal Stevens, will begin in Lone Pine, California, on Saturday, September 28 and conclude on Sunday, September 29, 1991.

In addition to spectacular views and geologic exposures of Owens Valley, a comparison of Silurian through Mississippian carbonate shelf rocks in the southeastern section of the region, with their basinal equivalents along the Paleozoic continental margin to the northwest, will be shown. After which, the focus will be on the mixed carbonate and siliciclastic slope and basinal rocks of Permo-Pennsylvanian and Early Triassic age deposited above older carbonate shelf deposits.

More details and reservation forms will be available early this summer. Call Margaret Keller at 415/354-3016 or Dalton Lockman at 805/494-2205 for further information.

#### OREGON DEPARTMENT OF GEOLOGY AND MINERAL INDUSTRIES PUBLICATIONS

A new index released by the Oregon Department of Geology and Mineral Industries Publications (DOGAMI) provides easy access to the information published in the proceedings of the first 25 meetings of the Forum on the Geology of Industrial Minerals. Index to Proceedings of the Forum on the Geology of Industrial Minerals, First (1965) through Twenty-Fifth (1989), compiled by Robert L. Bates is now available as DOGAMI Special Paper 24. The document is 43 pages in length. The cost is \$6.00.

A new geologic map that describes in detail the geology and oil and gas potential of the Reston Quadrangle in southwestern Oregon has also been released by DOGAMI. **Geologic Map of the Reston Quadrange, Douglas County, Oregon**, by DOGAMI geologist G. L. Black, is available as Geologic Map Series GMS-68. The two-color geologic map (scale 1:24,000) two cross sections and four-page text discussing geologic history and hydrocarbon

potential is available for \$5.00.

These publications are available through the Oregon Deparmtnet of Geology and Mineral Industries, 910 State Office Building, 1400 SW Fifth Avenue, Portland, Oregon 97201-5528. Orders may be charged to credit cards by mail, fax or phone. Their fax number is 503/229-5639 and their telephone number is 503/229-5580. Orders under \$50.00 require prepayment, except for credit card holders.

#### SEQUENCE STRATIGRAPHY AS AN EXPLORATION TOOL: CONCEPTS & PRACTICES IN THE GULF COAST

The Gulf Coast Section of the Society of Economic Paleontologists and Mineralogists (GCSSEPM) Foundation will present its Eleventh Annual Research Conference, "Sequence Stratigraphy as an Exploration Tool: Concepts and Practices in the Gulf Coast", on June 2 through 5, 1991, at the Adam's Mark Hotel in Houston. Topics will include:

#### **Sequence Recognition**

#### Depositional Systems within a Sequence Stratigraphy Context

#### **Duration & Frequency of Sequence Development**

#### **Factors Controlling Sequence Development**

#### **Calibration of Seismic Sequences**

#### Exploration Examples of Sequence Stratigraphic Analysis

The \$250.00 registration fee includes admission to all technical and poster sessions, welcoming reception, two lunches, evening buffet, refreshment breaks and a copy of the 400 page program with extended and illustrated abstracts. Registration will increase to \$300.00 after April 30, 1991. A limited number of student registrations are available at \$50.00.

Please send registration checks to the Gulf Coast Section SEPM Foundation, 1416 Creekford Drive, Arlington, Texas 76012, made payable to GCSSEPM Foundation. Hotel reservations are available by contacting the Adam's Mark Hotel at 713/978-7400. Be sure to request special rates for the GCSSEPM Foundation Conference.

For more information and student reservation forms, please contact either Denise Butler at 713/552-3867, Michael Nault at 713/552-6405 or Sheila Barnette at 713/552-3820.

## NEW CO-EDITOR FOR PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

We would like to welcome **Carol Clayton** aboard as the new Co-Editor of the **Pacific Petroleum Geologist Newsletter**.

Carol is a Senior Staff Production Geologist with Mobil Exploration and Producing U.S. She has recently moved from Denver to Bakersfield with Mobil.

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#### **RECOMMENDED READING**

#### **GEOLOGICAL SOCIETY** OF AMERICA BULLETIN

Vol. 101, No. 11, November, 1989

Uniqueness of Geological Correlations: An Example from the Death Valley Extended Terrain, by J. K. Snow and B. Wernicke

Accelerator Mass Spectrometry Radiocarbon Dating of Rock Varnish, by R. I. Dorn, A. J. T. Jull, D. J. Donahoe, T. W. Linich and L. J. Toolin

Geomorphic Response of Coastal Streams in Low, Intermediate and High Rates of Uplift, Mendocino Triple Junction Region, Northern California, by D. Merritts and K. R. Vincent

The Southern Kahiltna Terrane: Implications for the Tectonic Evolution of Southwestern Alaska, by W. K. Wallace, C. L. Hanks and J. F. Rogers

Extended Period of Extinctions Across the Cretaceous/Tertiary Boundary in Planktonic Foraminifera of Continental Shelf Sections: Implications for Impact and Volcanism Theories, by G. Keller

Terranes, Early Faults and Pre-Late Jurassic Amalgamation of the Western Sierra Nevada Metamorphic Belt, California, by S. H. Edelman and W. D. Sharp

Isotopic Systematics of Pb/U (Zircon) and  $^{40}\mathrm{Ar}/^{39}\mathrm{Ar}$  (Biotite-Hornblende) from Rocks of the Central Foothills Terrance, Sierra Nevada, California, by J. B. Saleeby, E. E. Geary, S. R. Paterson and O.T. Tobisch

Vol. 101, No. 12, December, 1989

Thrust Faults and Related Structures in the Crater Floor of Mount St. Helens Volcano, Washington, by W. W. Chadwick, Jr., and D. A. Swanson

Deformational Styles in a Sequence of Olistostromal Melanges, Pacific Rim Complex, Western Vancouver Island, Canada, by M. T. Brandon

Implications of Paleozoic and Mesozoic Rocks in the Soda Mountains, Northeastern Mojave Desert, California, for Late Paleozoic and Mesozoic Cordilleran Orogenesis, by J. D. Walker and B. R. Wardlaw

Vol. 102, No. 4, April, 1990

Pore Pressure Response During Failure in Soils, by E. L. Harp, W. G. Wells II and J. G. Sarmiento

Omissional Faulting During Mesozoic Regional

#### **NEWSLETTER** Pacific Section A.A.P.G. Post Office Box 1072 Bakersfield, CA 93302

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Contractions at Carlin Canyon, Nevada, by P. E. Jansma and R. C. Speed

Lithostratigraphy, Biostratigraphy and Geochronology of the Barstow Formation, Mojave Desert, Southern California, by M. O. Woodburne, R. H. Tedford and C. C. Swisher III

Paleomagnetism, Geochronology and Possible Tectonic Rotation of the Middle Miocene Barstow Formation, Mojave Desert, Southern California, by B. J. MacFadden, C. C. Swisher III, N. D. Opdyke and M. O. Woodburne

#### **AAPG BULLETIN**

Vol. 74, No. 3, March, 1990

Hydrothermally Derived Petroleum: Examples from Guaymas Basin, Gulf of California and Escananba Trough, Northeast Pacific Ocean, by K. A. Kvenvolden and B. R. T. Simoneit

Stratigraphic Simulation of Sedimentary Basins: Concepts and Calibrations, by D. T. Lawrence, M. Doyle and T. Aigner

Basin Evaluation by Integrated Two-Dimensional Modeling of Heat Transfer, Fluid Flow, Hydrocarbon Generation and Migration, by P. Unger, J. Burrus, D. Doligez, P. Y. Chenet and F Ressis

Vol. 74, No. 5, May, 1990

A Foreward Modeling Strategy for Balancing Cross Sections, by V. S. Mount, J. Suppe and S. C. Hook

#### **CALIFORNIA GEOLOGY**

Vol. 43, No. 2, February, 1990

A Geological Journey through Red Rock Canyon State Park and the El Paso Mountains, Kern County, California, by E. J. Baldwin

Vol. 43, No. 3, March, 1990

Mesquite Mine: A Modern Example of the Quest for Gold, Imperial County, California, by C. T. Higgins

Vol. 43, No. 4, April, 1990

Coastal Landslides Caused by the October 17, 1989 Earthquake, Santa Cruz County, California, by N. Plant and G. B. Griggs

Cactus Gold Mines, Kern County, California, by J. L. Burnett and J. Brady

> Lucy Birdsall (Deceased)

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copies, and communications about advertising costs should be addressed to NANCY HOUGHTON, Chevron U.S.A., Post Office Box 1392, Bakersfield, California 93309. CHANGE OF ADDRESS, subscription, and membership inquiries should be directed to: MEMBERSHIP SECRETARY, PACIFIC SECTION AAPG, P.O. BOX 1072, BAKERSFIELD, CA 93302. PUBLICATIONS COMMITTEE: Pacific Section - American Association of Petroleum Geologists, Post Office Box 631, Ventura, California 93302.

#### **DEADLINE FOR** JUNE / JULY ISSUE JUNE 1, 1991

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## PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

of the Pacific Section American Association of Petroleum Geologists

June / July 1991 No. 4

#### THE PRESIDENT'S COLUMN

Time flies when you're having fun! Unfortunately, this past year has dragged from time to time, what with continued erosion of oil finders and operators, which prompted the creation of the reorganization query you were asked to complete and comment on in May. The level of responses is gratifying, looking at the early returns. When the total results are in, your new Executive Committee will massage the data and determine the appropriate course of action. For your information, amendments to the Pacific Section AAPG constitution must be approved by two-thirds of the ballots received to become effective.

At the Executive Committee meeting held on May 21, 1991 in Camarillo, a significant step was taken toward becoming pro-active as regards publications sponsored by the Pacific Section. For many years, our publication policy was driven by exigency. Our Publications Committee was Hans Schwing. Hans has handled the responsibility of getting books, maps, and sections printed, inventoried, and sold for six years. Considering the demands of the job, it's a great credit to Hans that he didn't bow out long ago. As reported in a previous Pacific Petroleum Geologist Newsletter (PPGN), Dan Olson is assuming the chair, but this time with a strong staff to provide the guidance necessary to plan ahead and be ready with the publications when they're needed. This will work hand-in-hand with the refurbished Planning and Organization Committee. which will move ahead at least one year of previous convention planning, such as section meetings through 1996 (i.e., 1996 National Convention in San Diego).

History has shown that publishing for the Section is like climbing a shale scree: You can work like hell and make little profit, but you can go downhill in a hurry. The Committee is chaired by Dan, who will be the Sales Coordinator, and Mike Dumont (also of ARCO), who will act as Managing Editor. A seasoned staff of advisors, such as Bill Bazeley, Dick Hester, Reinhard Suchsland and Hans Schwing, will assist.At the July Executive Committee meeting a new slate of Officers and Committee Chairmen will assume the leadership of the Pacific Section. I can't thank them all here, but I do want to say thanks to Bob Lindblom who is leaving our post on the National Advisory Council. Bob assumed the position in 1987 when Wes Bruer was stricken, and he then served an additional term of three years. I can't imagine the Executive Committee without Bob's input,

## PACIFIC SECTION AAPG PUBLICATIONS COMMITTEE REORGANIZATION

After nine years of dedicated service as Publication Sales Chairman, HANS SCHWING will step down on July 1, 1991. The Publications Committee has been reorganized with Dan Olson serving as both Chairman and Sales Coordinator. Michael P. Dumont will become Managing Editor. An Advisory Board has been created consisting of William (Bill) J. M. Bazeley, Richard L. Hester, Hans Schwing and Reinhard J. Suchsland. The goal of the new organization is to provide long-term consistent leadership and direction for future Pacific Section publications, to enhance the quality of the publications and maintain healthy publication sales. The new Committee is presently drafting a formal policy regarding sales and support for local Society publications along with guidelines for authors. The Committee is now soliciting ideas for future guidebooks, symposium volumes and cross sections.

Please contact Michael Dumont at ARCO (805/321-4265) with future publication ideas or comments. The new publications address is Pacific Section AAPG, Post Office Box 1072, Bakersfield, California 93302.

### **BALLOTS & QUESTIONNAIRES STATUS**

At the time of this writing, June 1, 1991, the election ballots for new Officers and the questionnaires concerning the possible reorganization of the Pacific Section are pouring into my office. This has made me *persona non grata* with the mail room personnel since, as of right now, over 370 responses have been received, averaging twenty to thirty per day after an initial deluge. Although the deadline for counting the election ballots for new Officers is June 15, 1991, there is no deadline for the questionnaires. So keep those card and letter coming!

It is too early to comment on the results of the questionnaires at this time, but by the next issue of the Pacific Petroleum Geologist Newsletter (PPGN) some preliminary results should be available for publication. It is especially gratifying that we are getting such a great response in returning the questionnaires. So far about eighty to ninety percent of the letters that I have received include the questionnaires, and a significant number of people have included comments. These comments are particularly important to the Executive Committee and are being compiled for review. The comments will play a major part in guiding us in determining whether we should undertake a reorganization.

The Executive Committee would like to thank everyone for taking the time to vote and for responding to the questionnaire.

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San Joaquín

July & August - No meeting.

September 13 - Annual Fall Barbecue and Golf Tournament, Stramler Picnic Area.

Suggestions for meeting speakers or topics should be addressed to Larry Knauer at 805/763-6280.

The meetings are held at the American Legion Hall at 2020 "H" Street in Bakersfield. Attitude adjustment starts at 6:00 p.m. and dinner is served at 7:00 p.m. For more information and reservations please contact Laura Bazeley at 805/326-1112.

Coast

Meetings are held the third Tuesday of every month. Meeting time is at 6:00 p.m., dinner at 7:00 p.m. at the American Legion Hall in Ventura. The address is 83 South Palm. For reservations please contact Marty Meyer at 805/494-2226.

Los Angeles

The meetings will be held alternate months at noon at UNOCAL Center, California Room, 1201 West Fifth Street, Los Angeles.

For reservations or information, call Randall Ferguson at 714/842-6331 or Ken March at 213/436-9211 - #357.

Northwest

For suggestions or questions, please contact Lanny Fisk at 503/382-0825, Barbara Portwood at 503/287-2762, or any other member of the NWPA Program Committee: Phil Brogan, Harry Jamison, Paul Dudley or Nancy Ketrenos.

#### SAN JOAQUIN GEOLOGICAL SOCIETY

#### **ELECTION RESULTS**

The newly elected Officers for the San Joaquin Geological Society are as follows:

#### President

RANDY METZ Pacific Geotechnical Associates

#### President-Elect

LARRY KNAUER Bechtel

#### Vice President

MIKE LEWIS Santa Fe Energy

**Secretary** 

LES COLLINS Epoch

**Treasurer** 

DONNA MILLER Chevron

#### **Delegates**

ROBERT COUNTRYMAN Chevron

> DAVE WRACHER Santa Fe Energy

ROBERT HORTON California State University -Bakersfield

#### Alternate Delegate

WILLIAM FEDEWA ARCO Oil and Gas Company

Laura M. Bazeley

#### COMING EVENTS

August 15 to 18 - SEPM Mid-year Meeting, Portland, Oregon.

September 11 to 13 - Pacific Coast Gas Association 98th Annual Meeting, Seattle, Washington.

September 28 and 29 - SEPM Fall Field Trip to Owens Valley in the Vicinity of Lone Pine and Darwin Canyon.

September 29 to October 2 -International AAPG Conference, London.

October 6 to 9 - SPE Annual Technical Conference and Exhibition, Dallas.

November 10 to 14 - Society of Exploration Geophysicists 61st Annual International Meeting, Houston.

November 17 to 19 - API Annual Meeting, Houston.

April 29 to May 1, 1992 - Pacific Section AAPG Convention, Sacramento, Rich Boyd, Chairman (Capitol Oil).

#### SACRAMENTO PETROLEUM ASSOCIATION

Meetings are held at noon at Neptune's Table Restaurant, 5990 South Land Park Drive. For reservations please contact Rich Boyd at 916/929-4141.

#### **RECENT MOVES**

- BONNIE BLOESER, after obtaining her Ph.D. and teaching at San Diego State University and the University of California at San Diego, Bonnie has returned to work in industry. She now works for UNOCAL in Los Angeles.
- STEVE KIOUSER, has accepted the position of Vice President and Manager of Exploration/Development with Western Continental Operating Company In Bakersfield.

#### Page 3 1991 No. 4

#### SEPM ELECTION

The newly elected Officers for the SEPM are as follows:

#### President

GAIL M. ASHLEY Rutger's University New Brunswick, New Jersey

#### President-Elect

HARRY E. COOK U. S. Geological Survey Menlo Park, California

#### Paleontology Counselor

GREGORY H. BLAKE UNOCAL Los Angeles, California

#### Sedimentology Counselor

#### STEPHEN A. GRAHAM

#### Secretary - Treasurer

MICHAEL E. FIELD U. S. Geological Survey Menlo Park, California

**Research Activities Counselor** 

#### LISA M. PRATT

Editor - Journal of Sedimentary Petrology

HARVEY BLATT University of Oklahoma

#### Editor - PALAIOS

DAVID J. BOTTIER University of Southern California Los Angeles

#### Editor - Special Publications

BARBARA H. LIDZ U. S. Geological Survey

#### THE PRESIDENT'S COLUMN (continued from Page 1)

so we will have to recycle him in on some advisory capacity. Taking on the next term will be Jack West. Jack's had lots of Section experience and will be a strong representative for us on the Council. Our thanks to WZI Inc. for supporting AAPG by providing time and travel expenses.

Good news from the Cross-Section Committee - - like the Publication Committee was, a Committee of one. Ernie Rennie tells me that there will be seven (7!) new Sections ready for pre-Convention sale, covering both the delta and the Forbes producing areas. Like other publications now, the editing and printing of new Sections will be handled by the Publications Committee, leaving Ernie more time to organize the planning and execution of the geologic work.

Preliminary plans for the 1992 Sacramento meeting have been formulated by Rich Boyd and his Committee. In addition to structural and stratigraphic sessions on the Sacramento Valley and the Great Valley, there will be sessions on the Pacific coastal and interior basins, and the Basin and Range. For the first time, the Association of Engineering Geologists (AEG) will participate with two half-day sessions, workshops and two field trips.

The current Board has left John Randall and the new electees with plenty to do, including the writing of this column. My foot will still be stuck to Section business as Past President, which will terminate in 1992. My involvement with Section business started in 1986, planning the Santa Barbara meeting. We don't all get the chance to put back into the pot which has served us so well for so many years. Thanks for the opportunity.

Jack S. Cunningham, President

#### **PPGN ADVERTISEMENTS**

The PPGM would like to solicit advertisements from members. If you are interested in advertising, please contact either Nancy Houghton (805/395-6351) or Carol Clayton (805/665-4011).

#### **NEW MEMBERS IN SOUTHERNCALIFORNIA**

MICHAEL R. BRICKEY, United States Department of the Interior, Camarillo.
REED J. BOWLES, State of California Division of Oil and Gas, Bakersfield.
RICHARD P. WILKERSON, Geraghty & Miller, City of Industry.
DONALD J. KROTSER, Pasadena.
JOANN B. CONARD, Bakersfield.
PHILIP R. KINNEY, Ventura.
WILLIAM R. HARZ, Department of Earth and Planetary Sciences, Santa Barbara City College, Santa Barbara.
RICHARD E. THESKEN, State of California Division of Oil and Gas.



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## PACIFIC SECTION AAPG FIELD SUMMARIES

## HUENEME OFFSHORE FIELD, CALIFORNIA

by C. D. Cavit

#### **STATISTICS**

#### **STRUCTURE**

Discovery Well

Mobil OCS P-0202 No. 1 Federal Offshore, Santa Barbara Channel T. D. 8,452 MD

#### Discovery Date

May, 1969

Initial Production

Platform Well H-1 1,104 BOPD and 223 MCFG/D

#### Productive Formations

Miocene Hueneme Sand Oligocene Sespe Formation

#### Trap

Anticline

#### Average Pay Depth

5,200 feet

#### **Total Productive Wells**

Six (6)

#### **Cumulative Production**

Seven (7) MMBO 1.8 BCFG

#### Proved Acreage

140 acres

Hueneme Field is located in the southeastern corner of the Santa Barbara Channel about three (3) miles offshore from Port Hueneme, Ventura County, California. This offshore oil field was discovered in 1969 and developed from Platform Gina.

The field structure is a simple doubly plunging anticline associated with an east-west trending regional thrush fault system. The thrust faults are north dipping with the field forming on the upthrown side. The faults have 300 feet and 400 feet of displacement and forms the south flank of the Santa Clara Syncline.

#### **STRATIGRAPHY**

The main reservoirs of the Hueneme Field are the Miocene Hueneme Sand and the Oligocene Sespe Formation. The non-marine Sespe Formation consists of a series of isolated sand lenses interbedded with shales. The average thickness of the individual sands is about twenty (20) feet. The Sespe Formation is at least 3,000





#### STRATIGRAPHY (continued)

feet thick, however the oil occurs only in the upper 500 feet. The Sespe Formation is unconformably over-lain by the Miocene Hueneme Sand. This sand probably represents highly reworked Sespe Sands as the depositional environment changed from non-marine to marine. The Hueneme Sand accounts for the bulk of the production in the Hueneme Field. It reaches a maximum thickness of slightly more than 100 feet near the top of the Hueneme Field structure and appears to be thin in all directions away from the crest of this anticline.

#### **RESERVOIR**

The Sespe Sands are characterized as fine-grained and poorly sorted with a mean porosity of 23 percent and a mean permeability of 260 millidarcies. The Hueneme Sand, by contrast, is a medium to coarse-grained sandstone cemented by petroleum. Porosity averages 34 percent and permeability averages over 5,000 millidarcies in this massive sand.





### **DEVELOPMENT AND PRODUCTION**

Platform Gina, a fifteen-slot platform, was set by UNOCAL in 1980 to develop the Hueneme and Sespe reservoirs. Six producers and five injectors have been drilled since 1981. Reservoir pressure has been maintained by seawater injection (the second development well drilled in this field was an injector). Initial production rates from the six producers averaged 794 barrels of oil per day per well, with a gas-oil ratio of 212 SCF/STB. Peak production from the field was 4,700 BOPD with an estimated ultimate recovery of eight (8) million barrels of oil and two (2) billion cubic feet of gas.

### AAPG HOUSE OF DELEGATES

The AAPG House of Delegates met April 7, 1991 at the Annual Convention in Dallas. Roger Prince, Northern California Delegates Chairman, reports that several interesting issues were discussed, but no vote was taken.

#### **International**

AAPG now considers itself an international organization and has at least two non-United States affiliates. The issue of representation in the House of Delegates in an important one for international members. Under the current constitution, only international members who are members of a local affiliated society have representation. One solution proposed by the Canadian Society of Petroleum Geologists (an affiliated society) is that at-large international delegates be established. This issue is expected to receive more attention in future years as United States' membership in AAPG continues to drop and international membership grows. Non-United States members comprise about twenty percent of the total AAPG membership. Slightly more than half of these members favor a name change (i.e., drop "American" to become "Association of Petroleum Geologists").

#### Non-Geologists as Members

A Delegate raised the issue of whether technical people who are not geologists, but who work in the oil industry, should be allowed to join the AAPG. There did not appear to be much support for this idea among the Delegates.

#### Proposed Environmental Science Division

Roger Prince spoke on behalf of the Northern California Delegation, supporting a proposal that environmental science be brought into the AAPG, either as a separate Division or as part of a renamed Energy Minerals Division. In a non-binding vote, eighty percent favored supporting a new Environmental Science Division. The Environmental Committee, sponsor of the proposal, is now drafting a formal proposal to establish an Environmental Science Division. This will be voted on in 1992 at Calgary.

Sandra Feldman, one of the Northern California Delegates, observed that, since "change" was the theme of the American Association of Petroleum Geologists 75th Annual Convention, it somehow seems appropriate that the terms discussed by the Delegates affected the words "American", "Petroleum", and "Geologists". The only words not affected were "Association" and "of".

#### NEW FELLOWSHIP IN GEOLOGY AT THE UNIVERSITY OF NEW MEXICO

The Department of Geology and Meteoritics at the University of New Mexico has just received a new on-going Travelling Fellowship designed to help graduate students pursue field work toward Masters and Doctoral degrees. Modeled after the well-known Broderick Travelling Fellowship at Harvard University, these fellowships will, for the first few years, provide funds of \$1,000 per summer season based on need, scholastic ability, and the students' intentions of becoming professional geologists in the search for natural resources.

Donors of these fellowships are Dr. Sherman A. Wengerd, emeritus Professor of Geology, and his wife, Florence Mather Wengard, daughter of the late Kirtley F. Mather who was Professor of Geology at Harvard from 1924 to 1954, and who spent the last seven years of his life on the University of New Mexico Geology Staff as part-time Visiting Professor of Geology. The Wengerds' are making the \$1,000 fellowships available by annual donations to the University of New Mexico Foundation, with near-future plans to establish and finance an endowment fund in perpetuity, for the education of geologists in this most important phase of their careers - learning to do field geology.

A committee of the University of New Mexico Geology Faculty, presently chaired by Dr. Stephen Wells, will choose the fellowship recipients each year.



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#### RECOMMENDED READING

#### **AAPG BULLETIN**

Vol. 74, No. 4, April, 1990

Minipermeameter-Based Study of Permeability Trends in Channel Sand Bodies, by T. Dreyer, A. Scheie and O. Walderhaug A. Scheie and O. Walderhaug Corelike Descriptions P. Definer

from Open-Hole Logs, by H. Anxionnaz, P. Delfiner and J. P. Delhomme

Anoxia vs. Productivity: What Controls the Formation of Organic-Carbon-Rich Sediments and Sedimentary Rocks?, by T. F. Petersen and S. E. Calbert

Late Cenozoic Fold and Thrust Belt of the Southern Coast Ranges and Santa Maria Basin, California, by J. Namson and T. L. Davis

#### Vol. 74, No. 8, August, 1990

High-Temperature Hydrothermal Origin for Fractured Carbonate Reservoirs in the Blackburn Oil Field, Nevada (page 1262), by J. B. Hulen, S. R. Berskin and L. C. Bortz

Vol. 74, No. 9, September, 1990

Permian and Triassic Sedimentation in the Northeastern Brooks Range, Alaska: Deposition of the Sadlerochit Group (page 1351), by R. K. Crowder

Porosity Prediction, Prior to Drilling, in the Sandstones of the Kekiktuk Formation (MIssissippian), North Slope of Alaska (page 1371), by S. Bloch, J. M. McGown, J. R. Duncan and D. W. Brizzolara

Vol. 74, No. 10, October, 1990

Identification of Wrench Faults Using Subsurface Structural Data: Criteria and Pitfalls (page 1590), by T. P. Harding

#### Vol. 74, No. 12, December, 1990

A Practical Model for Organic Richness from Porosity and Resistivity Logs (page 1777), by Q. R. Passey, S. Creaney, J. B. Kulla, F. J. Moretti and J. D. Stroud

#### GEOLOGY

Vol. 18, No. 4, April, 1990

Angles of Repose that Exceed Modern Angles, by J. C. Mann and S. P. Kanagy III

#### NEWSLETTER Pacific Section A.A.P.G. Post Office Box 1072 Bakersfield, CA 93302

FORWARDING AND RETURN POSTAGE GUARANTEED

Reading the Moon's Volcanic Record by Ion Microprobe Analysis of Apollo 14 Glass Beads, by J. J. Papike, C. K. Shearer and K. C. Galbreath

U. S. West Coast Revisited: An Aeromagnetic Perspective, by P. R. Johnson, I. Zietz and K. R. Bond

Two-Stage Rifting of Pangea by Two Different Mechanisms, by A. Hynes

Precambrain Time Units and Nomenclature -The Geon Concept, by H. J. Hofmann

Yukon-Tanana Terrance: A Partial Acquittal, by V. L. Hansen

Cathodoluminescence Microscopy of Myrmekite (Rubidoux Mountains, Riverside County, California), by R. F. Hopson and K. Ramseyer

#### Vol. 18, No. 5, May, 1990

Cenozoic Thrust Emplacement of A Devonian Batholith, Northeast Brooks Range: Involvement of Crystalline Rocks in a Foreland Fold-and-Thrust Belt, by C. L. Hanks and W. K. Wallace

High-Latitude Application of <sup>87</sup>SR/<sup>86</sup>SR: Correlation of Nuwok Beds on North Slope Alaska, to Standard Oligocene Chronostratigraphy, by D. H. NcNeil and K. G. Miller

Sequence Stratigraphy and Evolution of the Antler Foreland Basin, East-Central Nevada, by J. H. Trexler, Jr. and S. P. Nitchman

Stratigraphic Modeling of Foreland Basins: Interpreting Thrust Deformation and Lithosphere Rheology, by P. B. Flemings and T. E. Jordan

Pennsylvanian Times Scales and Cycle Periods, by G. Klein

#### **CALIFORNIA DIVISION OF MINES & GEOLOGY**

Bulletin 207: Geology of the California Continental Margin: Explanation of the California Continental Margin Geologic Map Series - Interpretive Methods, Symbols, Stratigraphic Units and Bibliography (72 pages), by M. P. Kennedy, H. G. Greene and S. H. Clarke, \$15.00

> Map 1: Inner Southern, \$13.00 Map 2: Mid-Southern, \$13.00 Map 3: Outer Southern, \$13.00 Map 4: South-Central, \$15.00 Map 5: Central, \$13.00 Map 6: North-Central, \$13.00 Map 7: Northern, \$13.00

> > Lucy Birdsall (Deceased)

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#### **DEADLINE FOR** AUGUST / SEPTEMBER ISSUE AUGUST 1, 1991

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## PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

of the Pacific Section American Association of Petroleum Geologists

August / September 1991 No. 5

#### THE PRESIDENT'S COLUMN

"Thanks, Jack Cunningham" - because you challenged paradigms, this Section is better positioned for the future. I find comfort in knowing that I will be able to haunt the immediate Past President as this Section accomplishes a transformation.

Congratulations to our new Officers: President-Elect, **Paul Hacker**; Vice President, **Rick Bowersox**; Secretary, W. C. Rusty Riese; and Treasurer, **Muriel R. Norton**. The gavel was passed and new Officers installed at the July Executive Committee Meeting. Outgoing Officers, **Frank Cressy**, **Bob Countryman** and **Marty Hall-Burr**, did an outstanding job managing affairs and left a richer prospect file and stronger Section.

Although recent in-depth philosophical discussions have focused on possible restructuring, our basic purpose remains the same:

"The object of this Section shall be to provide for discussion of subjects and problems coming within the scope of the profession and by such intercourse, to promote the advancement and aims of the AAPG ...."

It has also be our style to have as much fun as possible. In the spirit of perpetuating the right things, and changing those things that improve our prospects for future success, I encourage the membership to send me your vision, comments and opinions. I shall include them on the Executive Committee meeting agenda, especially those that are fun, make us technically smarter and financially stronger.

The 1991 AAPG-SEPM-SEG Good news! Convention in Bakersfield was a technical and financial success, as reported by Dan Schwartz, General The total income from donations, Chairman. advertising, exhibitors and registration was \$116,945. Total convention expenses were \$83,560. The final profit from the convention was \$33,385. Comprising the total of 734 registrants were 539 member/non-members, 79 exhibitors, 34 students and 82 spouses. There were 129 papers presented and 21 poster sessions. The AAPG Levorsen Award winner was "Controls on the Development of Depositional Sequences and Facies Along an Active Margin", presented by John Lomar and Scott Morgan, both with Exxon. Dan and the Committee members worked tirelessly to bring off a successful meeting. THANKS!

## THE FUTURE PACIFIC SECTION: MEMBERS SUPPORT CHANGE

Results of the recent questionnaire on possible restructuring of Pacific Section AAPG (PS/AAPG) indicate strong support for broadening the technical scope of the Section and for restructuring into a Pacific Coast Association of Geological Societies. As of July 23, 1991, 504 questionnaires have been returned out of a total membership mailing of

1,060, a statistical sampling that would impress any professional pollster. These results show that 82% of our members favor broadening the technical scope of PS/AAPG and 78% would accept a restructuring into a Pacific Coast Association of Geological Societies (PCAGS).

The poll, as tabulated and analyzed by former PS/AAPG Secretary, Bob Countryman, provides significant information on our membership. The most basic includes distribution by age (Figure 1) and area of professional practice (Figure 2).





### THE PRESIDENT'S COLUMN

(continued from Page 1)

Update on the 1992 Pacific Section Convention, April 27 to May 1, 1992, Sacramento. California: Rich Bovd. Chairman General reports that preparations are well underway. Α general announcement and Call for Papers has been mailed. AAPG will be hosting eight symposia and two short EMD will be hosting one courses. symposium and SEG three symposia, with the Mesozoic Symposium of special interest. The Association of Engineering Geologists will be participating in the Convention for the first time. The AEG will be hosting two symposia and two short courses. There are also plans for three to five field trips and corresponding poster sessions will be held with each For more information. symposium. please contact Rich Boyd, Capitol Oil, 1545 River Park Drive #501, Sacramento, California - 916/929-4141.

The new Executive Committee has received feedback from the reorganization survey and will be examing alternatives. **Tom Wright**, Planning and Organization Chairman, has very capably summarized the survey results in this issue. Tom will continue to facilitate and communicate efforts until we have the kind of organization the membership desires. In the changing environment we live in today, it's great to have a man of vision like Tom.

Hope to see you on September 13 at the California Oil Scouts and San Joaquin Geological Society Barbecue. Let's exchange ideas, toast to higher oil prices, and enjoy that good Bakersfield vitality and hospitality.

John W. Randall, President

## Coast

September 17 - Mark Molinari, Dames & Moore, Santa Barbara, will speak on faults in Alaska.

Meetings are held the third Tuesday of every month. Meeting time is at 6:00 p.m., dinner at 7:00 p.m. at the American Legion Hall in Ventura. The address is 83 South Palm. For reservations please contact Linda Saunders at 805/494-2210.

## San Joaquín

#### August - No meeting.

September 13 - Annual Fall Barbecue and Golf Tournament, Stramler Picnic Area.

Suggestions for meeting speakers or topics should be addressed to Larry Knauer at 805/763-6280.

The meetings are held at the American Legion Hall at 2020 "H" Street in Bakersfield. Attitude adjustment starts at 6:00 p.m. and dinner is served at 7:00 p.m. For more information and reservations please contact Laura Bazeley at 805/326-1112.

#### SACRAMENTO PETROLEUM ASSOCIATION

Meetings are held at noon at Neptune's Table Restaurant, 5990 South Land Park Drive. For reservations please contact Rich Boyd at 916/929-4141.

## PACIFIC SECTION AAPG

**NEW OFFICERS** 

#### President

John W. Randall Chevron U.S.A. Inc.

#### President-Elect

Paul D. Hacker Consulting Geologist

#### Vice President

Rick Bowersox Bakersfield Energy Resources, Inc.

#### Secretary

W. C. Rusty Riese ARCO Oil and Gas Company

#### Treasurer

Muriel R. Norton Geoquip Corporation

### COAST GEOLOGICAL SOCIETY

#### **NEW OFFICERS**

#### **President**

Robert C. Michael Consultant

#### Vice President

Peter J. Raftery Groundwater Technologies, Inc.

#### **Secretary**

Dave C. Salter Retired, Chevron

#### <u>Treasurer</u>

Randall W. Altobelli Minerals Management Service

#### **COMING EVENTS**

September 11 to 13 - Pacific Coast Gas Association 98th Annual Meeting, Seattle, Washington.

September 13 - California Oil Scouts and San Joaquin Geological Society Annual Fall Barbecue and Golf Tournament, Stramler Picnic Area.

- September 28 and 29 SEPM-CGS Fall Field Trip to Owens Valley in the Vicinity of Lone Pine and Darwin Canyon.
- September 29 to October 2 -International AAPG Conference, London.
- October 6 to 9 SPE Annual Technical Conference and Exhibition, Dallas.
- November 10 to 14 Society of Exploration Geophysicists 61st Annual International Meeting, Houston.
- November 17 to 19 API Annual Meeting, Houston.
- April 29 to May 1, 1992 Pacific Section AAPG Convention, Sacramento, Rich Boyd, Chairman (Capitol Oil).

## THE FUTURE PACIFIC SECTION: MEMBERS SUPPORT CHANGE Page 3 1991 No. 5 (continued from Page 1)

For the two professional fields most directly concerned with the proposed changes -- petroleum geologists and hydrogeologists/environmental geologists -- Figure 3 shows a predictable difference in age distribution. Petroleum geologists are skewed toward the older groups and hydrogeologists toward the younger.



Within each age group and speciality, Figure 4 shows the percentage of members that favor or oppose a change in PS/AAPG (responses to Question #2). The support for change varies little between groups. Predictably, it is highest among hydrogeologists and environmental geologists and lower among petroleum geologists. More than 70% in each group favor restructuring.



The question yielded 65% as "Yes", 25% as "No", and 10% with no response.

Taken as a whole, the response suggests that a thoughtfully developed proposal for a Pacific Association of Geological Societies might well receive the required two-thirds majority vote of our membership. A Constitution and By-laws

> Committee will begin meeting to develop that proposal, and members wishing to serve on that committee should contact PS/AAPG President John Randall. Articles in subsequent issues of the Newsletter will cover specific aspects of the proposed restructuring and will report on progress of the Constitution and By-laws Committee.

> Our direction will be guided not only by the statistical results of the questionnaire, but by the many thoughtful comments provided by members. A few of these are:

"I would recommend that the name <u>Pacific</u> <u>Section AAPG</u> be retained and that a new group be formed called Pacific Coast Association of Geological Societies, of which Pacific Section AAPG would be a member. PCAGS would put on an annual convention and a newsletter in place of Pacific Section AAPG." (John Kilkenny)

"I don't oppose an umbrella organization uniting various societies. I <u>do</u> oppose that umbrella organization and AAPG being one and the same."

"<u>Subsections</u> of Pacific Section AAPG can be created to accommodate the new fields." (E. F. Reid)

"Regarding dues: Either it is an association of societies or individuals, not both".

"Contacts should be made with our sister societies before deciding to change Pacific Section AAPG into "PCAGS" because it is possible that our sister societies (or their memberships) may not wish to affiliate with AAPG as "PCAGS". Their input is needed early."

> "A wider scope of affiliation to local societies of varying disciplines within geoscience (i.e., hydrogeology, engineering geology, any university geological society). The PCAGS could continue to use economies of scale to aid member societies with mailings, dues collections/rebates, etc.. and thus would be very valuable."

"I favor expanding support and providing proper professional society "home" for younger geologists working in the newer environmental, et al fields. But, I also favor assuring that Californian's in general don't lose sight of AAPG's importance..."

In response to the question on how the proposed PCAGS should be supported financially, a scant majority (55%) favored individual dues to members, 22% indicated surplus funds from conventions and publications, and 18% favored per-member assessments to local societies. Some members marked more than one option. The question "If the proposed PCAGS does not have individual membership-and-dues, would <u>you</u> be likely to subscribe (at \$5.00+/- per year) to a PCAGS Newsletter?"

Common themes include:

"I hope that the Section will not lose its loyalty to its roots in the petroleum industry."

"I am in favor of the AAPG pushing quality, not guantity."

(continued on Page 6)

## GEOLOGY & EXPLOITATION OF THE COSO GEOTHERMAL RESERVOIR

by M. C. Erskine & J. L. Moore

#### INTRODUCTION

The Coso geothermal power development is located in the Coso Range of eastern California (Figure 1). The Coso Range, the first mountain range east of the southern Sierra Nevada, is about forty miles north of the northern Mojave Desert. California Energy Company, Inc. generates electrical power from geothermal fluids derived from wells drilled into fractures in the basement rocks of the Coso Range. The electricity is delivered to the Southern California Edison Company grid at Inyokern, California. The current output of the Coso geothermal development is 240 megawatts.

The Coso Range is one of the western-most ranges of the Basin Range physiographic province. It is located in the

southwestern-most portion of the Great Basin region of internal drainage and just south of an imaginary eighty-mile-long line that connects Mount Whitney, the highest elevation in the continental United States, with Badwater in Death Valley, the lowest elevation in the United States. The average topographic gradient represented by this relief is about 180 feet per mile in a southeasterly direction across the entire region.

The Coso Range is separated from the Sierra Nevada on the west by Rose Valley, the southern extension of Owens Valley. The Range is bound on the east by Darwin Wash and the Argus Range. It is bound on the north by Owens Lake, which is a saline playa courtesy of Los Angeles Department of Water and Power. Owens Lake is a closed basin and the



southern terminus of the modern Owens River. The southern boundary of the Coso Range is Indian Wells Valley, a deep structural valley that contains two playas, Airport Lake and Searles Lake, that were fed by the ancestral Owens River during the glacial-pluvial periods of the last three million years.

The bedrock of the Coso Range consists of Mesozoic crystalline igneous rock and metamorphic rocks similar to the adjacent Sierra Nevada. This bedrock outcrops over most of the Range, but is locally covered by Neogene continental sediments of the Coso Formation or by Pliocene to Recent volcanics of the Coso Volcanic Field. The geothermal system is spatially associated with the youngest rhyolite domes (0.06 to 1.00 million years) of the Coso Volcanic Field at the surface. However, at reservoir depths, intrusives associated with the young volcanics are rare and where encountered, do not appear to directly support the present geothermal system.

The Coso geothermal reservoir consists of fractures in crystalline basement rocks and the produceability of the thermal resource is dependent upon the productivity of this fractured regional hydrologic system. To make reasonable estimates of the reserves and rate of economic produceability of the system it is necessary to understand where the water is coming from, where it is heated, and how the fractures control convective heat transport to bring the heated water to within economic reach of the drill.

#### GEOLOGY OF THE GEOTHERMAL RESERVOIR

The Coso geothermal reservoir consists primarily of complexly fractured Mesozoic igneous and metamorphic rocks of the Sierran basement complex. The igneous rocks range in composition from alaskite granite to diorite to gabbro. The more mafic rocks appear to "float" as irregularly shaped small to large bodies in more abundant, more siliceous rocks. Contacts may be diffuse and irregular or sharp, structural and irregular. It is only from the small scale averaging viewpoint of aeromagnetic data that a sense of overall northwest striking compositional banding may be observed.

The rhyolite dome field and associated volcanic ejecta cover much of the basement complex in the area of the reservoir. It is generally less than 200 feet thick and at reservoir level, related rhyolite dikes or sills are rather rare. The rhyolites intersected at reservoir levels do not appear to be directly related to the present hydrothermal system. Chemical and thermal gradients within the reservoir suggest that the hydrothermal system is very young, much younger than even the youngest of the rhyolite domes.

The thermal energy produced at Coso is carried from the reservoir to the turbines by hydrothermal fluids. These hydrothermal fluids are meteoric water (normal groundwater) with 5,000 to 10,000 parts per million of total dissolved solids that have been heated by flowing through fractures in hot rocks. The source of the heat for the geothermal fluids is assumed to be the same silicic magma reservoir that sourced the young Coso rhyolite dome field.

The hydrothermal alteration most closely associated with present production consists of abundant deposition of vein carbonates, although much of the vein carbonate deposition appears to pre-date the present high temperature regime. The non-condensable gases in the hydrothermal fluids are very high in carbon dioxide. The concentration of carbon dioxide in the fluids at the high-temperature south end of the reservoir reaches over 15,000 parts per million. Silica veining is conspicuous by its rarity.

#### REGIONAL HYDROLOGY

A topographic gradient of nearly 140 feet per mile exists between the high-precipitation groundwater recharge area on the Kern Plateau of the Sierra Nevada and the desert plava of Panamint Valley. The groundwater gradient between the Kern Plateau and the top of the Coso geothermal reservoir is about 235 feet per mile. The Coso Range reaches an altitude of 8,160 feet at Coso Peak in the headwaters of Coso Wash. The vegetation density seen on thematic mapper images suggests that this higher country also has significant precipitation. The chemistry of the reservoir fluids from the geothermal reservoir suggest that magma heated normal groundwater, but did not significantly interact chemically with it. This means that heat from the magma was conductively transported to the groundwater system. This in turn means that the groundwater must have had long contact with fracture surfaces in rocks conductively heated by the magma to temperatures about 345° C, which is the highest measured reservoir temperature, but at temperatures low enough to allow the rocks to maintain significant open fractures. Deep, long-distance circulation of groundwater controlled by local and regional topographic heads seems well established in purely sedimentary regimes both in a theoretical sense and in the measurements within the Great Basin. Fractured crystalline basement, however, seems to give some geologists serious mental indigestion. The existence of the Coso geothermal reservoir, currently producing 240 megawatts, seems to indicate that the question should be how does it happen, rather than whether it is possible.

Perhaps the most important hydrologic point to make is that heat transport to the geothermal reservoir is controlled by hydrologic permeability. The geothermal reservoir exists where it does because the more-or-less-vertical fracture permeability in this local area is adequate to allow significant convective heat transport by fluids in the fractures. Exploration for geothermal resources in this environment then must become a search for local, deep-penetrating, more-or-less-vertical fracture systems in the post-magma groundwater flow path.

#### COMMERCIAL DEVELOPMENT

Steam fumorales and recent volcanic activity in the Coso Range suggested the presence of a large geothermal resource. The discovery well at Coso, 75-7, was drilled to a depth of 1,329 feet in December, 1981, and completed "open hole" from the steam cap. Subsequently, five confirmation wells were drilled to establish Coso as a viable geothermal field. Testing of these wells in 1982 established the existence of a reservoir sufficient to meet the Department of Defense electrical requirements of 30 megawatts at the Naval Weapons Center, China Lake. After several years of additional negotiations with the Navy, and the passage of two pieces of enabling legislation, contracts were finally let in February of 1986 to build the first commercial geothermal powerplant at Coso.

Ground was broken for the first Coso plant in March of 1986. Sixteen months later, on July 15, 1987, the first geothermal power was delivered to the Inyokern Substation from the Coso geothermal field. Currently, nine turbine generator units deliver in excess of 240 megawatts of electrical power to the Southern California power distribution network at delivery points in Inyokern and Kramer.

#### Page 6 1991 No. 5

The facility consists of approximately 100 production and injection wells distributed over some nine square miles of project lands. It is interesting to note that the best producing wells lie nearly one mile from the fumorales which first drew attention to the area.

Reservoir pressure decline has been as expected and the replacement/infill program has been able to maintain production at levels in excess of plant design. Step-out wells located easterly of the primary development area proves the existence of what appears to be a large undeveloped reservoir. Development in the eastern area is planned to provide supplemental make-up steam for the existing surface installations. Additional surface generating facilities may be constructed based on continuing resource performance.

**M.** C. Erskine is a Consulting Geologist in El Cerrito, California and J. L. Moore is Vice President of Exploration for the California Energy Company, Inc., San Francisco, California.

#### THE FUTURE PACIFIC SECTION: MEMBERS SUPPORT CHANGE

(continued from Page 3)

"I would favor broadening of scope, but no name change, please." (Phil Ryall)

"I do not want the special focus of Pacific Section diluted [it is] an excellent context for those of us interested in basin and petroleum geology of the West Coast to exchange information."

A great many comments simply reinforced the respondent's position for or against change. Not surprisingly, those who voted "No" on #2 commented much more frequently (including three who promised to quit if a major change was made). Representative comments include:

"This is a rotten idea . . . "
"Sounds great!"
"We should remain independent and be proud of it."
"If Pacific Section AAPG is to survive, it must broaden its scope as proposed."
"Keep 'em OUT!"
"Facing reality is a good idea."

In the deliberations of our Constitution and By-Laws Committee and in future Newsletter articles, we hope to provide satisfactory answers to these and other questions and concerns expressed by our members.

> Tom Wright, Chairman Planning & Organization Committee

#### SEPM SHORT COURSE

SEPM's Society for Sedimentary Geology and the Paleontological Society are sponsoring a one day short course titled:

#### "Sequence Stratigraphy and Biostratigraphic Patterns: An Integrated Approach to Defining Basin History"

The presentation is scheduled for Saturday, October 19, 1991, in San Diego, California and will be instructed by John M. Armentrout, Mobil Research and Development, Dallas, Texas.

This eight hour hands-on course consists of a series of exercises in integration of seismic record selections, wireline logs, and biostratigraphic data. Each participant receives a complete set of short course notes and exercise materials. The study area is offshore Texas, where the Pliocene/Pleistocene stratigraphy is dominated by progradational cycles across a tectonic framework of basin -



margin subsidence and salt-withdrawal. The course is organized for geologists and geophysicists with introductory knowledge of stratigraphy and sedimentation. The sequence of exercises will expose the participants to: (1) depositional systems, (2) facies analysis, (3) chronostratigraphic framework, (4) integration of multiple data sets, (5) comparison of local to global depositional patterns, and (6) application of the integrated approach to stratigraphic problems.

The tuition is \$185.00 for SEPM/PS members and \$200.00 for non-members, which includes all course materials. CEU credit of .7 will be awarded. Payment of tuition or authorization to invoice must be obtained when registering.

For more information or to enroll, please contact Susan Green, SEPM Society for Sedimentary Geology, Post Office Box 4756, Tulsa, Oklahoma 74159-0756 - (918) 743-9765.

#### WEST TEXAS GEOLOGICAL SOCIETY PUBLICATIONS

The following publications are now available from the West Texas Geological Society.

		Non-Member	<u>Member</u>
Field Trip G	uidebooks		
59-43-	Val Verde Basin Guidebook	8.00	6.00
74-63	Oiinaga - Chihuahua City - Los Mochis Train Trip. 1974	9.00	7.00
77-68	Geology of Sacramento Mountains. Otero County, New Mexico	13.00	10.00
80-73	Geology of Llano, Austin, Texas	23.00	20.00
81-74	Lower Cretaceous Stratigraphy and Structure. Northern Mexico	24.00	20.00
82-76	Delaware Basin Guidebook	24.00	20.00
83-77	Structure and Stratioraphy of the Val Verde Basin, Devils River Uplift, Texas	20.00	17.00
84-80	Geology and Petroleum Potential of Chihuahua. Mexico	20.00	18.00
85-81	Structure and Tectonics of Trans-Pecos. Texas	50.00	35.00
86-82	Geology of Rig Bend Park Area (Includes Ross Maxwell's Big Bend of the Rio Grande)		
00 02.	Two Volume Set	50.00	37.00
88-84:	Guadalupe Mountains Revisted	42.00	30.00
<u>Special Pub</u>	lications		
51-23:	Introduction to the Petroleum Geology of the Permian Basin of West Texas and		
	Southeastern New Mexico	7.00	5.00
53-29:	Stratigraphy of the Permian Basin of West Texas	7.00	5.00
58-42:	Lexicon, Pre-Penn, Stratigraphic Names	7.00	5.00
61-45:	Shallow Formation and Aquifers	7.00	5.00
62-45:	Supplement to Above, 1962	3.00	2.00
73-62:	History of WTGS, Charles D. Vertrees, Sr.	7.00	5.00
79-71:	Petroleum Geology of the Permian Basin	20.00	17.00
84-78:	Transaction Southwest Section, AAPG, 1984 Convention	12.00	10.00
89-85:	Search for the Subtle Trap: Hydrocarbon Exploration in Mature Basins	40.00	30.00
90-87:	Permian Basin Oil and Gas Fields: Innovative Ideas in Exploration and Development	40.00	35.00
<u>Oil and Gas</u>	Fields of West Texas		
82-75:	Selected Oil and Gas Fields of West Texas (Reprint of Volumes I, II and III with		
	Updated Production Data)	65.00	50.00
87-83:	Selected Oil and Gas Fields of West Texas, Volume IV	30.00	25.00
90-86:	Selected Oil and Gas Fields of West Texas, Volume V	60.00	50.00
Set:	82-75, 87-83 and 90-86	140.00	115.00
Cross Secti	ons		
62-47:	Southwest - Northeast Marathon Basin to Midland Basin, Colored	10.00	8.00
64-49:	Delaware Basin - Val Verde Basin, Colored	12.00	10.00
84-79:	Permian Basin East - West, Colored (1984)	28.00	20.00



#### **NEW PROPRIETARY STUDIES**

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#### Ordering Information

Send orders to the West Texas Geological Society, Inc., Post Office Box 1595, Midland, Texas 79702. Please include \$3.00 shipping and handling for orders under \$50.00 and \$5.00 for orders over \$50.00. In Texas, add 7.75% sales tax. To order by credit card, telephone (915) 683-1573. Please call or write for more information on ordering or to be placed on the mailing list for publications.

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#### **RECOMMENDED READING**

#### WASHINGTON DIVISION OF **GEOLOGY & EARTH RESOURCES**

Open File Report 91-2: Coal Maturation and the Natural Gas Potential of Western and Central Washington (26 pages), by T. J. Walsh and W. S. Lingley, Jr.

#### GEOBYTE

Vol. 5, No. 5, Oct./Nov., 1990

De-Xpert: An Expert System Approach to Identifying Depositional Systems, (Page 57), by G. S. Visher

Vol. 5, No. 5, Oct./Nov., 1990

Geobyte Index and Reference - 1985 through 1990, (Page 20), by F. J. Wagner

#### **GEOLOGICAL SOCIETY OF AMERICA**

Vol. 102, No. 9, September, 1990

Diamicton at Deadman Pass, California: A Residual Lag and Colluvial Deposits, Not a 3 Ma Glacial Till, (Page 1165), by R. A. Bailey, N. K. Huber and R. R. Curry

Vol. 102, No. 9, September, 1990

Molluscan Evidence for Early Middle Miocene Marine Glaciation in Southern Alaska, (Page 1591), by L. Marincovich, Jr.

#### BOOKS

Miocene and Oligocene Petroleum Reservoirs of the Santa Barbara-Ventura Basin, California, edited by M. A. Keller and M. K. McGowen, 1990. Core Workshop Notes #14, SEPM, \$38.00 for members and \$46.00 for non-members.

Drilling Through Time, by W. Rintoul, California Department of Conservation, Division of Oil and Gas, \$10.00

Review: This book is another of Mr. Rintoul's fine historical works dealing with oil, gas and geothermal exploration and production activities in California. It documents the 75 year history of the Division of Oil and Gas with his easy to read journalistic style, and includes abundant photographs.

#### NEWSLETTER Pacific Section A.A.P.G. Post Office Box 1072 Bakersfield, CA 93302

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#### GEOLOGY

Vol. 18, No. 9, September, 1990

Reworking of Cretaceous Dinosaurs into Paleocene Channel Deposits, Upper Hell Creek Formation, Montana, (Page 874), by C. L. Horton and A C Runkel

Sampling, Species Abundance and the Stratigraphic Signature of Mass Extinction: A Test Using Holocene Tidal Flat Molluscs, (Page 890), by K. H. Medahl

Comment and Reply on "Northeastern Basin Province Active Tectonics: An Alternative View, (Page 914), by M. H. Anders, J. W. Geissman and N. H. Sleep

#### Vol. 18, No. 10, October, 1990

Search for Periodicity in Global Events in the Geologic Record: Quo Vadimus, (Page 83), by A. Bakis

#### Vol. 18, No. 11, November, 1990

Intra-Arc Extension and Magmatic Evolution in Central Aleutian Arc, Alaska, (Page 1050), by B. S. Singer and J. D. Myers

Doomed Pioneers: Gravity-Flow Deposits and Bioturbation in Marine Oxygen-Deficient Environments, (Page 1069), by K. B. Follme and K. A. Grimm

Deep High-Amplitude Reflection from a Major Sheer Zone Above the Sebducting Juan de Fuca Plate, (Page 1091), by A. J. Calvert and R. M. Clowes

#### Vol. 18, No. 12, December, 1990

Ancient Subaerial Exposure and Fresh Water Leaching in Sandstone, (Page 1178), by D. Emery, K.J. Myers and R. Young

Eocene Deep-Sea Communities in Localized Limestone Formed by Subduction-Related Methane Seeps. South Western Washington, (Page 1182), by J. L. Goedert and R. L. Squires

Russ Robinson

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#### **DEADLINE FOR OCTOBER / NOVEMBER** ISSUE **OCTOBER 1, 1991**

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## PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

of the Pacific Section American Association of Petroleum Geologists

October / November 1991 No. 6

#### THE PRESIDENT'S COLUMN

The Pacific Section continues to take great pride in the Martin Van Couvering Fund, the Dibblee Map Foundation and the California Well Sample Repository. These entities further the goals and objectives of our science, profession and Section. Their continued success is dependent on donations and support from individuals and companies. With our declining membership. industry. and government "belt-tightening", it is critical that we establish a more generous level of giving. Membership gifts in 1991 total \$1,625. Please make your check payable to the Pacific Section AAPG, Post Office Box 1072, Bakersfield, California 93302.

The Martin Van Couvering Award is a student grant program that pays expenses during a convention or field trip. It is financed by the Pacific Sections of SEPM, SEG and AAPG.

The Dibblee Map Foundation was founded by friends of Tom who wanted to see his maps published. The U. S. Geological Survey and the California Division of Mines and Geology had no available funds. Initial funding was a grant of \$25,000 from the Section.

The Core Repository is a "work station" at the California State University in Bakersfield where working geologists from industry, government and academia can examine rock samples and related data sets.

We greatly appreciate **Carol Clayton** and **Joann Connard**, our new editors, and **Frank Cressy**, who are working to ensure a successful PPGN. Carol and Joann are "doing it" without Nancy Houghton, who was transferred. Frank, unable to secure a promised paper, had to originate this issue's field summary article. Please join our effort to improve content: articles dealing with new and developing technology, challenges facing our profession, academic trends that impact us, environmental issues, and basic local petroleum geology (like the field summaries).

The 1992 Pacific Section Meeting, "Creative Approaches to Environmentally Sound Exploration", is moving ahead smoothly. **Rich Boyd** and **Ben Cahill** report that a meeting was held with the Association of Engineering Geologists (AEG) - - "AEG is excited to be involved with AAPG".

## THE FUTURE PACIFIC SECTION: THE SAME NAME & GAME . . . WITH A NEW "UMBRELLA"?

"I would recommend that the name <u>Pacific Section AAPG</u> be retained and that a new group be formed called the Pacific Coast Association of Geological Societies (PCAGS), of which the Pacific Section AAPG would be a member. PCAGS would put on an annual convention and a newsletter in place of Pacific Section AAPG."

This suggestion was submitted by John Kilkenny during the recent poll regarding the possible restructuring of the Pacific Section AAPG (PS/AAPG). In that poll (please see the August/September Newsletter), four-fifths of those responding favored broadening and restructuring of the PS/AAPG. The PS/AAPG Executive Committee voted on September 12, 1991 to adopt the Kilkenny suggestion as its preferred alternative for restructuring. Many respondents expressed the hope that the identity of PS/AAPG, with its 67 years of history and tradition, would not be lost through merger into a larger regional association. Unlike the proposal outlined in the questionnaire, the present proposal essentially retains PS/AAPG in its present form, while providing the means to maintain the present strength of our conventions, publications and other activities.

Our interest in the local and regional aspects of Pacific Coast geology is a common bond that unites PS/AAPG members with other professionals who also apply geoscience to the needs of society. Petroleum geologists and geophysicists have significant data and insights to offer on subjects that range from contaminant hydrogeology to earthquake studies. We have sought to share this knowledge through the programs, field trips and publications of PS/AAPG and its affiliated local societies and through personal contacts fostered by these activities. As envisioned, the proposed PCAGS would broaden our outreach and ensure that PS/AAPG continues to play an important role in advancing the geologic knowledge of this region.

To stay viable, the Pacific Section and our affiliated local societies require two resources. The first is enough members to provide the "critical mass" needed to organize and attend meetings and to prepare and purchase publications. The second is active local societies that can host our annual conventions. Over the past 25 years we have evolved an informal rotation of convention sites that distributes this task among the local societies in California, brings this meeting to geologists throughout the State, and allows our members to see a wide variety of geology on convention-related field trips. Past and scheduled conventions have been held in Bakersfield (seven meetings), Sacramento (three meetings), Long Beach (three meetings), Anaheim (two meetings), San Diego (two meetings), Santa Barbara (two meetings), and one meeting each in San Francisco, Anchorage, Palm Springs, Los Angeles (Airport) and Newport

### THE PRESIDENT'S COLUMN

(continued from Page 1)

For the record, December 31, 1990 membership totals show PS/SEG at 250, PS/SEPM at 700, and PS/AAPG at 1,045. With confirmation by **Mr. Eliades** and **Mr. McClean**, the 1991 convention split will be based on those numbers. The AAPG membership in the Pacific Section geographic area totals over 3,100. **Bob Hindle** and **Betty Bean** are maximizing our effort to narrow the gap.

The status of the reorganization of the Pacific Section into a broader based geological society is reported in this issue by Tom Wright. What are we trying to accomplish? Will the "umbrella group" conflict with our traditional membership? How will our annual conventions, publications and newsletter change? Which local geological societies that are not now affiliated with National AAPG will we affiliate? For a view of these new directions, see Tom!

John W. Randall, President

## Northwest

For suggestions or questions, please contact Lanny Fisk at 503/382-0825, Barbara Portwood at 503/287-2762, or any other member of the NWPA Program Committee: Phil Brogan, Harry Jamison, Paul Dudley or Nancy Ketrenos.

#### SACRAMENTO PETROLEUM ASSOCIATION

Meetings are held at noon at Neptune's Table Restaurant, 5990 South Land Park Drive. For reservations please contact Rich Boyd at 916/929-4141.

Los Angeles

The meetings will be held alternate months at noon at UNOCAL Center, California Room, 1201 West Fifth Street, Los Angeles.

For reservations or information, call Randall Ferguson at 714/842-6331 or Ken March at 213/436-9211 - #357.

## San Joaquin

**November 12** - Dr. Robert Crewdson, Sierra Scientific, "Geothermal Potential of the Long Valley Caldera, Mono County, California".

December 10 - To be announced.

Suggestions for meeting speakers or topics should be addressed to Mike Lewis at 805/322-3992.

The meetings are held at the American Legion Hall at 2020 "H" Street in Bakersfield. Attitude adjustment starts at 6:00 p.m. and dinner is served at 7:00 p.m. For more information and reservations please contact Les Collins at 805/397-7472.

#### ANNUAL FALL BARBECUE & GOLF TOURNAMENT

On September 13, 1991, the California Oil Scouts and San Joaquin Geological Society held their 1991 Annual Fall Barbecue and Golf Tournament.

During the morning and afternoon, 77 golfers batted the ball around the links at the Kern River Golf Course. **Tony Morris** earned the overall high gross score. **Les Collins** gave Tony a real battle for this prize, but couldn't quite resist using his foot wedge to get out of several tight spots. **Bryan Joyce** earned the overall low gross score. **Mark Wilson** and **Tony Reid**, still recovering from their Mount Whitney climb, managed to shoot somewhere in the middle.

During the evening, 140 people attended the barbecue, which was held at Stramler Park this year. They enjoyed a delicious tri-tip meal cooked by the Oil Scouts. They listened to the quips and music of **Peter Wonderly**, and won many prizes, which included **Bill Rintoul's** new book, *Drilling Through Time*.

The Scouts and the SJGS thank Bryan Bell of Goode Core Analysis and Les Collins of Epoch Well Logging Service for coordinating these events. The Scouts and SJGS also want to thank the many companies and individuals who donated money and prizes to support these popular events.

#### **COMING EVENTS**

- November 10 to 14 Society of Exploration Geophysicists 61st Annual International Meeting, Houston.
- November 17 to 19 API Annual Meeting, Houston.
- February 18 to 20, 1992 The Eighth Annual U. S. Geological Survey "V. E. McKelvey Forum on Energy and Mineral Resources", Wyndham Greenspoint Hotel, Houston, Texas.
- April 29 to May 1, 1992 Pacific Section AAPG Convention, Sacramento, Rich Boyd, Chairman (Capitol Oil).

## Coast

November 19 - Dr. Helmut Eckert, Department of Chemistry, University of California, Santa Barbara, "The Glassy State - A Search for Order".

December 17 - Helmut Ehrenspeck, "A Geologists' View of San Miguel Island". This will be Spouse's Night.

January 21, 1992 - Jay Namson, "Structural Interpretation of the Western Transverse Ranges and Southern Coast Ranges".

February 18, 1992 - Luke Hall and LaVern Hoffman, "Seawater Intrusion and Groundwater Conditions, Southern Ventura County".

March 17, 1992 - Richard Squires, "Geology of the Bateque Formation of Baja California Sur and Biogeographic Implications".

April 21, 1992 - Robert Whitney, "The Structural Evolution of the Los Posas Anticline in Camarillo, California".

Meetings are held the third Tuesday of every month. Meeting time is at 6:00 p.m., dinner at 7:00 p.m. at the American Legion Hall in Ventura. The address is 83 South Palm Street. For reservations please contact Groundwater Technology's Receptionist at 805/664-9811 by 10:00 a.m. at least one day before the meeting. Reservations are required to guarantee dinner.

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#### MEMBERSHIP MAIL NOTICE

The following member's mail is being returned. Please contact Betty Bean, Post Office Box 1072, Bakersfield, California 93302, if you know their correct address.

Dennis A. Lynch, Atlas Wireline Robert Pinotti, Great Valley Production Edmujd Russell, Walnut Creek Matt W. Hutson, Bakersfield David Lawler, Bakersfield Hebert D. Duey, Houston Dawn Garcia, Long Beach Stephan Bork, Bakersfield

#### **RECENT MOVES**

- BRIAN E. SEALY has transferred to Dallas, Texas from Bakersfield with Mobil Oil.
- GUILLERMO HOUGHTON has transferred to Dallas, Texas from Bakersfield with Mobil Oil.
- NANCY HOUGHTON has moved to Dallas, Texas. She was formerly with Chevron U.S.A. Inc.
- JOANN CONNARD has moved from Denver, Colorado to Bakersfield as a consulting geologist.

#### **PPGN ANNOUNCEMENT**

Nancy Houghton has been transferred to Dallas and will no longer be able to serve as Co-Editor. She would like to thank everyone for the opportunity to work on the Newsletter and to serve the geological community. We will miss Nancy and want to thank her for her contribution to the Society.

In addition, the PPGN would like to welcome **Joann Connard** aboard as Newsletter Co-Editor. Joann, a consulting geologist, has moved to Bakersfield from Denver. She will be joining Carol Clayton, Co-Editor, and the rest of the PPGN Staff.

#### NEW MEMBERS

#### SOUTHERN CALIFORNIA

JOHN W. CAPPON Explorametrics, Inc., Santa Barbara MATTHEW DUKE UNOCAL Oil and Gas Company, Bakersfield MARK A. JONES Borton, Petrini & Conron, Bakersfield MICHAEL F. DOE UNOCAL Oil and Gas Company, Bakersfield **VERONICA TRIGG** MacPherson Oil Company, Bakersfield **DAVID A. GARDNER** Exxon USA. Thousand Oaks **MICHELLE ANN WEIS** UNOCAL Oil and Gas Company, Bakersfield LAURA ORNEALAS Chevron, Bakersfield **DAVID RIGHTMER** San Diego **GARY TAUTHUS** Telico, Ventura **DAVID STONE** Stone Exploration, Palo Alto JANICE DEPENDAHL SBCC, Santa Barbara **KEVIN SMITH** Bakersfield

#### **OTHER STATES**

CARL CANNIZZARO Amoco, New Orleans



## PACIFIC SECTION AAPG FIELD SUMMARIES

#### KING ISLAND GAS FIELD

by F. B. Cressy & J. M. Tasker

#### **STATISTICS**

**Discovery Well** 

Quintana "Moresco Unit A" No. 1 Section 28, T.3N., R.5E., M. D. B. & M. San Joaquin County, California T. D. - 6,500 feet

**Discovery Date** 

September, 1986

Initial Production

8,200 MCF/D

Productive Zone

Cretaceous Mokelumne River Formation

Trap

Capay shale drape over erosional Mokelumne River Formation "Island"

Average Pay Depth

4,700 feet

Total Productive Wells

Two (2)

Cumulative Production as of December 31, 1990

7,816,000 MCF

#### INTRODUCTION

The King Island Gas Field, located in the southern Sacramento Valley between the cities of Sacramento and Stockton, is a small but unique gas accumulation. The field is



a combination erosional and stratigraphic trap formed by deep erosion of the Upper Cretaceous Mokelumne River Formation by the Paleocene Meganos Channel and the subsequent drape over the erosional remnant by Eocene Capay Shale. King Island is unique in that it represents a completely emergent island within the Meganos submarine channel system. This island lies near the southern end of a erosional lona peninsula formed by two major tributaries of the Meganos channel which extend southerly from either side of the Thornton Gas Field. A major shift in the channel axis separated King Island from the rest of this peninsula and left this Mokelumne River "island" surrounded by deep channels with at least 1,000 feet of relief.

The discovery of King Island was a result of a detailed study of the eastern portion of the Meganos channel. This area differs from



the better known western channel in that instead of being entirely shale filled, the eastern channel is filled with a heterogeneous mix of siltstone, mudstone and sandstones. Recognition of the differences between channel sands and Mokelumne River sands was instrumental in the field's discovery. The presence of minor lithologies such as lignite and conglomerate, the recognition of Mokelumne River markers, the log character of thick sandstone beds, and the presence of thick mudstone and siltstone beds were all used to differentiate between the two formations. Meganos channel isopachs were then constructed and integrated into regional seismic control. Seismic definition of the channel was extremely difficult due to the lack of significant velocity contrasts between the two formations and the rather poor data quality in the area due to areas of shallow peat. In areas of good data quality, however, seismic data was able to identify compaction areas along the channel edges and over the Mokelumne River Formation remnant "islands". The King Island prospect was an area where a thin Meganos channel section was noted in the Osborne "Piacentine" No. 1, located in Section 33, T.3N., R.5E., M. D. B. & M., near the center of the eastern Meganos channel system. Additional seismic data acquired over this prospective area indicated a compaction

#### Page 5 1991 No. 6

feature associated with a significant amplitude anomaly at the top Mokelumne River Formation. Acreage was acquired over the prospect and in September of 1986 the Quintana "Moresco Unit A" No. 1 was drilled, resulting in the discovery of the two well, Island Gas Field. Kina Subsequent analysis of the seismic amplitude anomaly associated with the gas zone indicated increasing amplitude with increasing offset.

#### **STRUCTURE**

The structure of the Upper Cretaceous Starkey and Mokelumne River Formations is a southwestdipping homocline based on well control and dipmeter. The Cretaceous dip averages two degrees.

Up to 1,300 feet of the Mokelumne River Formation is eroded and filled with thick Meganos channel sands and shales. Differential compaction of the channel shales as compared to the Mokelumne River Formation along channel edges is responsible for the somewhat erratic nature of the structure of the overlying formations, especially that of the Eocene

Capay shale which directly overlies the Meganos. The regional Capay structure is also a southwest-dipping homocline with superimposed anticlinal noses paralleling both underlying channel edges and Mokelumne River "islands".

Capay shales drape over the erosional "island" at King Island because of compaction of the surrounding channel-edge shales around the more competent Cretaceous sediments. This situation created a low relief anticline at the base Capay horizon. Critical updip closure to the northeast is believed to be related to the Capay drape as the gas accumulation is coincident with the Capay spill point. Regional southwest homoclinal dip is present on the King Island feature where Capay shales overlie Mokelumne River sediments.

#### **STRATIGRAPHY**

The deepest well drilled in the vicinity of King Island is the Osborne "Piacentine" No. 1, which drilled to a total depth of 10,500 feet into Upper Cretaceous Winters shale. Equivalent basinal Winters sands are located west of the field area. Overlying the Winters shale are 1,650 feet of thick sandstones and shale of the shallow-water marine Starkey Formation.



Upper Cretaceous fluvial-deltaic sediments of the Mokelumne River Formation are the most important stratigraphic unit as they include the gas reservoir. A complete section of the Mokelumne River is present in the discovery well, the Quintana "Moresco Unit A" No. 1. The formation reaches a thickness of nearly 1,700 feet and is composed of interbedded sandstones and shales together with minor amounts of lignite. Correlative markers are present in the formation and help to differentiate it from thick incised Meganos channel sediments.

The Mokelumne River is unconformably overlain by the Paleocene Meganos Channel or where absent, by the Eocene Capay shale. Meganos channel sediments are not encountered in the two productive wells at King Island, however, three wells lying immediately off the edge of the field, the Great Basins "Rio Blanco" No. 1 (Section 27, T.3N., R.5E., M. D. B. & M.), the W. W. Holmes "Klein" No. 1 (Section 28, T.3N., R.5E., M. D. B. & M.), and the Osborne "Piacentine" No. 1 contain up to 450 feet of Meganos channel mudstones. Away from the erosional high at King Island, Meganos channel sediments reach nearly 1,300 feet in thickness and are composed of thick interbedded sandstones, mudstones and siltstones.

Eocene Capay shales unconformably overlie Mokelumne River sandstones or where present, Meganos channel sediments. The Capay is 90 to 100 feet thick at King Island and is slightly thicker where underlying channel shales have compacted. The unit is composed of thick gray-green silty mudstones and forms an excellent seal for underlying productive sands. Overlying the Capay are Eocene Domengine sands, Nortonville shales and Markley sands. These Eocene units are unconformably overlain by undifferentiated Mio-Pliocene non-marine sediments.

#### RESERVOIR

Gas production occurs in the top 120 feet of the Mokelumne River Formation in an erosional trap which appears filled to the basal Capay spill point. The drape of the Capay shale around the trap appears to be the critical factor controlling the accumulation. Initial production in the discovery well was 8,200 MCF/D on a 25/64" choke with a flowing tube pressure of 1635#. Average log porosity is 28.7%; water saturation (log) is 22 percent. The gas has a heating value of 915 BTU and is composed of 91.7 percent methane, 8.2 percent nitrogen, and 0.1 percent ethane. Maximum gas pay reaches 110 feet in the Quintana "Piacentine" No. 1. The field has produced 7.8 BCF of gas through December 31, 1990. The remaining recoverable reserves are estimated at 3.7 BCF. Reservoir pressure is maintained by an active water drive.

**F. B. Cressy** is a consulting geologist in Bakersfield, California and **J. M. Tasker** is a consulting geologist in Moraga, California.

#### THE FUTURE PACIFIC SECTION: THE SAME NAME & GAME . . . WITH A NEW "UMBRELLA"?

(continued from Page 1)

Beach. Conventions that are produced by volunteer effort usually earn substantial surpluses that have been used to underwrite publications, cross sections, the Dibblee maps, the Core Repository, and the Van Couvering Student Awards.

However, recent trends raise doubts as to whether the Pacific Section can long continue to rotate meeting sites around the State. The Los Angeles Basin Society (LABGS) has already declined below the numbers needed to host our meeting, and the same process threatens the Northern California and Coast societies. Over the last several years the membership of the PS/AAPG has had an annual decline of ten percent. Registration at our annual meetings, which hovered around 1,200 per meeting from 1982 to 1988, has declined to between only 725 and 734 at our last two conventions. An imminent decline in the number of petroleum-related papers and exhibitors seems not unlikely.

For our 1993 meeting in Long Beach, the non-affiliated South Coast Geological Society (SCGS) has agreed to act as co-host with the LABGS. Without wider participation of this sort, we can only foresee declining attendance at annual meetings that would nearly always be held in Bakersfield. The alternative initially proposed - - to convert PS/AAPG into PCAGS - - would have done away with AAPG's oldest regional section with its long traditions. Another alternative might be to rely on an active Pacific Section unit of AAPG's Division of Environmental Geosciences, being launched next year, to provide a professional home for the West's growing number of hydrogeologists, including many "retreaded" petroleum geologists. This will probably happen, but it won't answer our need for multiple local host societies. PCAGS is the best way to satisfy that need.

As a possible model for a PCAGS, we have looked at the structure of the Gulf Coast Association of Geological Societies (GCAGS). In the organization, each member society designates one representative on the Board of Directors. The Board elects the GCAGS Officers from the society that will host the next year's annual meeting, except for the Vice President, who succeeds as President and is elected from the following year's host society. The basic work of the GCAGS is done by its Annual Meeting, Publications, and Finance Committees. The table below summarizes the major differences between the envisioned future PS/AAPG and a PCAGS (structured similarly to GCAGS) to which PS/AAPG would belong.

	Future <u>PS/AAPG</u>	Proposed <u>PCAGS</u>
Individual Membership & Dues	Yes	No
Election of Officers by	Membership Ballot	Board
Primary Source of Funds	Dues	Convention Revenues
Number of Affiliated Societies	7 - 9	15 - 20
Affiliated with National AAPG	Yes	No

Through membership in PCAGS, local societies and regional professional societies (SEPM, SEG, SPWLA, and perhaps the AEG and AIPG) would participate on an equal-footing in shaping the annual meeting and in determining the use of its net revenues. PCAGS would promote economies and broader coverage in a joint newsletter and in publication sales. The creation of PCAGS would benefit PS/AAPG by maintaining the "critical mass" needed for viable conventions and publications, and by allowing continued rotation of convention sites. Freed from responsibility for the annual meeting, PS/AAPG could focus on petroleum-related publications, technical sessions, and legislative/regulatory issues. Local societies not affiliated with PS/AAPG would benefit from the opportunity to participate in major conventions and in an organized publications program.

The PS/AAPG Executive Committee has appointed a Constitution and By-laws Committee to determine what changes are needed to permit affiliation with a future PCAGS. Chaired by Bob Lindblom, the Committee includes Bob Countryman, Jack Cunningham, Paul Hacker, John Kilkenny, Sue Kiser, John Randall and Tom Wright. This Committee will also consider the broader aspects of restructuring. For the 1993 Long Beach Meeting, a prototype PCAGS structure might be created, to include the SCGS and perhaps the California AIPG and the southern California chapter of the AEG. Also expected to participate would be the Pacific Sections of SEPM and SEG, SPWLA and LABGS. Farther down the road, key issues to be resolved will include the sharing of convention revenue, assurance that PS/AAPG retains the ability to publish petroleum-related books, and the timing of the PCAGS

takeover of the newsletter and publications.

Our member's comments have greatly influenced the direction that PS/AAPG's restructuring plans are taking. We hope that you'll keep them coming, in writing or in person, to Section Officers or to members of the Constitution and By-laws Committee.

> Tom Wright, Chairman Planning & Organization Committee



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#### **RECOMMENDED READING**

#### **AAPG BULLETIN**

Vol. 75, No. 4, April, 1991

with Modeling Oil Generation Time-Temperature Index Graphs Based on the Arrhenius Equation, (Page 795), by J. M. Hunt, M. D. Lewan and R. J. Hennet

Vol. 75, No. 5, May, 1991

Facies Analysis of the Monterey Formation in the Northern Santa Barbara Channel, (Page 894), by J. S. Hornafius

Vol. 75, No. 8, August, 1991

Fracture Density in the Subsurface: Techniques with Application to Point Arguello Oil Field, (Page 1,300), by W. Narr

Thin-Skinned Tectonics in the Upper Ojai Valley and Sulfur Mountain Area, Ventura Basin, California, (Page 1,353), by B. J. Huftile

#### GEOBYTE

Vol. 6, No. 1, February/March, 1991

Stanford Rock **Physics** Database. (Page 20), by R. Nolen-Hoeksen and C. Hart

Vol. 6, No. 4, August/September, 1991

Petrophysical Software Directory for 1991, (Page 20).

#### GEOLOGY

Vol. 19, No. 5, May, 1991

EDGE Deep Seismic Reflection Transect of the Eastern Aleutian Arc-Trench Lavered Lower Crust Reveals Underplating and Continental Growth, (Page 420), by J. C. Moore, J. Diebold, M. A. Fisher, J. Sample, T. Brocher, M. Tawani, J. Ewing, R. VonHuene, C. Rowe, C. Stevens and D. Sawyer

#### NEWSLETTER Pacific Section A.A.P.G. Post Office Box 1072 Bakersfield, CA 93302

Seismic Evidence of Evaporite Diapirs in the Chukchi Sea, Alaska, (Page 477), by D. K. Thurston and R. T. Lothamer

Vol. 19, No. 9, September, 1991

Evidence for Latest Pleistocene Holocene Movement on the Santa Cruz Island Fault, California, (Page 909), by N. Pinter and C. Sorlien

#### **GEOLOGICAL SOCIETY OF AMERICA BULLETIN**

Vol. 103, No. 1, January, 1991

**High-Resolution** Strontium-Isotope Stratigraphy and Biostratigraphy of the Miocene Monterey Formation, Central California, (Page 112), by D. J. DePaolo and K. L. Finger

Vol. 103, No. 2, February, 1991

Subaerial to Submarine Transitions in Early Miocene Pyroclastic Flow Deposits. Southern San Joaquin Basin, California, (Page 221) by R. B. Cole and P. G. DeCelles

Vol. 103, No. 5, May, 1991

Porosity Reduction and Burial History of Siliceous Rocks from the Monterey and Sisquoc Formations, Point Pedernales Area. California, (Page 625), by J. S. Compton

#### GEOTIMES

Vol. 36, No. 1, January, 1991

Tomorrow's Geoscientists: Recruiting and Keeping Them, (Page 12), by M. Suiter

Vol. 36, No. 1, February, 1991

Economic Geology - Energy Resources. (Page 14), by A. A. Meyerhoff, J. C. Cobb, C. F. Eble, A. M. Skov and M. J. Reed

Russ Robinson / Pat Bell

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#### **DEADLINE FOR DECEMBER / JANUARY** ISSUE **DECEMBER 1, 1991**

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## PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

of the Pacific Section American Association of Petroleum Geologists

December 1991 & January 1992 No. 1

#### THE PRESIDENT'S COLUMN

I hope you had a safe and happy holiday. The road ahead, 1992 and on to the 21st century, is filled with opportunities. A Golden Age of capitalism is dawning worldwide. What a great time to be alive!

Last year the membership was open to examining the challenges, possibilities and questions that face our Section. Thanks to the membership's strong support for broadening the technical scope of this Section, we now have a clearer sense and vision of the road ahead. **Bob Lindblom**, General Chairman of the Constitution Committee, will report at the January Executive Meeting on the status of the proposed Pacific Coast Association of Geological Societies (PCAGS). Plans are underway to develop a proposal that will receive the required two-thirds majority vote of the membership.

I also look forward to attending the Annual AAPG Day in Tulsa this January. Two important issues scheduled for discussion are: (1) Recommendations on the 21st Century Committee Report and, (2) Suggestions about what AAPG might do to assist unemployed and underemployed members. I intend to share with you what this Section's commitment might be regarding these important concerns. Obviously, AAPG will summarize the results of the laudable undertakings in the *Explorer*.

#### ANNUAL CONVENTION

Rich Boyd, General Chairman, reminds us that: The Pacific Sections of AAPG, SEPM, SEG and EMD will hold the 67th Annual Convention at the Hyatt Regency Hotel in Sacramento, California, from April 27 through May 2, 1992. This year, for the first time, the Association of Engineering Geologists (AEG) will participate in the Convention. Over 1,000 geologists, geophysicists, petrophysicists, environmental geologists and engineers, students and other earth science professionals are expected to attend. A full week of events is planned, including the technical program, field trips, continuing education seminars, exhibits and social events. Please contact Rich Boyd, Capitol Oil Corporation, at 916/929-4141 for more information. For us all who want to add creative value, keep up with technology and elevate our morale - let's go to the Convention!

## PACIFIC SECTION AAPG: PAST, PRESENT, . . . FUTURE?

Once upon a time (the 1920's) there was an oil boom in California that shook the price of oil worldwide. Most of the major oil companies and dozens of smaller ones had offices in Los Angeles. AAPG's first regional section, the Pacific Section, was formed there in 1924 to serve as the local center of professional activity. Through depression, war and two post-war decades, that center was predominant. From the war years until 1965, Los Angeles geologists hosted the Pacific Section's Annual Meeting, in addition to National Meetings in 1937, 1947, 1952 and 1958.

In San Francisco and Bakersfield, AAPG members met as informal groups from the late 1920's onward and National Meetings were held in San Francisco in 1928 and 1962. But local societies in these cities and in Santa Barbara/Ventura and the Pacific Northwest did not formally affiliate with the National AAPG until 1955. Pacific Section AAPG continued to serve as the "local society" for Los Angeles geologists until 1967, when the formation of the Los Angeles Basin Geological Society (LABGS) finally saw that area on the same footing as other local societies. By that time, Bakersfield members had proclaimed their equality, hosting the Annual Meeting in 1965 and again in 1968 and 1972.

Local AAPG activities in the Los Angeles area were impacted first by urban sprawl. By the mid 1960's, company offices were spread from West Los Angeles to La Habra and meetings were inconvenient for almost everyone. In the early 1970's, exploration bans in Alaska and offshore prompted the first wave of corporate exodus to Texas, Colorado and San Francisco. Successive waves during the past decade have seriously weakened our affiliated societies in the Los Angeles and San Francisco areas.

Membership in the LABGS has declined from 350 to 250 since 1988 and will suffer a further drop as UNOCAL International moves to Houston over the next few months. The Northern California Geological Society (NCGS) has dropped from 140 members to 100 since 1987. During that same period, the Coast Geological Society (CGS) has stayed level at about 200 members, as has the Sacramento Petroleum Association (SPA) at about 60 members. The San Joaquin Geological Society (SJGS) bottomed out in 1987 at 300 members, before the influx of UNOCAL and Chevron personnel raised it to 370 members. From 1987 to 1990, the total Pacific Section AAPG membership fell from 1,300 to 1,050, but has stayed level this past year. These trends have led Pacific Section's Officers to ask:

"Can the Section continue to fulfill its role in geological activities on the West Coast?"

#### THE PRESIDENT'S COLUMN

(continued from Page 1)

Regarding this issue's field summary on Denverton Creek, it should be noted that Chevron's interest in the field is being offered for sale. **Frank Cressy**, who has been doing a great job of gathering field summaries, has recently run out of inventory. In today's customer-supplier focus, maybe we can utilize the Pacific Section Geologist Newsletter (PPGN) as a market place. For those of you who have properties to sell or want to contribute a geologic article, please contact Frank at 805/323-6828.

Please join me and **Paul Hacker**, President-Elect, in making 1992 a successful, fun-filled and exciting year.

John W. Randall, President

Northwest

For suggestions or questions, please contact Lanny Fisk at 503/382-0825, Barbara Portwood at 503/287-2762, or any other member of the NWPA Program Committee: Phil Brogan, Harry Jamison, Paul Dudley or Nancy Ketrenos.

#### SACRAMENTO PETROLEUM ASSOCIATION

Meetings are held at noon at Neptune's Table Restaurant, 5990 South Land Park Drive. For reservations please contact Rich Boyd at 916/929-4141.

## San Joaquín

January 14 - Steve Kovacevich, Santa Fe Energy Resources, Inc., "Steam Flood Pilot for the Spellacy Sand of the Midway-Sunset Field."

June 9 - "Applications of Horizontal Drilling Techniques in California", Bakersfield. Please see Page 3 for more details.

Suggestions for meeting speakers or topics should be addressed to Mike Lewis at 805/322-3992.

The meetings are held at the American Legion Hall at 2020 "H" Street in Bakersfield. Attitude adjustment starts at 6:00 p.m. and dinner is served at 7:00 p.m. For more information and reservations please contact Les Collins at 805/397-7472.

Los Angeles

The meetings will be held alternate months at noon at UNOCAL Center, California Room, 1201 West Fifth Street, Los Angeles.

For reservations or information, call Randall Ferguson at 714/842-6331 or Ken March at 213/436-9211 - #357.

#### **RECENT MOVES**

The California Division of Mines and Geology, Bay Area Regional Office, has moved from Pleasant Hill to San Francisco.

Their new address is 1145 Market Street, Third Floor, San Francisco, California 94103. The new telephone number is 415/557-1500.

They are now open for publication sales and information. The library is also now in operation.



#### **COMING EVENTS**

February 18 to 20 - The Eighth Annual U. S. Geological Survey "V. E. McKelvey Forum on Energy and Mineral Resources", Wyndham Greenspoint Hotel, Houston, Texas.

April 29 to May 1 - Pacific Section AAPG Convention, Sacramento, Rich Boyd, Chairman (Capitol Oil).

May 12 to 14 - U. S. Department of the Interior, Minerals Management Service, Pacific Outer Continental Shelf, Information Transfer Meeting. Please see Page 3 for more information.

June 9 - Applications of Horizontal Drilling Techniques in California, Bakersfield, California. Please see Page 3 for more information.

## Coast

January 21 - Dr. Richard Squires, California State University, Northridge, "Biogeographic Implications of the Batique Formation, Baja California Sur, Mexico".

**February 18** - Luke Hall and LaVern Hoffman, "Seawater Intrusion and Groundwater Conditions, Southern Ventura County".

March 17 - Richard Squires, "Geology of the Bateque Formation of Baja California Sur and Biogeographic Implications".

**April 21** - Robert Whitney, "The Structural Evolution of the Los Posas Anticline in Camarillo, California".

Meetings are held the third Tuesday of every month. Meeting time is at 6:00 p.m., dinner at 7:00 p.m. at the American Legion Hall in Ventura. The address is 83 South Palm Street. For reservations please contact Groundwater Technology's Receptionist at 805/664-9811 by 10:00 a.m. at least one day before the meeting. Reservations are required to guarantee dinner.

#### BUREAU OF LAND MANAGEMENT TO OFFER OIL LEASES

Bidding on potential oil development sites in the southern San Joaquin Valley is scheduled to take place in 1992 when two lease sales are offered by the U. S. Department of the Interior's Bureau of Land Management. Fifty-two parcels are scheduled to be offered for bid during sales set for June 5 and September 3, 1992 at the Federal Building in Sacramento.

Environmental review of public land to be offered for lease is now going on. The majority of the fifty-two parcels are located within Kern County in the Midway-Sunset, Maricopa, Chico-Martinez and Los Hills areas. Six parcels are in Kings County in the South Kettleman Dome/Devils Den area, and one parcel is in the Earlimart area in Tulare County.

An Environmental Assessment is being prepared that will assess the impacts of oil exploration, and spell out any special conditions for leasing. Among other things, an inventory of plants or wildlife officially listed as threatened or endangered will determine what conditions will be imposed.

Anyone interested in making a comment on the environmental review process, or obtaining more information on the parcels to be offered for lease, should contact Del Fortner or Ed Lynch at the BLM's Bakersfield District Office (805/861-4191). The address is 800 Truxtun Avenue, Room 300, Bakersfield, California 93301.

#### MINERALS MANAGEMENT SERVICE INFORMATION TRANSFER MEETING

The U. S. Department of the Interior, Minerals Management Service, Pacific Outer Continental Shelf Region will hold an Information Transfer Meeting on May 12 and 14, 1992, in Ventura, California.

This year's theme is "Our Changing Coastal Waters: Research on the

*Effects of Man and Nature".* The Information Transfer Meeting will include presentations from the scientific community, as well as a number of agencies, academia and other groups.

The Information Transfer Meeting will be held at the Doubletree Hotel, 2055 East Harbor Boulevard, Ventura, California 93001. A more detailed announcement, including a preliminary agenda and hotel information will be mailed at a later date to those who request it.

To request more information, please contact either Kathy Mitchell of MBC Applied Environmental Sciences at 714/648-1601 or Mary Elaine Dunaway of the Minerals Management Service at 805/389-7848.

#### APPLICATIONS OF HORIZONTAL DRILLING TECHNIQUES IN CALIFORNIA

The **San Joaquin Geological Society** is organizing this seminar to take place on Tuesday, June 9, 1992 in Bakersfield, California.

Speakers will be drawn from most companies doing this type of drilling in California. Likely participants, at this time, include Bechtel Petroleum, ARCO Oil and Gas, UNOCAL, Shell Western E & P Inc., Texaco, CUSA, Berry Petroleum, Eastman-Christensen, Teleco and Schlumberger.

Project locations include Elk Hills, Midway-Sunset, Yowlumne, Kern River, Jacalitos, Coalinga, Lost Hills, Dos Cuadras and Point Pedernales.

We have requested that speakers cover all aspects of planning, drilling and completion of each project, since these projects are very much dependent on good communication and planning by the various disciplines involved. For this reason, anyone involved in a horizontal well project should benefit from attending this seminar.

This technology may be the answer to many of the problems in the California oil patch: drilling offshore fields from fewer platforms or from onshore; developing pools that were uneconomic with vertical wells; realizing the economic benefit of reaching more areas of mature fields for primary depletion and steamflood/waterflood projects. Many aspects of this technology are still unfolding and being tested. This seminar provides a forum to exchange information and come away with a better understanding of what horizontal drilling is accomplishing in California.

For additional information about the seminar, please contact Larry Knauer at 805/763-6280.



## PACIFIC SECTION AAPG FIELD SUMMARIES

#### DENVERTON CREEK GAS FIELD

by R. G. Lindblom & J. B. Jacobson

#### INTRODUCTION

The Denverton Creek Gas field is located in Solano County, California, 40 miles northeast of San Francisco on the west side of the Sacramento Valley (Figure 1). The field was discovered in 1966 by the Mobil Oil Corporation "Trojan Powder#1" well, located in Section 33, T.5N., R.1E., M.D.B. & M., from a sand of Paleocene age within the Martinez Channel. During 1967 and 1968, new pool discoveries were made in other Paleocene sands. Commercial gas deliveries began in March of 1967, and the field was abandoned in 1973 with a cumulative production of 712 million cubic feet of gas from three wells. Production was re-established at Denverton Creek by the McCulloch Oil Corporation in 1977. Chevron USA, in joint ventures with Cities Service (OXY USA Inc.) and Channel Exploration, developed three new pool discoveries. The field, as of January 1, 1991, has a cumulative gas production of 23.8 billion cubic feet with 33 productive wells. Currently, the field produces 1.4 million cubic feet per day from 9 wells.

Gas entrapment in the Denverton Creek field is caused by a number of anomalies, including sand pinch-out, faulting and truncations by unconformities and the Martinez Channel. Although these types of entrapping mechanisms are found in other fields in the Sacramento Valley, the Denverton Creek field is unique in that all are present in one producing area.

The field is a broad, easterly dipping structural nose, located adjacent and west of the axis of the main valley syncline. The syncline separates two contrasting structural styles as shown on the structure map contoured on top of the Eocene Domengine sand (Figure 1). To the west is the moderate to steeply dipping Coast Range compressional style. To the east the style is

related to a more rigid Sierran basement, resulting in a gently westerly dipping homocline cut by northwest - southeast normal faults.

The Mobil "Trojan Powder #1" discovery well was drilled to a total depth 11,209 of feet and bottomed in the upper Cretaceous Winters formation. The well was completed for a 1.3 million cubic feet gas rate from 9,893 to 9,921 feet. The interval was reported to be sand in the upper а Cretaceous Peterson formation, however, studies of subsequent well data revealed that the sand is within the Martinez Channel. During the next two years, new pool discoveries located one mile south of the "Trojan well were Powder #1" made by Occidental Petroleum and Mobil Oil from the Paleocene Martinez and Anderson/ Wagenet sands. This drilling with completion in different sands than found in the discovery well was an early indication of the field's complex geology related to gas entrapment.

In the mid 1970's, increasing demand for hydrocarbons and a related





increase in gas purchase prices by the Pacific Gas and Electric Company resulted in a very significant increase in exploration and field development throughout the Sacramento Valley. One area that Chevron recognized as having potential was between the Rio Vista and Kirby Hill fields. This was based on a better understanding of the structure and stratigraphy in the area as a result of on-going regional geologic studies. New 2,400 percent vibroseis data was acquired to provide the definition needed to exploit these ideas. With the new data, Chevron identified the channels, unconformities, structural dip and faulting predicted in the area. There was uncertainty, however, as to what high amplitude events may represent gas. Chevron acquired over 3,300 acres in the Denverton Creek area. Other operators were also active in the area, including McCulloch Oil and Gas, Channel Exploration and Occidental Petroleum. This competitive land picture and complicated trap geometry resulted in several joint drilling ventures.

#### **GEOLOGY**

The electric log type section (Figure 2) of the field shows seven producing zones. They are the Anderson, Martinez, McCormick, Bunker, H & T. Peterson and the Martinez Channel, which range from Paleocene to upper Cretaceous in geologic age. Gas production was discovered from the Anderson sands in the Mobil "Lambie #1" in 1967. After rejuvenation of the field in 1977, new development of gas in the Anderson sands, located north of the Mobil discovery, was made by McCulloch Oil and Channel Exploration. Gas entrapment is caused by bowing and updip closure adjacent to an anomalous north-south trending normal fault upthrown to the east. Other normal fault trends mapped in the field are commonly upthrown to the west. The Martinez sands were completed in the Occidental- Mobil-Signal #1 well in December of 1968 at a rate of 4.1 million cubic feet per day. The sands range in thickness up to 15 feet and have an erratic occurrence within the interbedded shale and siltstone Martinez interval. In the area where found productive, the sands pinch-out to the northwest on the south flank of the Denverton Creek structure.

The structure map (Figure 3) contoured on the "H" electric log marker near the top of the upper Cretaceous shows the entrapment of gas accumulations by truncation, pinch-out and faulting. The "H" marker is truncated by the Martinez Channel in a general northeast-southwest trend across the northern part of the structure.

The Bunker sands of Paleocene geologic age are trapped by interformational truncation with lateral fault closure. These are the most prolific reservoirs in the field and have contributed over 75 percent of the field's cumulative production. The field has two principal areas of Bunker sand production. The Westerly Pool was discovered in October of 1977 by McCulloch Oil in "Lambie #1-4", which was originally completed in the shallower Anderson sands, and later recompleted in the Bunker sand.

The easterly accumulation of Bunker gas was discovered by Chevron in the "Emigh #7" in October of 1984. The final location of the well was the result of a detailed seismic and geologic review to the east of the original field area. The "Emigh #7" was drilled to 11,100 feet and

completed for a gas rate of 3 million cubic feet per day, with a net pay thickness of 90 feet in the Bunker sand. The entrapment is similar to the westerly pool. The structure section (Figure 4) shows gas entrapment is caused primarily by updip truncation of the sand by the unconformity at the base of the McCormick formation. The McCormick sands overlying the productive Bunker sand are generally tight and provide a caprock. However, small amounts of gas have been recovered from the sands.

Chevron USA, in joint venture with OXY USA Inc., drilled "Emigh #1" in 1982 to 12,540 feet to evaluate the deep upper Cretaceous Peterson and Winters sands, but they were found non-productive. The well was completed, however, for a new pool discovery in thin sands within the H & T interval near the top of the upper Cretaceous section with entrapment caused by pinch-out of the sands on the south flank of the Denverton Creek structure.

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drilled USA Chevron "Emigh #3" to 10,307 feet to evaluate the Peterson sand updip from previously drilled wells. The well encountered 35 feet of gas sand and was completed as a new pool discovery in January of 1984 for a gas rate of 3 million cubic feet per day. The structure section (Figure 4) shows the "Emigh #3" updip entrapment caused by erosion of the sand by the Martinez Channel. The arcuate pattern of this erosional feature and normal faulting also influence closure. The discovery well is the only completion in the pool and produced 1.6 billion cubic feet of gas.

**R. G. Lindblom** retired from Chevron USA, Western Region Exploration Department, in 1990. He is currently a Petroleum Consultant in Menlo Park, California, and a Consulting Professor in the School of Earth Sciences, Stanford University.

J. B. Jacobson retired from Chevron USA, Western Region Exploration Department, in 1988 and enjoys the great golf courses of the United States and Europe when he is not at his home in Lafayette, California.





### PACIFIC SECTION AAPG: PAST, PRESENT, . . . FUTURE?

#### (continued from Page 1)

That special role is the dissemination of information on local and regional aspects of applied geology relating to sedimentary rocks, and fostering communication between geologists involved in that work. This role is accomplished through our Annual Conventions, publications and Newsletter. We must have active local societies to host our conventions and an active membership to produce and purchase our publications.

The chart below summarizes convention data from 1976 to 1996. We have evolved an informal rotation of convention sites (including National Meetings) that distributes this task among the local societies in California and allows our members to see a wide variety of geology on convention-related field trips. Geologists who "drop in" for a local convention are more likely to stay on as active members. Among the local societies affiliated with the Pacific Section and National AAPG, only San Joaquin seems certain to maintain the strength needed to host our Annual Meeting.

V		Registration
<b>year</b> s	Locations	500 1000 1500
<b>19</b> 76	San Francisco	S
1977	Bakersfield	Memb S
<b>19</b> 78	Sacramento	(M) ers
<b>19</b> 79	Anaheim	缀 // S
<b>19</b> 80	Bakersfield	M
<b>19</b> 81	San Francisco	Joint With National
1982	Anaheim	M
<b>1983</b>	Sacramento	M
1984	San Diego	No Data
1985	Anchorage	No Data
1986	Bakersfield	M
1987	Los Angeles	Joint With National
1988	Santa Barbara	M B S ?
1989	Palm Springs	M
1990	San Francisco	Joint With National
1991	Bakersfield	M
1992	Sacramento	
1993	Long Beach	
1994	Santa Barbara	
1995	San Francisco	
1996	San Diego	Joint With National
<b>-</b>		
		Non - Members 📶 Student
		Exhibitors , etc. S Spouse

Pacific Section Conventions

Location & Registration

For the 1993 Pacific Section Convention in Long Beach, the non-affiliated South Coast Geological Society (SCGS) has agreed to co-host with the LABGS. This may well be the pattern of the future. Other non-affiliated geological societies in San Diego, Sacramento and the Bay area might well co-host future conventions in those locations. That is why the current Pacific Section AAPG leadership has envisioned the creation of a Pacific Coast Association of Geological Societies (PCAGS), to provide a formal structure for cooperative efforts of this nature.

PCAGS is intended to reach out to those geologists who are interested in local and applied aspects of Pacific Coast geology, but have no ties to the petroleum industry or AAPG. Several responses to our recent membership questionnaire suggest that the petroleum industry was still the largest employer of geologists on the West Coast, and that any effort to outreach to other geologists was not necessary. A comparison of recent membership data for the AAPG and

some other major professional societies in the earth sciences, for the states of California, Oregon, Washington and Alaska, which are included in the Pacific Section.

The data suggests that, although we should redouble our efforts to enroll those AAPG members who do not now belong to the Pacific Section, that there is a large population of geologists who do not belong to AAPG, yet might become active in PCAGS through their local societies.

As explained in the October/November 1991 Newsletter, within the proposed PCAGS the Pacific Section AAPG would retain its present form and its existing relationship with National AAPG. The structure suggested by John Kilkenny would provide for the transfer of some of the Pacific Section's major functions, such as:

- Sponsoring the Annual Convention,
- Publication Sales, and
- the Newsletter (perhaps),

to PCAGS as this become appropriate. Bob Lindblom's Constitution and By-laws Committee is drafting the amendments necessary to accommodate a possible future affiliation with a PCAGS and will present them to our membership within a few months. Throughout this process, your questions and comments will help to keep us on the right track.

> Tom Wright, Chairman Planning & Organization Committee

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#### RECOMMENDED READING

#### AAPG BULLETIN

Vol. 75, No. 9, September, 1991

Carbon Dioxide Injection and Resultant Alteration of the Weber Sandstone, Rangely Field, Colorado, (Page 1489), by K. A. Bowker and P. J. Shuler

Vol. 75, No. 10, October, 1991

Petrography and Reservoir Physics I: Objective Classification of Reservoir Porosity, (Page 1547), by R. Ehrlich, S. Crabtree, K. Horkowitz and J. Horkowitz

Petrography and Reservoir Physics II: Relating Thin Section to Capillary Pressure, the Association Between Pore Type and Throat Size, (Page 1563), by C. McCreesh, R. Ehrlich and S. Crabtree

Petrography and Reservoir Physics III: Physical Models for Permeability and Formation Factors, (Page 1579), by R. Ehrlich, E. Edwards, D. Brumfield, L. Yuan and S. Crabtree

#### GEOBYTE

Vol. 6, No. 2, April/May, 1991

Programming in PROLOG for Paleontologic, Stratigraphic and Paleoenvironmental Applications, (Page 31), by W. R. Reidel and L. E. Tway

Vol. 6, No. 3, June/July, 1991

Electromagnetic Propagation Log Interpretation on the Computer, (Page 33), by A. May

Vol. 6, No. 5, October/November, 1991

Determination of ARCHIE Parameters M and N Using Least Squares Summation and Dialectic Water Saturations in the Pascal Computer Program MN, (Page 24), by G. Asquith and S. Saha

NEWSLETTER Pacific Section A.A.P.G. Post Office Box 1072 Bakersfield, CA 93302

#### GEOLOGY

Vol. 19, No. 1, January, 1991

Antler Orogeny: A Mediterranean-Type Orogeny, (Page 66), by B. C. Burchfield and L. H. Royden

#### Vol. 19, No. 5, May, 1991

Hiatus Distribution and Mass Extinction at the Cretaceous Tertiary Boundary, (Page 497), by N. MacCleod and G. Miller

Vol. 19, No. 10, October, 1991

Neogene Rotations and Quasi Continuous Deformation of the Pacifc Northwest Continental Margin, (Page 961), by P. England and R. Wells

#### Vol. 19, No. 11, November, 1991

Current Sierra Nevada-North America Motion from Very Long Baseline Interferometry: Implications for the Kinematics of the Western United States, (Page 1085), by D. Argus and R. Gordon

Role of Crustal Thickening and Extensional Collapse in the Tectonic Evolution of the Sevier-Laramide Orogeny, Western United States, (Page 1104), by R. Livaccari

#### GEOLOGICAL SOCIETY OF AMERICA BULLETIN

Vol. 103, No. 11, November, 1991

The Uplift of the Sierra Nevada and Implications for Late Cenezoic Epriogeny in the Western Cordilleria, (Page 1395), by J. Unruh

#### GEOTIMES

Vol. 36, No. 1, January, 1991

Geoscience Careers - The Diversity is Unparalleled, (Page 15), by N. Clandy

Russ Robinson / Pat Bell

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