PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

of the Pacific Section
American Association of Petroleum Geologists

JANUARY 1982

ACCESS TO FED LANDS: THE KEY TO NEW SUPPLIES OF DOMESTIC CRUDE OIL AND NATURAL GAS

(Reprinted from American Petroleum Institute)

America is rich in energy resouce potential. By conservative estimates, the United States has more crude oil and natural gas liquids still in the ground than have been produced to date; far more natural gas than we have consumed; and enough recoverable coal reserves to last 300 years at today's production rate. In addition, there is enough uranium concentrate here to sustain the nuclear industry well into the 21st century.

And these vast energy resources represent only conventional sources of energy. We have, in addition, as much as 600 billion barrels of commercially recoverable shale oil; many billion barrels more of oil in U.S. tar sand depostits; and renewable energy sources, such as solar and geothermal energy and biomass (essentially waste and vegetable matter), which can ultimately contribute significantly to our energy supplies as the technology becomes competitive.

Why, then, do we continue to waver between momentary surplus and temporary shortage—and slide from time to time into serious energy crises? The simple answer is that we, as a nation, have too often chosen not to produce or use the energy resources we have.

To a large extent, the problem has been a lack of consistent and balanced federal energy policies, including policies relating to access and to use of federal lands. In recent years, especially, federal land use policies, administrative actions delaying the leasing of federal lands and non-land use laws affecting access to federal lands have severely limited oil and gas exploration and production activities. One result has been our nation's heavy dependence on foreign oil supplies.

To place the federal access and use problem into perspective, consider this: The United States government owns some 738 million acres of onshore land in this nation. That's more than one-third of the entire land mass of this country. The federal government also retains control over the subsurface mineral right to another 64 million acres. Offshore, the federal government owns 528 million acres of submerged lands on the Outer Continental Shelf (OCS)—the area seaward of state ownership to the 200 meter water depth.

Together, these onshore and offshore federal lands are thought to hold more than one-half of the remaining energy supplies of the United States. Yet, at present, less than 15 percent of federal onshore public and acquired lands are under leases for oil and gas exploration and production. Offshore, less than 2 percent of the federal OCS is leased to such activities.

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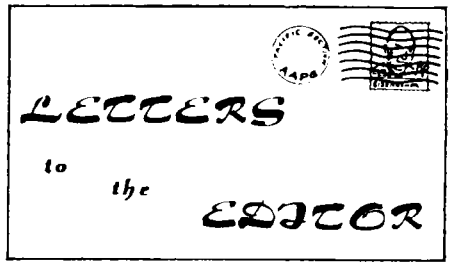

McCLOSKEY SAYS FED WON'T INTRUDE IN OFFSHORE DRILLING CONTROVERSY

Rep. Paul McCloskey, Jr., (R-CA), of the House Merchant Marine and Fisheries Committee, told the Western Oil & Gas Association's annual membership meeting that the Administration has chosen not to intrude into the fight between the Federal Government and California over control of offshore drilling between 3 and 200 miles.

McCloskey said his committee had before it a few weeks ago a bill which would have re-established federal control of the decisions on oil drilling between 3 and 200 miles. He told the WOGA annual meeting luncheon:

"The Administration, in the face of an adverse vote in our committee, withdrew that proposal, but has had the option since to introduce a new proposal that might serve as a compromise and a basis for ultimately deciding who is to make the decisions on offshore drilling between 3 and 200

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OILFIELD IN MONTEREY FM SYMPOSIUM PLANNED

Plans are underway for a symposium, tentatively entitled *Oil Fields in the Monterey Formation,* to be presented at the spring 1983 meeting of the Pacific Sections AAPG-SEPM. This would not duplicate the subject matter of the June, 1981 SEPM symposium on the Monterey but would directly address hydrocarbon occurrences in the Monterey—including types of reservoirs and traps, geophysical detection, stratigraphic relations in specific oil fields, maturation of organic matter, migration, etc. Both fractured reservoirs within the Monterey and sandstone reservoirs closely associated with the Monterey would be covered. Papers decribing individual oil fields are encouraged. If enough manuscripts can be produced, a symposium volume would also be prepared.

In order for this symposium to be successful, technical contribution from industry is *essential!* We urge you to consider presenting a talk and/or preparing a manuscript on those oil fields or research topics which you have worked on—and to inform other geologists and geophysicists who might wish to make a presentation.

If you are interested in contributing and wish to receive subsequent notices about this symposium, please send your name, address, and phone number to: Caroline M. Isaacs, U.S. Geological Survey, 345 Middlefield Road—MS 99, Menlo Park, California 94025. For further information or discussion, contact any of the symposium organizers: Robert E. Garrison, University of California Santa Cruz (408−429-2114); Stephan A. Graham, Stanford University (415−497-0507); Caroline M. Isaacs (415−856-7010); and Wallace A. Jensky II, Argo Petroleum (213−452-8676).

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ACCESS TO FED LANDS

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Moreover, in addition to energy supplies, federal lands are believed to be rich in many of the nonenergy minerals essential to our economy and security. Yet, we are dependent on foreign nations—in whole or in part—for 22 of the 74 most essential nonenergy minerals. Again, to a large extent, that dependency is attributable to a national choice to enact or promulgate federal laws and regulations adversely affecting access to and use of public lands.

Whether these energy and nonenergy mineral sources can be developed will depend on timely and meaningful changes in legislative and regulatory policies that currently constrain access and use of federal lands. That doesn't mean removing all environmental protections or backsliding on improvements in the quality of the air we breathe and the water we drink. It does, however, mean modifying laws and regulations so that this nation can meet all of its national goals—including energy development *and* a cleaner environment.

What is needed is careful management of public lands to maximize the use of those lands for the public benefit through the receipt of fair value for the minerals produced and availability of secure domestic energy supplies. This cannot be done if the lands are closed to exploration and production even before an assessment of mineral values can be made. Yet this has been the case for tens of millions of acres of federal lands.

According to government estimates, two-thirds of all federal onshore lands are either totally or partially restricted to minerals exploration and development. Offshore, any of the sedimentary basins thought to have oil and gas potential have never been opened to exploration and production.

This can be changed. If it is, we can significantly reduce our current dangerous dependence on oil from a small number of insecure foreign sources.

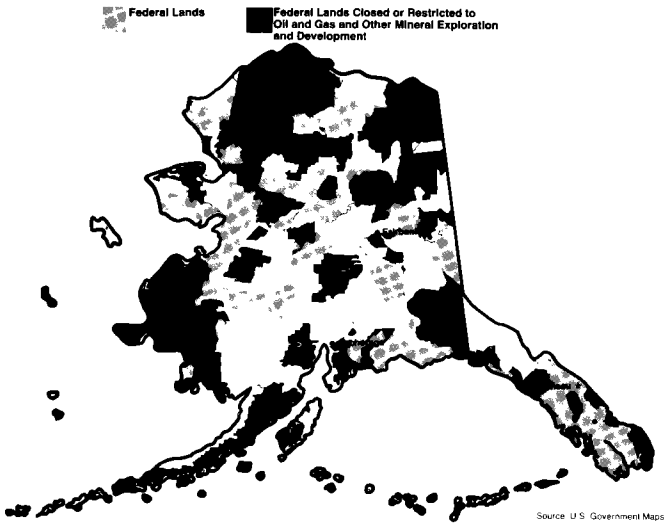
With adequate access and land use policies—including policies that balance energy and environmental goals—this nation could, by 1990:

- —reduce our reliance on foreign oil by as much as one-half from the level at the beginning of this decade;
- —Maintain domestic oil and gas production near today's levels;
- —double our use of coal;
- —triple the contribution of nuclear power; and
- —help buy the time needed to carefully research and develop synthetic, alternative and renewable energy sources for the future.

There is, of course, nothing sacred about attaining that exact mix of energy or doing so precisely within the timeframe of the 1980s decade. But these are realistic and attainable goals, if the people of this nation make the right choices.

Our success in increasing new supplies of domestic energy rests largely on the decisions the federal government makes on access and land use policies. Unless there is access, there can be no exploration and production on federal lands. Unless there are sound land use policies, there can be no development of the mineral resources of those federal lands. The two go hand in hand. And, without both, our dependence on foreign sources for critical energy and nonenergy minerals is certain to increase, to the detriment of the nation and its people.

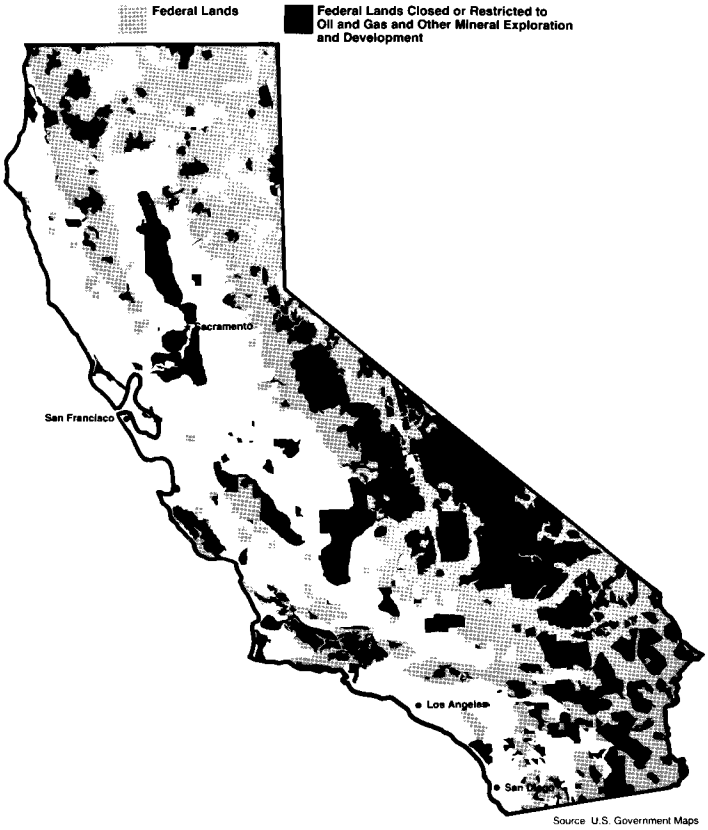
Oil, Gas, and Mineral Restrictions on Federal Lands in Alaska



Source: U.S. Government Maps

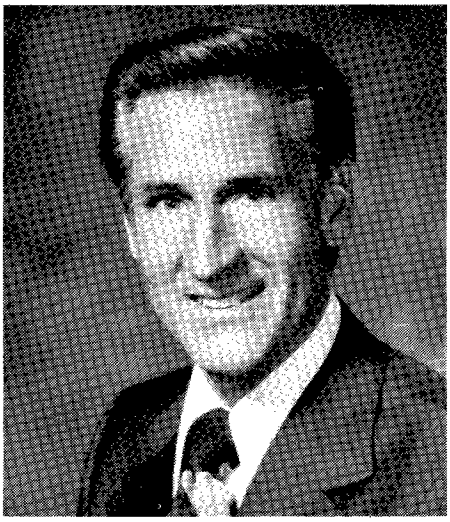
Both shaded areas on this map show federal lands in Alaska—which account for 81 per cent of the state. The darker shaded areas show lands closed or restricted to oil and gas and other mineral exploration and development in the state.

Oil, Gas, and Mineral Restrictions on Federal Lands in California



Source: U.S. Government Maps

Both shaded areas on this map show federal lands in California—which account for 47 per cent of the state. The darker shaded areas show lands closed or restricted to oil and gas and other mineral exploration and development in the state.



ASSEMBLYMAN DON ROGERS

SACRAMENTO—Assemblyman Don Rogers, Republican legislator from Bakersfield, has just returned from a trip through the Imperial and Mexicali Valleys along the California/Mexico border.

Chairman of the Assembly Economic Development and Planning Committee of the California State Legislature and a geologist by profession, Rogers observed the economic and energy development projects which are taking place in that region. On his return, he said he was "particularly impressed with the progress being made by the Mexicans in developing their geothermal energy projects."

Rogers noted that the Mexican government is now ahead of schedule in bringing on line their next geothermal power plant. They plan to eventually complete one new plant every six months.

Besides the power plants, the Mexicans are also developing a major fertilizer production facility, and experimenting in raising freshwater shrimp and other seafood as well as moving into hydroponic farming as by-products of their new geothermal developments.

Rogers said the border industrial proposal would attract companies from all over the world and would provide new jobs and renewed energy to the economies of both countries.

Rogers' Assembly committee handles all legislation in the areas of international trade and economic development.

(Editor's Note: Don said his first interest in politics came as a result of receiving a property tax bill several years ago when his taxes increased 45 percent in one year. In addition to this, in operating his own small business as a geological consultant, he had been feeling the increasing pressure of more and more regulation and taxation. He said there just had to be a better way and, after expounding on this theme, he was persuaded by neighbors to run for the Bakersfield City Council in 1973. He was first elected to the California Legislature in 1978 and re-elected in 1980.)

LETTERS TO EDITOR

McCLOSKEY

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miles. As of this moment, it is clear the Administration has chosen not to intrude upon that fight.

"And I suspect that it is not because of any change of position that there should be federal control between 3 and 200 miles, but rather because the Administration does not want to create a further forum for dispute with Gov. Brown (Edmund Brown, Jr.) of California on this issue—an issue which has been embarrassing politically to some members of the President's own party here in California.

"I regret that decision by the Administration because if there is one thing true and for certain about the moral equivalent of war, it is that in the cases where the national security is threatened or war is a possible alternative, the Federal Government should make the same kind of preemptive decision that it would, say, in the case of condemning Camp Pendleton for use of the Marines in preparing for World War II, or a military installation, or any other installation necessary for the national security."

He said that the history of offshore drilling "makes it clear that out to 3 miles the states were intended to have jurisdiction, but that from 3 to 200 miles it was not intended that the consistency provision of the Coastal zone Management Act would govern federal decisions as to the use of those resources."

McCloskey also said that "because of the economic situation, in my judgment, the Administration has consciously chosen to defer any efforts to deregulate natural gas, even though that would be an appropriate part of the natural energy policy ... Republican accountability in the 1982 elections could not stand the additional burden on the public of the deregulation of natural gas along with the recognition that the budget cuts have failed to re-establish the economy."

Contributed by
Art Spaulding
from the Week in Review (12/11/81)
Western Oil & Gas Association

QUESTIONS AND ANSWERS ON FEDERAL LAND USE

(Reprinted from American Petroleum Institute)

Q. What has been federal policy concerning use of public lands?

A. Until recently, these lands have been managed under a broad "multiple-use" policy. This permitted fairly open access to mineral resources under either the Mining Law (governing "hard rock" minerals) or the Mineral Leasing Act and the Mineral Leasing Act for acquired lands (governing oil, natural gas, oil shale, coal, tar sands, phosphate, potassium and sodium.) During the past decade, however, access to federal lands has been curtailed sharply, either through limiting restrictions or, in many cases, out-right denial of access for mineral exploration, development and production. While land "withdrawal" is not new (it began in 1872, with the creation of Yellowstone National Park), it has reached alarming proportions and could seriously impact on this nation's ability to increase energy production and to reduce its heavy dependence on imported oil and other critical minerals. Of course, specific historic and scenic areas, such as our national parks, should be preserved. What the industry opposes is the arbitrary foreclosures of large public land areas without adequate assessment of their mineral resource value and other national needs.

Q. Why shouldn't we explore and produce minerals from public lands now? Wouldn't it be better to wait?

A. Keeping our mineral resources in the ground is not a valid response to our growing reliance on other nations for critical minerals. This is particularly true for exploration and production of our petroleum resources, yet it also applies to other minerals. In 1979, for example, the General Accounting Office reported that "the United States now depends on foreign sources, in whole or in part, for approximately 22 of the 74 nonenergy mineral commodities considered by the Department of Interior to be most essential to our economy." Policies which have kept these minerals in the ground through land use limits, environmental constraints, restrictions on joint ventures and the added labor costs arising from strict safety and health standards have affected normal market forces. Moreover, according to a recent U.S. General Accounting Office report:

> "The decline of the (mineral) industry has resulted in (1) increased concern about U.S. vulnerability to supply interruptions, (2) lost job opportunities in the mineral industry, and (3) pressure on the U.S. balance of trade."

Time is another factor often overlooked by those advocating delay in minerals development. You simply don't walk into a frontier (unexplored) area, drill a well or sink a mine, and start producing minerals. It now takes years of exploration, years more to acquire permits, and additional years to develop an oil field or mine, once it has been determined that the venture is economically and technologically feasible. That's why it's so important to have access to public lands *now*, in order to have resources available when we will desperately need them 10, 15 or more years from today.

NPRA INIGOK No. 1— USE OF LOPATIN'S METHOD TO RECONSTRUCT THERMAL MATURITY

By Leslie B. Magoon
and
George E. Claypool
U.S. Geological Survey
Menlo Park, California

INTRODUCTION

In 1977, the Department of the Navy turned the Naval Petroleum Reserve No. 4 (NPR-4) over to the Department of Interior to be the National Petroleum Reserve in Alaska (NPRA). The Department of Interior designated the U.S. Geological Survey (USGS) as the organization to continue the exploration effort initiated by the Navy in 1974. To prepare for taking over this sizable exploration program, in late 1976 the USGS began to plan studies intended to fully assess the petroleum potential of NPRA. A petroleum-geochemistry study was initiated to evaluate the drilling well, to aid in the selection of new well locations, and to contribute to hydrocarbon-resource estimates for NPRA. The location of NPRA on the Alaskan North Slope is shown on Figure 1.

The purpose of this paper is to use the present-day subsurface temperatures in conjunction with Lopatin's method of calculating the integrated time-temperature index (TTI) from vitrinite reflectance (Waples, 1980) and gas wetness to investigate the earliest geologic time certain stratigraphic horizons penetrated by the Inigok No. 1 well (fig. 1), one of the deepest wells (20,102 ft.) on the North Slope, would have been sufficiently mature to generate hydrocarbons.

GEOLOGY

Physiographically, the North Slope of Alaska can be subdivided into three major provinces from south to north: the Brooks Range, the foothills, and the coastal plain. Gross structural features that correspond to these provinces are, from south to north: (1) Brooks Range orogen, (2) Colville trough or fore deep, and (3) Barrow arch (Carter and others, 1977; Grantz and others, 1979; Bird, 1981). Major stratigraphic sequences have been proposed for the Yukon Territory in Canada by Lerand (1973) and extended to northern Alaska by Grantz and others (1975) to include the Ellesmerian sequence whose primary source of sediment is from a continental mass to the north of the present coastline and the Brookian sequence whose primary source of sediment is from the Brooks Range orogen to the south. The Inigok No. 1 well is located in the Colville trough in NPRA and penetrates 11,062 ft. and 8.940 ft. of these two sequences, respectively. In the Inigok No. 1 well, the pebble shale separates the older, deeper Ellesmerian sequence from the younger, shallower Brookian sequence as shown in figure 2.

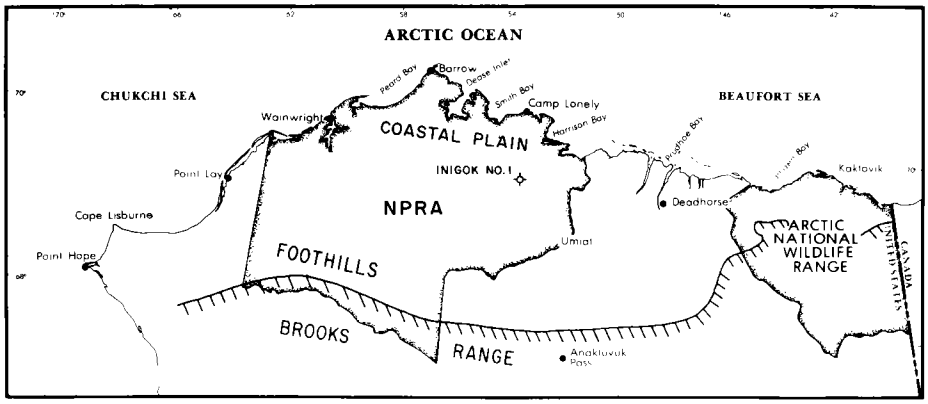


FIGURE 1. Map of the North Slope of Alaska showing the location of NPRA (National Petroleum Reserve in Alaska) and the Inigok No. 1 well.

GEOCHEMICAL DATA

Both vitrinite reflectance and the chemical composition (wetness) of gas are sensitive to the thermal maturity of organic matter in sedimentary rocks. Our data from the North Slope indicates that a vitrinite reflectance value of 0.6 percent is the beginning point for significant petroleum-hydrocarbon generation. Evidence for this is a significant increase in gas wetness, above 25 percent in the Inigok well (fig. 2). Where vitrinite-reflectance values of about 2.0 percent occur there is an absence of significant amounts of hydrocarbons larger than methane, due to earlier expulsion or thermal cracking. This degree of thermal maturity is also indicated by the occurrence of a zone of very low gas wetness of less than 25 percent beneath a zone of consistently wet gas. Gas compostition or wetness also can be influenced by the presence of migrated petroleum in rocks that contain thermally immature organic matter. For this reason, vitrinite reflectance is used as the primary indicator of thermal matruity, and other geochemical properties (in this case gas wetness) are used either to confirm the interpretation based on vitrinite reflectance, or to indicate the presence of migrating hydrocarbons. Good correlation also exists between the 65°C termperature surface and the 0.6-percent-vitrinite reflectance and the depth of significant wet gas generation.

THERMAL HISTORY

To illustrate the use of geochemical data in the interpretation of the geologic time of oil and gas generation for this area, the vitrinite-reflectance profile of the Inigok No. 1 well was used in conjunction with burial-history curves and the Lopatin-calculation method described by Waples (1980) to solve for the geothermal-gradient history at the Inigok location during the 350-m.y. period in which these rocks accumulated; the results of these geothermal-gradient calculations are sumarized in figure 3. The burial-history curves for selected horizons in the Inigok No. 1 well are shown in the geologic-time-vs.-depth plot at the left of figure 2. These burial curves are determined by the measured depths, the ages, and the assumptions regarding the timing and magnitude of uplift. To the right of the depth column appears the stratigraphic sequence of named rock units together with the ages of the horizons for which burial curves are constructed. The predominant lithology for each rock unit is shown to the left of the depth column. The three columns on the right-hand side of figure 2 show the gas-wetness-vs.-depth curve, the observed vitrinite reflectance, and the time-temperature index (TTI) values that correspond to the measured vitrinite-reflectance values at the depths shown. The TTI values are taken from Waples' (1980, table 4) discussion of Lopatin's method with the modification that the "onset of oil generation" occurs at a lower TTI of 10. Except for this modification, we assume that the calibration given by Waples is correct, and we use the TTI values given by measured vitrinite reflectance together with the burial curves for selected stratigraphic horizons in order to solve, by trial-and-error method, for the geothermal gradients that could have prevailed during geologic time at the Inigok locality.

Independent confirmation of the maturity calibration given by Waples (1980) is provided by the gas-wetness profile shown in figure 2. The inflections of the gas-wetness curve is not the result of caved samples (drill cuttings from shallower depths) because the casing points, shown here as solid triangles adjacent to the wetness profile, do not occur at the points where gas values change, but rather they occur above or below the major changes in gas wetness. The point predicted by theory for the onset of oil generation at TTI 10 (Ro = 0.6%) occurs at about 6,500 ft. depth in the Inigok No. 1 well. This corresponds very closely to the depth (6,150 ft.) at which the gas-wetness curve reaches the twenty-five percent level and after which the curve remains consistently above that level. The "upper TTI limit for occurrence of oil with API gravity less than 50°" of Waples (1980) at approximately TTI 1000 occurs in the Inigok well at about 12,200 ft., or below the

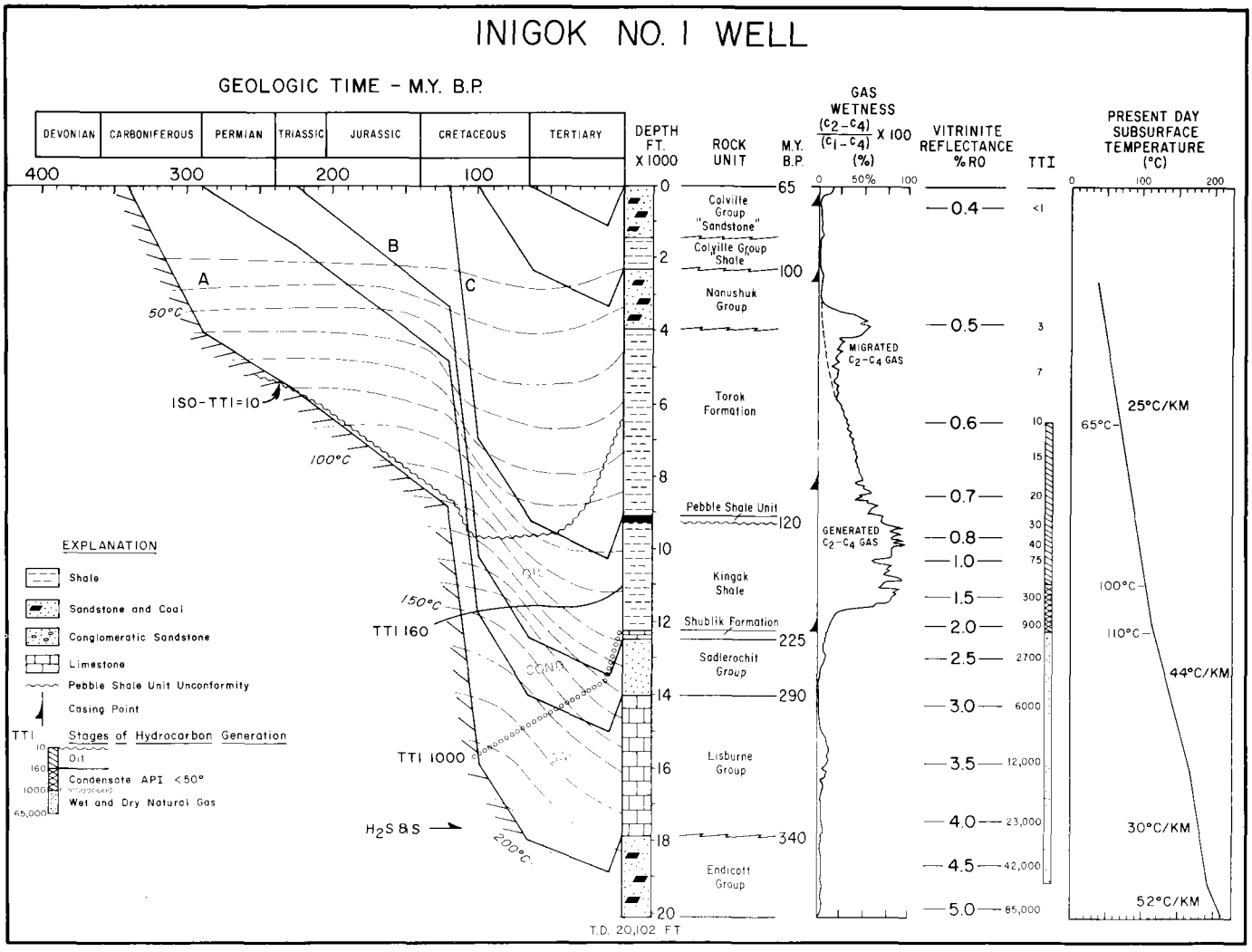


FIGURE 2. Burial and thermal history for the Inigok No. 1 well. *Three scenarios for geothermal gradients* were used to calculate three time-temperature indices (TTI), producing burial paths A, B, and C, respectively. Rock units, the ages assigned to certain horizons, gas wetness, vitrinite reflectance, and the present-day corrected subsurface temperature profile are shown. The time-stratigraphic index (TTI) as calibrated by Waples (1980) is shown next to the vitrinite-reflectance data acquired from the Inigok well. The dashed isotherms, every 10°C, are shown for Case III superimposed on the burial paths.

depth where gas wetness has decreased abruptly from 75 percent (at 11,300 ft.) to less than 20 percent (at 12,000 ft.). "Peak-oil generation" (TTI 75) occurs about midway between gas-wetness values that exceed 75 percent and the "end-of-oil generation" (TTI 160) occurs at the lower end of these high gas-wetness values. The high gas-wetness values at relatively shallow depths (3,400-4,200 ft.) in the Nanushuk Group are disregarded because this depth interval has reservoir rock character, and the gas-wetness values probably represent migrating hydrocarbons. The Nanushuk Group sandstone is the reservoir rock for the Umiat and Simpson oil fields.

Most of our calculations were based on the burial history of three stratigraphic horizons: the contact between the Lisburne and Endicott Groups (340 m.y.); the contact between the Shublik Formation and the Sadlerochit Group (225 m.y.); and the unconformity at the base of the pebble shale unit (120 m.y.). The isotherms shown superimposed on the burial-history curves of figure 2 represent the solution (Case III in figure 3) that most accurately reproduces the range of observed thermal maturities of organic matter in the Inigok well.

The three general approaches that were used in our calculations are summarized in figure 3 and table 1. TTI values were calculated on the basis of the assumption that the present-day geothermal gradient has prevailed throughout geologic time (Case I). This gradient reproduces the present-day thermal maturity or TTI of the pebble shale horizon, but gives relatively immature or low values for the two deeper horizons. A geothermal gradient that decreases linearly with time (Case II) was used to calculate TTI values for the three stratigraphic horizons. This gave thermal maturities that were too high for the pebble-shale horizon and too low for the Lisburne-Endicott and the Shublick-Sadlerochit horizons. The third assumption (Case III) of geothermal-gradient history shown in figures 2 and 3 best reproduces the present-day TTI for either of the following reasons (1) the heat flow associated with rifting in Late Jurassic to Early Cretaceous time may have been higher than normal or (2) as the present-day geothermal gradient shows, the gradient through the deeper carbonate and sandstone section is higher than that through the shallower shale section. Regardless of the reason, this solution shows good agreement between the TTI values calculated from burial history and assumed thermal gradients, and the TTI values derived from the measured vitrinite reflectance.

For Case III, the earliest times that oil and gas generation could have taken place for the rock units on either side of the three burial paths (A, B, and C) are shown on figure 2. The Endicott Group, a coaly "gas-prone" rock unit, encountered subsurface temperatures sufficient to generate oil during the Triassic (215 m.y.) and sufficient to generate wet gas by middle Cretaceous time

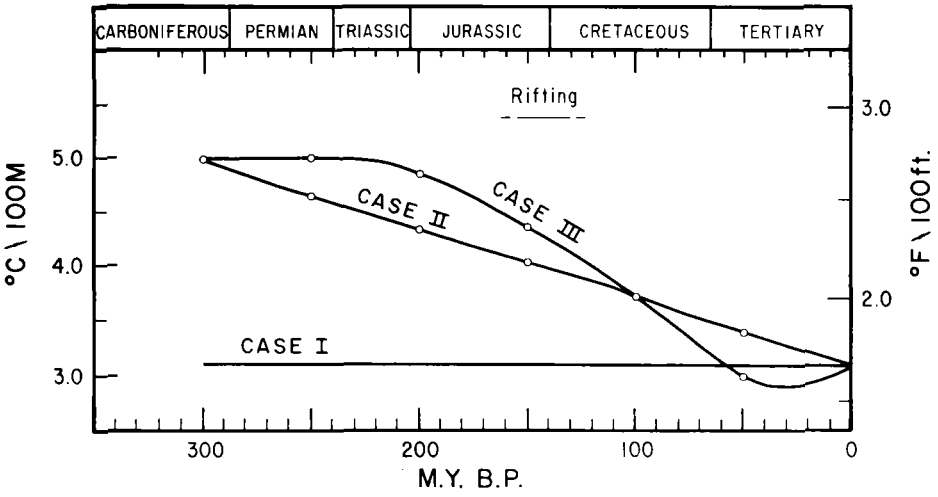


FIGURE 3. The change in the geothermal gradient through time is shown for each of the three possible scenarios: In Case I the geothermal gradient is constant; in Case II the gradient decreases linearly from 325 m.y. B.P. to the present; and in Case III a high geothermal gradient prevailed to the end of Jurassic time followed by a rapid gradient drop in Cretaceous and Tertiary times.

Table 1. Time-temperature index (TTI) calculations for three cases.

Stratigraphic Horizon	Age (m.y.)	Trial TTI Calculations Case I	Case II	Case III	Observed TTI
C-Pebble shale unit unconformity	120	25	45	25	30
B-Shublik Fm.-Sadlerochit Gp. contact	225	215	340	900	1,500
A-Lisburne Gp.-Endicott Gp. contact	340	18,000	24,000	34,000	35,000

(100 m.y.). The Shublik Formation and lower part of the Kingak Shale matured (TTI 10) in middle Cretaceous time (100 m.y.), reached the end of oil generation in Late Cretaceous time (80 m.y.), and is presently in the wet-gas generation stage (TTI 1000-1500) zone (TTI 160-1500). The lower part of the Torok Formation, pebble shale unit, and upper part of the Kingak Shale are presently capable of generating oil but experienced the onset of oil generation (TTI 10) in Tertiary time (45 m.y.).

SUMMARY AND CONCLUSIONS

Thermal maturity of organic matter can be used together with the burial history given by thicknesses and ages of the rock units to estimate the earliest time of oil and gas generation. At the location of the Inigok No. 1 well as shown in figure 3, the thermal gradient was high from the Carboniferous (50°C/km) to the end of the Jurassic (42°C/km). The prevailing geothermal gradient at the Inigok locality decreased during the Cretaceous to a low value of 32°C/km at the Cretaceous-Tertiary boundary. Since that time the gradient has decreased slightly to the present-measured average value of 31°C/km. The thermal-gradient history provided by the thermal maturity of the organic matter and the burial history indicates that the Shublik Formation and Kingak Shale were mature by middle Cretaceous time and the pebble shale unit, presently at 9,000 ft., started to generate oil in Tertiary time.

PACIFIC SECTION SEG EDUCATIONAL PROJECT

The Pacific Section of the Society of Exploration Geophysicists is organized into three districts. Northern (Bakersfield), Southern (Los Angeles) and Western (Ventura). Officers of the Society are:

President John Shastid
Union Oil Company
Vice President Northern R. D. Dennis
Gulf Oil Company
Vice President Southern Jeff Wright
Chevron Oilfield Research
Vice President Western Alan Hoffman
Consolidated Georex Geophysics
Treasurer William Fenley
Geophysical Systems Corp.
Secretary Roberta Walton
Guiberson Division
Editor Mark Magargee
Gulf Oil Company
Past President J. R. DesCamps
Husky Oil Company

The 1982 program for the Pacific Section SEG is to institute a multi-year *Special Educational Project.* The purpose of this project is to provide a "How To" series of demonstrations and instructional handbooks to enable the earth scientist to become tehnically proficient in the practical application of geophysical techniques.

The series will include:

—How to conduct a noise study for parameter design.
—How to interpret a noise study and design a field study.
—How to conduct a seismic field operation.
—How to process seismic data.

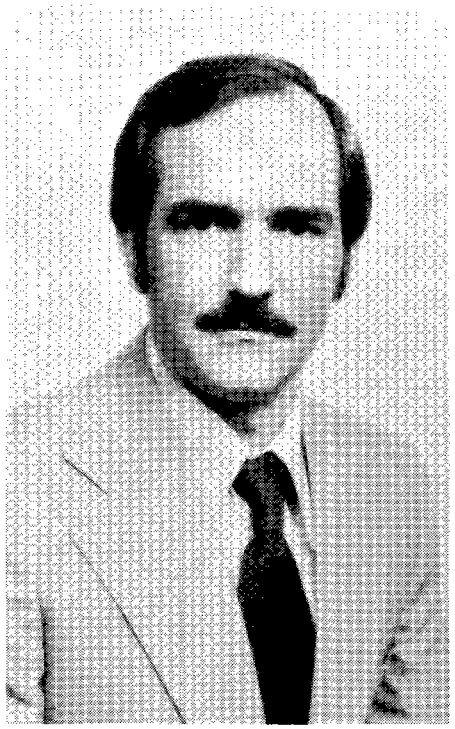
Other topics can be added as needed to satisfy the membership of the society.

The field demonstration is scheduled for late spring at a location near Bakersfield. Data and information are now being gathered and a handbook is being prepared.

Membership in the Pacific Section of AAPG and SEG will receive preferential pre-registration and a formal announcement will be made to each of the AAPG & SEG meetings and in their respective publications.

PACIFIC SECTION SEG SPRING OUTING

The Pacific Section SEG spring outing will be held June 18, 1982, at the Valencia Country Club in Valencia, CA. Friday's events include a golf tournament and a tennis tournament. Tentative activities for the 19th hole include bingo and a fashion show. Topping off the day will be the spring dinner. Awards will be presented to the day's winners along with the announcement of next year's section officers. If you are interested in helping with the outing, contact Co-chairman Lane Howell at Tenneco Oil Company, telephone (805) 395-5200 or Elmo Long at North American Exploration Company, telephone (805) 327-4197.



LEE WEISMEYER

Lee Weismeyer has been named Vice President of Acquisitions of Minoco Southern Corporation. Mr. Weismeyer had been Regional Exploration Manager at Texaco, Inc. Los Angeles Division.

Alaska

CALENDAR

February 17 & 18
AGS 1982 Symposium
Western Alaska Geology and Resource Potential
Captain Cook Hotel, Anchorage

March 25
AGS regular meeting
"Assessing Offshore Geohazards in Alaska"
Anchorage Westward Hilton

The Department of Interior has rescheduled the sale of the first oil and gas leases in the National Petroleum Reserve in Alaska (NPR-A), which had been scheduled for Dec. 16, 1981 in Fairbanks. It is *now scheduled for January 27.*The DOI said it delayed the sale because of concerns over antitrust review information required by the Department of Justice. The Justice Department is *no longer* requesting resource estimates from companies proposing to bid.

Coast

GOAST GEOLOGICAL SOCIETY
P.O. Box 3014
Ventura, California 93303

President	Tom Hopps
Consultant	
Vice-President	Ed Magdelana
Exxon	
Secretary	Susan Krosky
Conoco	
Treasurer	Paul Hacker
Argo	

The CGS CONTINUES TO HAVE GOOD ATTENDANCE. Over 100 members have attended each meeting. On Tuesday, Feb. 16, Greg Davis from USC will talk about the Columbia Plateau.

Personals: Louis Rothenberg, a geologist with Union Oil is being transferred to Lafayette, La. Bill Muldoon, geologist, has transferred from Conoco's Lake Charles, La. office to its Ventura office. Linda Coffey has joined Conoco as a geoscience assitant. Ron Benda, geologist, is transferring to Conoco's Ventura office from its Mineral Division in Denver. Kermit Giddens has taken early retirement from the Analyst and has formed his own company, Giddens & Associates Consulting. Dick Berger, geologist, has left Argo Petroleum and has started work with Bravo Oil Co. in San Francisco. Argo's new district geologist is Dan Pasquini.

Los Angeles

The Los Angeles Basin Geological Society is proud to announce that the following will represent the society as its officers in 1982:

President	Keith Yenne
Consultant	
Vice-President	Bonnie Bloeser
Texaco	
Secretary	Darlene Condra
Texaco	
Treasurer	Bill Goth
Union	

The January luncheon meeting will feature Tor Nielson speaking on "Hydrocarbon Exploration Strategies in Turbidite Sequences." The meeting will be held at Taix French Restaurant at the usual time and date.

On November 21 L.A.B.G.S. sponsored its annual Fire and Ice Dinner Dance at the Woodland Hills Country Club. We would like to thank Bob Hacker for his assistance in setting up the dance. Special thanks are extended to the following companies for their financial support:

Strata-Log, Inc., Core Laboratories, Inc., Munger Oil Information Service, Exploration Logging, Inc., Schlumberger, Welex, Burns Geological Exploration, Inc., Reese Sales Co., Seiscom Delta, Inc.

The officers and members of the Los Angeles Basin Geological society sincerely thank all of the speakers who made our meetings so successful in 1981. Special thanks are extended to Don Hallinger, Doug Traxler, Bob Hacker, and Bruce Barron for their volunteer work and assistance to the officers throughout the year. We would also like to express our deep appreciation to the service companies who were so generous with their financial support.

Edward Paden

San Joaquin

CALENDAR

Feb. 9—Jim Maples, hard mineral appraisro at assessors office will discuss how mineral property is evaluated.

March 8—Arnold H. Bouma will present "Intraslope Basins on an Active Diapiric Continental Slope—A Key to Sand-Body Geometry in Ancient Submarine Canyons & Fans.

BAKERSFIELD COLLEGE
Distinguished Lecturers

Feb. 22, 7-10 p.m., Math Science Bldg., Rm. 2. Gerard de Maisont, geochemical coordinator Chevron Overseas Petroleum, S.F., "Petroleum Source Beds: Environment of Deposition & Stratgraphy."

Feb 26, 7-10 p.m. and Feb. 27, 9 a.m.-5 p.m. Math Science Bldg., Rm. 2. John C. Crowell*, University of California, short course—"Working with California's Tectonic Problems."

March 1, 2 & 3, 7-10 p.m., Math Science Bldg., Rm. 2— Short course Rod Eson, Chemical Oil Recovery Company, "Downhole Steam Generation."

April 2 & 3, 7-10 p.m., Math Science, Rm. 2. J. Toth*, Alberta Research Council, "Ground Water Flow in Drainage Basins and Its Relevance to Hydrocarbon Exploration." (Generalized hydraulic theory of petroleum migration.)

(Speakers have been funded in part through grants from Tenneco Oil Company and Occidental Exploration and Production.)*

Other short courses being offered this spring at Bakersfield College:
Feb. 3 through March 10 — Wed., 7-10 p.m. "Basics of Hydraulic Fracturing".

March 17 through April 28 — "Well Cementing and Sand Control".

May 5 through June 9 — "Fundamentals of Acidizing".

Feb. 2, 7-10 p.m., M.S. #109. "Fundamentals of Petroleum Reservoir".

PROFESSIONAL MOVES

Rex Young, Mission Resources.

Wally Wrigley joined Oxy as Alaska District Geologist, prior to move was with Chevron in San Francisco.

BOARD OF REGISTRATION FOR GEOLOGISTS AND GEOPHYSICISTS MEETINGS

January 20, 1982	Sacramento
February 16, 1982	
March 16, 1982	
April 19, 1982	Anaheim
May 25, 1982	
June 22, 1982	

For additional information contact the office of John E. Wolfe, Executive Secretary, Board of Registration or Geologists and Geophysicists, 1020 N Street, Room 419, Sacramento, Ca 95814, Telephone (916) 445-1920.

'82 MAY BE EXCITING FOR CALIFORNIA EXPLORATION

by Bill Rintoul

If wildcatters drill the lands they showed interest in last year, this could be one of the most exciting years California exploration has seen.

While there was an accelerated scramble last year for leases in established producing provinces like the San Joaquin and Sacramento valleys, there also was strong interest in highly speculative areas not usually associated with oil or gas action.

One of the bigger land plays came in the Imperial Valley in response to an announcement by the Mexican government's oil agency of a discovery in waters of the Gulf of California on trend with Imperial.

During a 1½-week period would-be lessees swamped the Bureau of Land Management's Sacramento office with applications to lease oil and gas rights for about 1.7 million acres, or more than 2,600 square miles of wildcat ground.

The area of interest extends north from the border through Imperial County past the Salton Sea and into Riverside County, spilling over on the east into the Chocolate Mountain Gunnery Range and on the west into San Diego County.

Among those filing for large spreads were Amoco Production Co., Atlantic Oil Corp., Eagle Exploration Co., Hunt Petroleum Corp., Inexco Oil Co., Kimbark Oil & Gas Co., Ed Pendleton, Placid Oil Co., Dayle E. Rushing, Terra Resources Inc., Western Reserves Oil Co. and Marvin Wolf.

Another sector that attracted attention last year was the southeastern corner of California in desert country where the Overthrust Belt that winds down out of Alaska through the western United States to Mexico nips a corner of the state.

Mindful of exploratory successes in the Wyoming and Utah portions of the Overthrust, various companies sought a land postition on the California portion of the geological feature.

Among those active in land plays were Petrolic Corp., Phelps Dodge Fuel Development Corp., Placid, Snyder Oil Co. and Western Reserves Oil Co.

The possibility that military lands will be made available for exploratory drilling brought a rush to bases throughout the state by those anxious to enlist in the campaign to find domestic energy.

Among the more active companies seeking a land position were Champlin Petroleum Co., which applied for leases on about 200,000 acres; Monsanto Co., 176,400 acres; Shell Oil Co., 156,000 acres; and Husky Oil Co., 93,300 acres.

While bases near producing fields drew the keenest interest, others remote from production were not left out, with some drawing a surprising amount of attention.

One of the hotter areas would appear to be the Lemoore Naval Air Station in Kings County, where those competing for leases included Amoco, Beard Oil Co., Shell, Texaco, Union Oil Co. of California and Bruce Anderson.

Other lease applications were filed for acreage at Edwards Air Force Base, Camp Roberts, Hunter Liggett Military Reservation, Port Hueneme Naval Construction Center, Pendleton Marine Corps Base and El Toro Marine Air Facility, among other installations. Champlin included in the spread it is seeking a 594-acre parcel at the Navy's Postgraduate School in Monterey.

PACIFIC SECTION — AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS

OFFICERS 1981-82

President ..... JOHN A. CARVER (805) 871-1345
President Elect ..... THEODORE OFF (805) 643-8641
Vice President ..... REX S. YOUNG (805) 327-9891
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Treasurer ..... MARK R. COLE (213) 255-2541
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Recommended Reading ..... LUCY E. BIRDSALL (213) 688-2850

NEWSLETTER of the Pacific Section—American Association Petroleum Geologists is published bimonthly by the Pacific Section.

Material for publication, requests for previous copies and communications about advertising costs should be addressed to JOHN W. RANDALL, GULF OIL, 5200 STOCKDALE HWY., BAKERSFIELD, CALIF. 93309.

CHANGE OF ADDRESS, subscription, and membership inquiries should be directed to: MEMBERSHIP SECRETARY, PACIFIC SECTION AAPG, P.O. BOX 1072, BAKERSFIELD, CALIFORNIA 93302.

PUBLICATIONS COMMITTEE: Pacific Section American Association of Petroleum Geologists, P.O. Box 927, Camarillo, CA 93010.

Annual Meeting

PACIFIC SECTION

AAPG – SEPM – SEG

APRIL 14 – 17, 1982

DISNEYLAND HOTEL
Anaheim, CA

Watch mail for first registration packet — mailout mid-February.

NEWSLETTER
Pacific Section A.A.P.G.
P.O. Box 1072
Bakersfield, California 93302

Richard L. Hester
1911 Montecito Dr.
Glendale, CA 91208

DA-AM

PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

of the Pacific Section
American Association of Petroleum Geologists

MARCH 1982

PRESIDENT'S CORNER...

PACIFIC SECTION SYMPOSIA PROGRAM

Roger Alexander, Tom Wright and others have proposed that we develop a long-range plan for the publication of technical symposia.

The Executive Committee of the Pacific Section of the AAPG endorses this effort and have appointed Don Hallinger to initiate the program.

Their ideas are to coordinate a program with the SEPM and SEG. Following the proven formula already used by the SEPM, that is to:

1. Select a subject for which the unpublished work of many can be assembled into publications of major value to our science and profession;
2. Provide several years' lead time for preparation of initial papers;
3. Subdivide the subject into logical components for presentation as symposia at consecutive Pacific Section conventions;
4. Publish each symposium simultaneously with its presentation, and in inexpensive paperbound photo-offset form.

We would like to consider the Monterey Formation Symposium being planned for 1983 as the first in a coordinated series of symposia on California. Tentative ideas for continuing the series in future years are:

1. California Oil & Gas Reservoirs
2. Hydrocarbon Traps of California
3. Depositional Systems in California Basins
4. Tectonic Evaluation of California's Basins

Later symposia would be designed to cover other Pacific Section areas. We need reaction, constructive criticism and more input from you. Your comments and suggestions will receive careful consideration. You may write Don Hallinger, c/o Pacific Gas & Lighting, 720 W. 8th Street, Los Angeles, CA 90017, who is the chairman of long-range planning; or myself at Occidental Expl. & Prod. Co., 5000 Stockdale Hwy., Bakersfield, CA 93309.

JOHN CARVER

NOMINEES FOR PACIFIC SECTION AAPG PRESIDENT-ELECT 1982 – 83

Robert (Bob) J. Hindle

Manager of Geology, Sun Production Division, Western District, un Oil Co., located in Valencia, Calif.

Education

UCLA, A.B. in Geology, graduated 1948; selected post-graduate courses, University of Oklahoma, and University of California in Petroleum Engineering and Reservoir Engineering.

Employmnet

1948–1950 Barnsdall Oil Co., geologist
1950–1970 Sunray DX Oil Co., geologist in California, Wyoming, Colorado, and Alaska
1970–82 Sun Oil Co., Sun Production Co./Division, District Exploration; District Development Geologist to Manager of Geology.

Geological Society Activities

Member: AAPG: AIPG: API.
Delegate to National AAPG.
Coast Representative, Calif., Sect. AIPG.
Treasurer, Coast Geological Society.
Vice-President, Coast Geological Society.
President, Coast Geological Society.
Technical Chairman, AAPG, Pacific Section Convention.
Field Trip Chairman, Pacific Section, AAPG.
Vice President, Pacific Section AAPG.
Membership Committee Chairman (3 yrs.), Pacific Section, AAPG.

James R. Weddle

Consulting Geologist, Bakersfield.

Education

1957 B.A. — Geology, University of California, Berkeley

Employment

1970–75 Executive Officer, Calif. Division of Oil and Gas, Sacramento
1957–70 Oil and Gas Engineer, Calif. Division of Oil and Gas, Bakersfield, Taft, Los Angeles, Sacramento

Professional Activities

AAPG — Active member since 1958; District Representative, 1968; Member, Committee for Preservation of Cores, 1973-Present
Pacific Section — Secretary, 1973-1974; Chairman, Core Storage Committee, 1975-1976; General Chairman 1978 Convention, Sacramento; Vice President, 1979-1980; Member San Joaquin Geological Society
AIPG — Active Member since 1969
California Independent Producers Assn. — Member since 1979
California Well Sample Repository — Founder, Chairman Advisory Committee, 1975-1976 and 1980-Present; Co-Chairman Endowment Fund, 1979-Present
California Registered Geologist No. 45

PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

of the Pacific Section

American Association of Petroleum Geologists

MARCH 1982

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California Registered Geologist No. 45

Judge Says Proposition 13 Applies To Oil and Gas Producing Properties

The Superior Court of Sacramento, CA has issued a memorandum decision that Article XIII-A of the California Constitution, commonly known as Proposition 13, **does** apply to oil and gas producing properties — and, in so doing, **does not** violate the U.S. Constitution.

Furthermore, the Court said it **does not** believe the daily production of oil and gas constitutes constant new construction (as Sacramento County asserted), at least to the extent that oil properties would have to be reassessed annually at full value. However, the Court stated that "the production of oil and gas **does** constitute new construction, insofar as proved reserves are increased by discovery, construction of improvements and expansions of the reserves, based on technology and economic conditions prevailing."

Bill To Withdraw National Wilderness Preservation System And Other Lands Until Year 2000 Introduced In House

Rep. Manuel Lujan (R-NM) this week introduced in the House an Administration bill to withdraw approximately 100 million acres of the National Wilderness Preservation System and other lands in the 48 contiguous states from oil and gas, mineral and geothermal leasing, exploration and development until year 2000.

The legislation, entitled "The Wilderness Protection Act of 1982," would withdraw: (1) Lands designated by Congress as components of the National Wilderness Preservation System; (2) Congressionally designated wilderness areas, as of the date of enactment of the Act, including wilderness study areas formally identified by the Secretary of Interior; (3) Lands recommended afor wilderness designation by the Forest Service in the second Roadless Area Review and Evaluation program (RARE II); and (4) Lands identified as wilderness study areas by the Bureau of Land Management, pursuant to the Federal Land Policy and Management Act of 1976.

The bill, formulated by Interior Secretary James Watt, would not apply to: (1) Any National Forest System or Bureau of Land Management wilderness study lands released to management for uses other than wilderness by any statewide or other Act of Congress designating components of the National Wildnerness Preservation System, now in effect or hereafter enacted; (2) National Forest System lands designated as congressional wilderness study areas by the Act; (3) Any National Forest System or Bureau of Land Management lands released from wilderness study and returned to management for uses other than wilderness; or (4) Any land designated as a conservation unit under the terms of the Alaska National Interest Lands Conservation Act, where the provisions of that Act are inconsistent with the terms of the Wilderness Protection Act.

Lands under the Wilderness Protection Act would be subject to limited development during a national emergency, in which case the President could find that there is an urgent national need for entry into specified areas for specific purposes.

EXXON'S OFFSHORE WELLS FAST FLOWING

By BILL RINTOUL

The fastest-flowing wells in California are the offshore wells that Exxon is producing in Hondo Offshore field in the Santa Barbara Channel.

The company has 18 wells on production on Platform Hondo, and they're putting out 35,000 barrels a day of oil, or an average of 1,944 barrels per day per well.

The biggest onshore wells, by comparison, are the Department of Energy's Stevens zone wells at Elk Hills, which produce an average of approximately 360 barrels per day per well.

At Hondo, the oil that Exxon's producing represents the first installment of what may eventually amount to 500 million to 1 billion barrels of oil to be produced from the Santa Ynez Unit.

Production was a long time coming, but the wait for Hondo's oil finally ended on April 1, 1981, when Exxon put the first well on production on Platform Hondo.

Drilling continues from the platform, which has slots for 28 wells. The structure is positioned in 850 feet of water 5.5 miles offshore and some 20 miles west of Santa Barbara.

Exxon pipes crude oil from Hondo through oceanfloor lines to a Single Anchor Leg Mooring System, or SALM, in 490 feet of water 1.7 miles northeast of the platform.

The SALM provides a permanent mooring link for oil to flow from the platform to a tanker converted to service as a barge and rechristened the Exxon Santa Ynez. The vessel holds 200,000 barrels. Shuttle tankers moor to the Exxon Santa Ynez to offload crude for transportation to market.

Gas currently is reinjected, but Pacific Offshore Pipeline Co., a subsidiary of Pacific Lighting Corp., has begun construction to bring 30 million cubic feet per day ashore from Platform Hondo.

The project price of $80 million includes the cost of laying eight miles of 12-inch line and construction of an onshore gas treating plant. Target date for completion is July 1983.

Exxon plans eventually to install another platform some three miles west of Platform Hondo. The platform will be installed in more than 1,000 feet of water, possibly surpassing Shell's record of 1,025 feet of water at Platform Cognac in the Gulf of Mexico.

By the end of this decade, two other fields in the Santa Ynez Unit — Pescado and Sacate — may be on production. The Pescado platform would be installed in approximately 1,000 feet of water, the Sacate platform in about 700 feet of water. It's anticipated that production from the three fields in the unit could amount to 60,000 to 80,000 barrels daily.

Exxon was high bidder at the February 1968 OCS sale in Los Angeles for the bulk of the tracts in what later became the Santa Ynez Unit. The unit also includes leases that were won by Chevron and Shell.

In 1969, Exxon confirmed discovery of the Hondo, Pescado and Sacate fields. The long delay in beginning production involved three major environmental impact studies, 21 major public hearings, 10 major governmental approvals and many more minor ones, 51 studies by consultants costing more than $2 million, 12 lawsuits and one Santa Barbara County referendum, which Exxon won.

DEEP WATER CLASTICS CORE WORKSHOP

Two one-day core workshops on *DEEP WATER CLASTIC SEDIMENTS* will be sponsored by SEPM and RMS-SEPM in Denver on April 29 and 30. Organized by C. T. Siemers, R. W. Tillman, and C. R. Williamson, other lecturers are C. R. Handford, R. M. Scott, and R. D. Winn. Application of process sedimentology in the interpretationof depositional environments from the study of cores and associated subsurface data toward the generationof predictive sedimentary models will be emphasized. Complete course documentation is included. Registration is $150.00, $120.00 for full-time students. For information and reservations, contact the SEPM Continuing Education Department, (918) 743-9765.

CYPRESS COLLEGE FIELD TRIP

Dorothy Steller has organized summer field geology trips to Hawaii, Alaska, Australia and Kenya. This year she plans to take interested geologists and geology students to Bolivia, Peru and Ecuador from *June 26 to July 17*. An optional extension of a week in the Galapagos on a yacht is also planned.

For more information please contact:

Dorothy L. Steller,
Geology Instructor
Cypress College
Cypress, CA 90630
714–826-2220 or 714–879-0989

57th ANNUAL MEETING

PACIFIC SECTIONS AAPG – SEPM – SEG

FRONTIERS IN ENERGY EXPLORATION

APRIL 14 – 17, 1982

Disneyland Hotel Convention Center — Anaheim, California

JOINT SESSION AND AWARDS

THURSDAY MORNING
April 15, 1982

9:00 *Welcome and Introduction:* General Chairman Bill Reay; *Keynote Address* — NASA Astronaut Dr. Anthony W. England; *Presentation on geology and stratigraphy of N.P.R.A.* — Ken Bird (U.S.G.S.) and Mike Mickey (Biostratigraphics).

11:30 *Joint Luncheon* — AAPG, SEPM, SEG Awards Session; Joint Luncheon speaker Don Hendrickson, Vice President, Arco, "How Government Decisions Affect Oil Company Operations."

AAPG TECHNICAL PROGRAM

THURSDAY AFTERNOON
April 15, 1982

AAPG EXPLORATION SESSION
Center Ballroom

1:00 S. A. Eipstein, Q. L. Nary: **Correlations Between the Onshore and Offshore Santa Maria Basins — A Dilemma.**

1:25 W. C. Tracy, R. B. Grannell: **Precise Gravity Survey Across the Newport-Inglewood Structural Zone, Long Beach, Califoria.**

1:50 D. F. Collins: **The Cal Canal Field, San Joaquin Basin, California.**

2:15 J. R. Gilbert: **Stratigraphy and Sedimentology of the Upper Miocene Williams Sand of the San Joaquin Valley, California.**

2:40 M. L. Holmes, J. D. MacQueen, R. E. Sylvester: **Marine Geophysical Measurements in Central Puget Sound, Washington.**

3:05 M. A. Keller: **Lithostratigraphy and Diagensis of the Monterey Formation Near Ojai, California.**

3:30 G. W. Webb: **Turbidite Reservoir Facies and Trap Types.**

FRIDAY MORNING
April 16, 1982
AAPG TECHNICAL SESSION
Center Ballroom

8:30 J. C. Nellis: **Pisoliths of the Fairview Valley Formation, San Bernardino County, California.**

8:55 S. G. Barlow, W. C. Tracy: **Geology and Slope Stability of Point Delgata, California.**

9:20 L. D. Kourse, W. L. Cornell: **Silicoflagellate Biostratigraphy of the Upper Monterey and Lower Sisquoc Formations, Lompoc, California.**

9:45 G. Pischke: **Paleomagnetic Study of the Neogene Tectonic History of Baja California.**

10:10 John H. Lohmar: **Thermal Recovery of Heavy Oil at Edison Field, Bakersfield, California.**

10:35 T. Hartnett: **Late Pliocene Turbidites in Adams Canyon, California.**

11:00 J. C. Nellis: **Uranium Deposits in Channel Curves of the Salt Wash Sandstone Member of the Morrison Formation (Late Jurassic), Utah.**

FRIDAY AFTERNOON
April 16, 1982
AAPG GEOCHEMICAL SESSION
Center Ballroom

1:00 I. E. Kaplan, H. I. Halpern: **Mineral-Kerogen Interactions in Laboratory Experiments: Significance For Petroleum Genesis.**

1:25 P. J. Mankiewicz: **Use of Stable Isotopes in Assessing Petroleum Biodegradation.**

1:50 P. D. Jenden, I. R. Kaplan: **Diagenetic Relationships Between Inorganic Matrix and Kerogen in the Wilcox Group, Southwest Texas.**

2:15 A. Whittaker, R. Gurvis: **Wellsite Geochemical Analysis in Frontier Exploration — Logistics, Benefits and Examples.**

2:40 M. E. Baur, H. E. Halpern, I. R. Kaplan: **Reaction Kinetics or Laboratory Simulated Kerogen Maturation.**

SEG TECHNICAL PROGRAM

SOCIETY OF EXPLORATION GEOPHYSICISTS

Thursday Afternoon
April 15, 1982

NON-SEISMIC METHODS

1:00 A Review of Current Technology in Airborne Radioactivity Surveying.
William C. Kellogg, Kellogg Exploration Co.

1:25 Exploration for Subtle Sandstone Channels Using Electrical Geophysics.
J. M. Jordan, J. I. Pritchard, H. Renick, Jr. and R. W. West, Indesco Inc.

1:50 Deep Thermal Structure of the Mimbres Basin, New Mexico: Implications for Oil and Gas Exploration.
Chandler A. Swanberg, Teledyne Geotech, Garland, Texas.

2:15 Electromagnetic Oil Exploration Using Commensurate Frequency Phase Difference Technology.
Donald B. Daniel, Geo-Nav., Inc., Northridge, CA.

2:40 Airborne Geophysical Surveying; (subtitle) Don't Forget to Look At the Data.
William C. Kellogg, Kellogg Exploration Co.

3:05 Resolution of Reefs, Overthrusts, and Prevolcanic Sediments by Electrical Geophysics.
J. I. Pritchard, H. Renick, Jr., J. M. Jordan and R. W. West, Indesco, Inc.

Friday Morning
April 16, 1982

SEISMIC EXPLORATION

8:30 The Weathering Statics Problem and First-Arrival Time Surface.
Joong H. Chun and Chester A. Jacewitz, Seismograph Service Corporation, Tulsa, Oklahoma.

8:55 The Offset Panel Aids the Processor and the Interpreter.
Thomas K. Fulton and K. Michele Darr, Gulf Exploration and Production.

9:20 Location of Burns and Faults at the Hanna Underground Coal Gasification Area Using High Resolution Seismic.
A. D. Youngberg, Laramie Energy Technology Center, Layamie, Wyoming, and E. Berkman and A. Orange, Emerald Exploration Consultants, Inc., Austin, Texas.

9:45 Application of Nonlinear Constraints to the Processing of Seismic Data.
F. Baixas, P. Hooyman, C. Wu, C.G.G. and R. Inguva and L. Schick, University of Wyoming.

10:10 A Land Seismic Source Study.
William A. Schneider, Colorado School of Mines.

10:35 The P-Shooter, A Fast Seismic Source for Shallow Exploration.
Gildas Omnes and Robert Philippe, C.G.G. — Denver.

11:00 Physical Modeling And Its Role in Solving Geological Problems.
John A. McDonald, Seismic Acoustics Laboratory, University of Houston, Texas.

S.E.P.M. PACIFIC SECTION PROGRAM for OPEN SESSION

Thursday Afternoon Session
April 15, 1982

1:00 Ahmad, Raisuddin, University of Oregon, Eugene, Oregon.
Lithic wackes of the early-middle Eocene Lookingglass Formation, Southwestern, Oregon.

1:30 Bjorlykke, Knut O., University of California, Santa Barbara, California.
Sandstone diagenesis as a function of depositional environment and plate tectonic setting — a comparison between Jurassic sandstones from the North Sea and some Tertiary sandstones from the Coast Ranges of California.

2:00 von Huene*, R., J. Abouin, M. Baltuck, R. Arnott, J. Bourgois, M. Filewicz, R. Helm, Y. Ogawa, K. Kuenvolden, B. Lienert, T. McDonald, K. McDougall, E. Taylor, B. Winsborough c/o R. von Huene, U. S. Geological Survey, Menlo Park, California.
Preliminary results, DSDP Leg 84, middle America Trench off Guatemala.

2:30 Colburn, Ivan P. and Eric West, California State University, Los Angeles, California and Deborah Olson*, Getty Oil Co., Bakersfield, California.
Provenance and depositional mode of the Late Cretaceous Chatsworth Formation conglomerates, Simi Hills, California.

3:00 Bartling, William A. and Patrick L. Abbott, San Diego State University, San Diego, California.
Sedimentology of Upper Cretaceous submarine fan strata, San Miguel Island, California, and comparison to selected mainland localities.

3:30 Kies, Ronald P. and Patrick L. Abbott, San Diego State University, San Diego, California and Mark Filewicz, Union Oil Co., Ventura, California.
Sedimentology of the late Paleocene through middle Eocene Poway clast-bearing depositional system, southern California borderland.

4:00 Lagoe, Martin B., Stanford University, Stanford, California.
Miocene geologic history of the southern Salinian block, California — perspective from a study of the Monterey Formation.

4:30 Stanton, Robert J. Jr., Texas A&M University, College Station, Texas.
Inferred Late Miocene activity on the San Gabriel fault as indicated by Paleoenvironment of the Castaic Formation.

FRIDAY MORNING SESSION
April 16, 1982

8:00 Cooper, John D., California State University, Fullerton, California, Richard H. Miller and Frederick A. Sundberg, San Diego State University, San Diego, California.
Upper Cambrian stratigraphic cycles, southwestern Great Basin.

8:30 Van Atta*, Robert O., Portland State University, Portland, Oregon and Kevin B. Kelty, Diamond Shamrock Corporation, Denver, Colorado.
Non-marine lithofacies included in the Scappoose Formation, northwest Oregon.

9:00 Berry, K. D., Chevron, U.S.A., Concord, California.
New age for Franciscan limestone blocks near Branscomb, California.

9:30 Demere, Thomas, Natural History Museum, San Diego, California and Daryl Streiff, Woodward-Clyde Consultants, San Diego, California.
Recognition of middle and upper Pleistocene marine deposits in San Diego City, California.

10:00 Milan, Robert and James C. Ingle, Stanford University, Stanford, California.
Paleogeographic significance of Eocene diatomites in the Kreyenhagen Formation of California.

10:30 Wagner, Dana G., Chevron, U.S.A., Concord, California.
Foraminiferal distribution and environmental history of the Quaternary, San Francisco, California.

11:00 Miller, Peter L., Chevron, U.S.A., Concorn, California.
Point Arena coccolith correlations with mid-Tertiary California stage strato types.

11:30 Finger, Kenneth L., Chevron Oil Field Research Co., La Habra, California.
Biostratigraphy and paleocology of a new Ostracode fauna from the Rincon Formation (Oligo-Miocene), Los Sauces Creek, California.

* Indicates speaker.

Schedule of Symposium on "CENOZOIC NONMARINE DEPOSITS OF THE WESTERN USA

Friday, 16 April 1982
Anaheim

8:50– 9:00 Raymond V. Ingersoll, Michael O. Woodburne: Introduction.

9:00– 9:20 Christopher M. Palmer, Robert D. Merrill: Braided-stream and alluvial-fan depositional environment in the lower to middle Eocene Ione Formation, Madera County, California.

9:20– 9:40 Alan J. Bartow: Sedimentology of a middle Tertiary paludal deposit, northern San Joaquin Valley, California.

9:40–10:00 Lori L. Summa, Jeffery F. Mount, Kenneth L. Verosub: The depositional environment of the Neogene Mehrten Formation at its type section.

10:00–10:20 Stanford University Sedimentary Seminar (Catherine L. Gavigan, speaker): Tectonic and climatic controls on sedimentation of upper Miocene nonmarine strata east of San Francisco Bay, California.

10:40–11:00 Paul R. Smith: Sedimentology and paleolimnology of the Miocene Peace Valley Formation, Ridge Basin, central Transverse Range, California.

11:00–11:20 Keith W. Ehlert: Basin analysis of the Miocene Mint Canyon Formation, southern California.

11:20–11:40 Paul R. Smith, Andrew S. Harper, Mark F. Wood: Nonmarine trace fossils in the Mio-Pliocene Ridge Basin, central Transverse Range, California.

Lunch

1:30– 1:50 Craig G. Moseley, Don A. Williamson, Susan T. Miller: The stratigraphy of the northeastern Cady Mountains and its implications for the Cenozoic volcanic evolution of the Mojave Desert.

1:50– 2:10 Bruce J. MacFadden, Michael O. Woodburne*: Magnetic polarity stratigraphy of the middle Miocene Barstow Formation of the Mojave Desert, southern California.

2:10– 2:30 Sheila K. O'Connor: Palynology of the Barstow Formation (Miocene), Rainbow basin, southern California.

2:30– 2:50 Richard L. Squires, David M. Advocate: Sedimentary facies of the nonmarine lower miocene Diligencia Formation, Canyon Spring area, Orocopia Mountains, southern California.

2:50– 3:10 Dennis R. Kerr, S. Pappajohn: Sedimentologic, stratigraphic and tectonic significance of Neogene sedimentary megabreccias, western Salton Trough, California.

3:30– 3:50 William N. Krebs, J. Platt Bradbury: Neogene lacustrine diatom biostratigraphy of the western Snake River basin, Idaho-Oregon.

(continued on page 6)

SEPM SYMPOSIUM

(continued from page 5)

3:50– 4:10 Joseph R. Davis: Closed-basin lithofacies in the upper portion of the Esmeralda Formation, Clayton Valley, Nevada.

4:10– 4:20 J. D. Nations, J. J. Landye, R. H. Hevly: Location and chronology of Tertiary sedimentary deposits in Arizona: a review.

*Speaker.

SEPM SESSION

SEDIMENTARY MINERALS

Thursday Afternoon

1:30 Randell, David H., and Allen, Gerald R.
Aggregate-Resources Evaluation of the Lund, Nevada 1° by 2° Mapsheet.

2:00 Rushing, Roy J., and Woyski, M.S.. Geology and Mineralogy of the Vogel Specialty Sand Deposit, Barstow, San Bernardino County, California.

2:30 Shlemon, Roy J.
Buried Pleistocene Gold-Bearing Channels, Central Great Valley, California.

3:00 Unruh, Mark E., and Ruff, Robert W.
Lacustrine Diatomaceous Deposits of the Piute Valley, California-Nevada.

3:30 Hillibrand, Rick T., and Affolter, Ron.
Lacustrine Sedimentation in Part of the Goose Creek Lignite Field, Cassia County, Idaho. (Tert. Basins).

4:00 Roehler, H. W.
The Physical Evidence for Saline Cycles of Deposition in Eocene Lake Gosiute in Southwest Wyoming.

FRIDAY AFTERNOON

1:30 Ingle, James C., Lagoe, Martin B., Helenes-Escamilla, Javier.
Distribution and Depositional History of Neogene Phosphorites Along the Pacific Coast of North America.

2:00 Fife, Donald L. and Bryant, Mark E.
The Significance of Neogene Phosphorites in the Capistrano Embayment, Southern California.

2:30 Kupferman, Steven A.
Gypsum Deposits of the Fish Creek Mountains, Imperial and San Diego Counties, California.

3:00 Raup, Omer B.
Pennsylvania Evaporite Cycles, Paradox Basin, Utah.

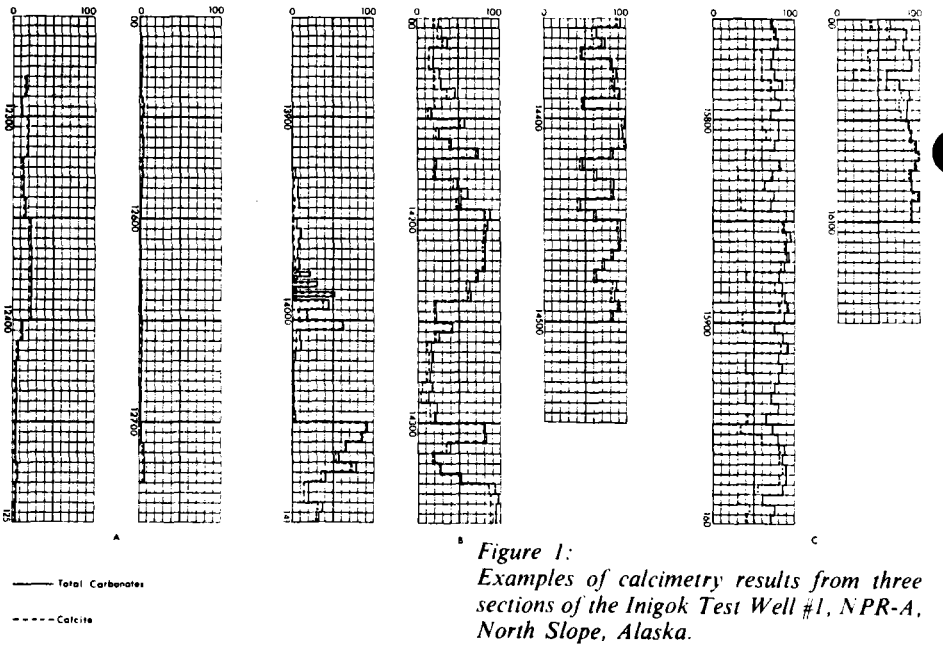

Figure 1:
Examples of calcimetry results from three sections of the Inigok Test Well #1, NPR-A, North Slope, Alaska.

CALCIMETRY IN THE FIELD; THEORY, OPERATION AND USES

DAVID C. ARNOTT
EXLOG
Exploration Logging USA Inc.
Ventura, California

ABSTRACT

Calcimetry is a method of determining the total cabonate content of a rock sample and for differentiating the various carbonates (in particular, calcite and dolomite). It is a useful correlatory and formation evaluation tool and can be performed under field conditions with a farily high degree of accuracy. At the present it is not used as often as it could be, partly due to an ignorance of its existence and partly because of a lack of understanding of its usefulness. This article covers the theory, the operation and the interpretation of field calcimetry and an actual example (using the Inigok #1 well on the NPR-A) is included.

"What is an Autocalcimeter?"

The advent of electronically sophisticated aids to formation evaluation (eg. GEMDAS, downhole tools, pyrolysis, etc.) has tended to overshadow the development of other, simpler but also useful, correlatory tools. One such aid is the Autocalcimeter, but one is often asked "What is an Autocalcimeter?" or, for that matter, what is calcimetry in general.

Calcimetry encompasses all the various techniques for establishing the carbonate content of a rock sample and for differentiating between the carbonate types. Clearly the best possible method is a complete chemical analysis under laboratory conditions, but when large numbers of samples need analysis (e.g. drill cuttings from an exploration well) this becomes both time consuming and very expensive. Ideally a simple, rapid but accurate field method is required and has been developed in the form of the Autocalcimeter.

Theory

When a pulverised and homogenised rock sample is mixed with dilute (generally 20%) hydrochloric acid, any carbonates present react and evolve carbon dioxide gas, the quantity of which is directly proportional to the total amount of carbonates present in the sample (provided sufficient acid is used to allow complete reaction). Consequently any method of determining the quantity of carbon dioxide evolved will, by extrapolation, yield the percentage of carbonates in the sample. Of course, different carbonates will react at different rates and so if the method also monitors the rate of evolution of the CO_2 the different carbonate types can be determined.

"What use is Calcimetry?"

To make the maximum use of calcimetry, readings are plotted on the master drill returns log for ease of correlation with other logging parameters and a typical example is shown in figure 4. The histogram type plot is used because of the puncutated sampling procedure (i.e. it is not a continuously recording instrument). As can be seen the plot is of calcium carbonate and total carbonates which permits the easy recognition of the limestones (below the dotted line), the dolomites (between the dotted and solid lines) and the non carbonates (above the solid line).

As a diagnostic tool calcimetry data can be used for:

1). Identifying carbonate stringers for stratigraphic interpretations and correlations.

2). Detecting subtle lithological variations which may affect trend line analysis of overpressure regimes.

3). Detecting the presence of carbonate

(continued on page 7)

CALCIMETRY

(continued from page 6)

reservoir seals and permeability barriers.

4). Enhancing formation evaluation by accurately determining the percentages of calcite and dolomite.

5). Enhancing wireline log analysis and formation evaluation by identifying matrix types and amounts.

6). Identifying more abrasive zones to aid in bit selection.

7). Recognizing zones of geothermal alteration (e.g. dolomitization, calcite veining, etc.)

Calcimetry has been used by several major oil companies in many areas of the world including Santa Barbara Channel, the Middle East, the Mediterranean, the North Sea and the North Slope (Alaska) to name but a few.

The author was involved in the use of calcimetry on Inigok Test Well #1 (Sec. 34, T8N-R5W; UM, NPR-A, North Slope, Alaska) and so, by kind permission of the USGS, some of the results are included here by way of examples. Figure 1 shows the calcimetry results from three sections of that well.

Section A covers the Shublik Formation. Ranging from dark grey shales in the Brooks Range to porous sandstones in the Prudhoe Bay area, the Shublik in this well proved to be a section of dark grey shales, dark grey siltstones, dark grey argillaceous limestones and minor sandstones all of which proved to be calcareous to some extent. Here used on the the total samples at 10 foot intervals, the sensitivity of the autocalcimeter to minor changes in carbonate content is demonstrated.

Section B covers the transition from the Lisburne Limestone into the overlying Sadlerochit Formation. In other areas of the North Slope this boundry is seen to be quite sharp but in the area of Inigok, as indicated by the calcimetry, the Lisburne did not end with a single transgression. Also note the minor but variable quantities of dolomite through this section.

Section C was taken from the middle o f the Lisburne group and very clearly indicates the autocalcimeters ability to distinguish the dolomitic zones of a thick, fairly uniform, limestone sequence, not only useful for correlation but also for indicating the potentially more porous zones.

Conclusion

It must be said that, as with all mechanical devices, the Autocalcimeter does have its limitations. Generally, complete samples are analyzed to give overall trends as opposed to picking out sufficient cuttings of a specific type (although this is quite possible it would prove very time consuming and thus reduce the effective sample turn around time). Also minerals such as pyrrhotite and sphalerite evolve H2S when subjected to hydrochloric acid and this would show up as a pressure increase in the reation cell. Luckily such minerals are rare in unaltered sediments and the distinctive odor of H2S would alert the operator to their presence.

All in all, however, the advantages and usefulness of the Autocalcimeter far outweighs these minor limitations.

PACIFIC SECTION

Society of Economic Paleontologists and Mineralogists
P.O. Box 10359
Bakersfield, CA 93389

The new officers of the Pacific Section SEPM are:

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Stanford, California 94305

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Mark Filewicz
Union Oil Company

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Caroline M. Isaacs
U.S. Geological Survey
345 Middlefield Road
Menlo Park, California 94025

BOARD OF REGISTRATION FOR GEOLOGISTS AND GEOPHYSICISTS MEETINGS

April 19, 1982—Convention Center Anaheim
May 11, 1982 Bakersfield
June 22, 1982 Sacramento

For additional information contact the office of John E. Wolfe, Executive Secretary, Board of Registration for Geologists and Geophysicists, 1020 N Street, Room 419, Sacramento, Ca 95814.

Alaska

CALENDAR

April 29
GSA Regular Meeting.
Dr. Thayne McCullon, USGS, Seattle.
"Thermal Evolution of Frontier Basins".

May
Alaska Geological Society Field Trip and Picnic.
Anchorage to Matanuska Glacier.

July 18-22, 1983
Fourth International Conference on Permafrost.
Fairbanks, Alaska.

Los Angeles

CALENDAR

March 25 "Abnormal Pressures Produced by Hydrocarbon Generation and Maturation and Their Relation to Migration and Accumulation", AAPG Distinguised Lecturer, Fred Meisner, Bird Oil Corp.

April 22 "Recent Developments Concerning Cenozoic Plate Tectonics of Western North America", Dr. Tanya Atwater, U.C. Santa Barbara.

DARLENE CONDRA

San Joaquin

1982-83 NOMINATIONS

The following names have been placed in nomination as officers for S.J.G.S. 1982-83:

President-Elect:
Jeff Smith — Maranatha
Frank Amato — Consultant

Vice President:
Susan Chandler Kiser — DEPCO
Bob Hunt — Tenneco

Secretary:
Frank Cressy — Quintana
Russ Robinson — Gulf

Treasurer:
Bill Long — OXY
Joe Laing — Getty

Nominated as representatives or alternates for San Joaquin Geological Society to the National AAPG are:

Leon Earnest — Getty
Jack Clare — Argonaut
Bob Horton — Consultant
Ken Wainwright — ARCO

June — Talk on Lost Hills

S.J.G.S.'s tentatively scheduled speaker for June is Mr. Leon Earnest with Getty, who will present a talk about Lost Hills.

The recent activity and the sharp increase in production at Lost Hills has created much interest in the industry. It is certain that Mr. Earnest's talk will be eagerly awaited.

Hibernating for Winter or What???

Locally, if anyone has been moving from company to company, they have certainly been discreet about it. Has someone moved quietly to another company? . . . Has everyone settled in for a winter siege? . . . or . . . Is the industry's version of musical chairs slowing down?

Buttes Rumor

The most popular rumor of the month has Buttes Resources closing the doors to its Bakersfield office (and possibly selling its properties in California).

MAGI NIELSEN

Sacramento

Officers of the Sacramento Petroleum Association for the calendar year 1982 are:

President:
Arsen A. Shahnazarian
Natural Gas Corporation of Calif.
706 Fifth Street
Davis, California 95616.

Vice President:
Basil R. Holmes
Tenneco Oil
2580 Sierra Blvd., Suite C
Sacramento, California 95825.

Secretary-Treasurer:
Don B. Pinnell
735 Commons Drive
Sacramento, California 95825.

The Association address: P.O. Box 254443, Sacramento, CA 95825.

Coast

CALENDAR

Tuesday, April 20
AAPG Distinguished Lecture
Tim T. Schowalter
Mosbacher & Pruet Oil Producers
"Interpretation of Subsurface Hydrocarbon Shows"

Tuesday, May 18
CGS Evening Meeting
Jack S. Cunningham
Husky Oil Co.
"Recent Developments of the Monterey Formation in the Santa Maria Basin"

Location for all meetings is the American Legion Hall, 83 S. Palm, Ventura.

Happy Hour — 6:00 p.m.
Dinner — 7:00 p.m.

For more information contact Ed Magdaleno, (805) 654-6829.

PROFESSIONAL MOVES:

Conoco:

Kevin Lant, geologist, has been promoted and transferred to Conoco's Midland, Texas, office.

Ed Russell, geologist, has transferred from Conoco's mineral division in San Antonio, Texas, to it's Ventura office.

Ken Tellsen has moved from Conoco's Lafayette, LA, office to join its staff of geologists in Ventura.

Hans Sheline, geophysicist, has joined Conoco's office in Ventura after receiving his Masters in Marine Geology and Geophysics from the University of California San Diego (Scripps).

Union:

Mike McCaskey has started work for Union in Ventura after recently receiving his Masters in geology from Texas A&M.

Jack Mayhew, geologist, has rejoined Union Oil. The previous eight years were spent in Nevada with a clay mining company.

Dan Burns and Randall Richter have been added to Union's staff of geophysicists.

Steve Pavlak and Bill Snydsman have been transferred to Union's Ventural office. Bill is from Union's Research Dept. and Steve was with Union's Minerals Exploration in Casper.

Getty:

Last July, Gardner M. Pittman transferred to Denver as Getty's District Exploration Geologist and Brad Newman took his place as District Development Geologist in Ventura.

Chris Bathker and Nancy Darigo are two new geologists in Getty's development group.

Argo:

Walt Remsen and Steve Langford have joined Argo's staff of geologists. Walt was previously working for Getty in Ventura and Steve was with Getty in Bakersfield.

SUSAN KROSKY

PACIFIC SECTION — AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS
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Material for publication, requests for previous copies and communications about advertising costs should be addressed to JOHN W. RANDALL, GULF OIL, 5200 STOCKDALE HWY., BAKERSFIELD, CALIF. 93309.

CHANGE OF ADDRESS, subscription, and membership inquiries should be directed to: MEMBERSHIP SECRETARY, PACIFIC SECTION AAPG, P.O. BOX 1072, BAKERSFIELD, CALIFORNIA 93302.

PUBLICATIONS COMMITTEE: Pacific Section American Association of Petroleum Geologists, P.O. Box 927, Camarillo, CA 93010.

PPG DEADLINE
for MAY ISSUE
APRIL 13

for JULY ISSUE
JUNE 15

NEWSLETTER
Pacific Section A.A.P.G.
P.O. Box 1072
Bakersfield, California 93302

J. D. Traxler DA-AM
15510 Friends St. Honorary
Pacific Palisades, CA 90272

PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

of the Pacific Section
American Association of Petroleum Geologists

JUNE 1982

PRESIDENT'S CORNER . . .

"My thanks to the members of the Executive Committee, Ted Off, Rex Young, Dan Pasquini and Mark Cole, for their efforts this past year. A very special thanks goes to Bill Reay, General Chairman of the 1982 Annual Meeting."

John Carver

PACIFIC SECTION AAPG New officers for 1982-83 are:

President ..... Theodore Off (Ojai Oil Co.)

President-Elect ..... James Weddle (Consultant)

Vice President ..... Stanley Karp (Professor, Bakersfield College)

Secretary ..... Joan Winterer (Union Oil Co. Calif.)

Treasurer ..... Mark Cole (Texaco)

Past President ..... John Carver (Occidental)

Dr. James E. Slosson

Dr. James E. Slosson, President of the Board of Registration for Geologists and Geophysicists, is a candidate for the Republican primary in the 43rd Assembly District (includes Beverly Hills).

Dr. Jim has been a Professor of Geology at Los Angeles Valley College for over thirty years and a private consultant for over twenty-five years. While working on his doctorate, he found time to coach track winning two State Championships for Valley College and three NCAA Championships for USC; he has coached and counseled many Olympic competitors.

He was appointed State Geologist and Chief of the California Division of Mines and Geology, serving 1973 through 1975. His activities on local and state boards and commissions include the Seismic Safety Commission, Board of Registration for Geologists and Geophysicists (President, three consecutive terms), Governor's Earthquake Prediction Evaluation Council, Solid Waste Management Board, Geothermal Resources Board, Commission on U. S. Forest Service Practices, West Los Angeles County Resources Conservation District, Community College District Building Committee, City and County Grading Appeals Boards, Hazardous Buildings Code Development Committee, Hospital Building Safety Board, Land Use Study Committee, and others. He is an author and lecturer, serving universities such as USC, UCLA, Harvard Graduate School, Occidental, UC Berkeley, and others. He is active in over fifteen professional organization in technology and education and is highly respected as a scientist, educator, and administrator.

MONTEREY OIL FIELDS SYMPOSIUM

LOOKING AHEAD TO 1983

Plans for the symposium on oil fields in the Monterey Formation are rapidly taking shape. The symposium, which is jointly sponsored by the Pacific Section SEPM and the Pacific Section AAPG, will be held at the 1983 convention in Sacramento.

We are actively soliciting participation in the technical program — both talks and papers for the symposium volume. Technical contribution from industry is absolutely essential, so plan ahead for your contribution! We are interested in:

- MATURATION OF ORGANIC MATTER
- PETROLEUM GENERATION
- TYPES OF HYDROCARBON RESERVOIRS
- RESERVOIR CHARACTERISTICS
- PETROLEUM MIGRATION
- WELL-LOG EVALUATION
- PRODUCTION PRACTICES

Papers on individual oil fields are encouraged. We would like to hear about the stratigraphy, structure, production, etc. of any or all of the following fields:

San Joaquin Basin

- LOST HILLS Field
- MIDWAY-SUNSET Field
- BELRIDGE Field
- McKITTRICK Field
- ELK HILLS Field
- BUENA VISTA Field

Central Coast

- SAN ARDO Field

Santa Maria Basin

- SANTA MARIA VALLEY Field
- ORCUTT Field
- CASMALIA Field
- LOMPOC Field
- CAT CANYON Field
- ZACA Field
- GUADALUPE Field

Santa Barbara Basin

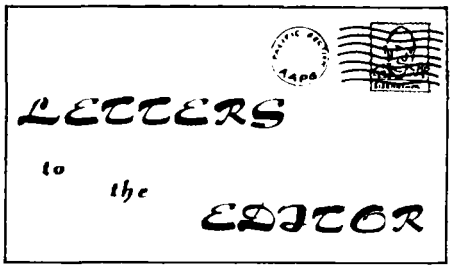
- SOUTH ELWOOD Field
- HONDO Field
- POINT ARGUELLO Field

Ventura Basin

- OXNARD Field
- OJAI Field
- SULFUR CREST Field
- SANTA CLARA Field

Please send tentative titles for talks to: Caroline M. Isaacs, U.S. Geological Survey, 345 Middlefield Road — MS 99, Menlo Park, CA 94025. For further information or discussion, contact any of the symposium organizers: Robert E. Garrison, UC Santa Cruz (408–429-2114); Stephan A. Graham, Stanford University (415–497-0507); Caroline M. Isaacs (415–856-7010); and Wallace A. Jensky II, Argo Petroleum (213–452-8676).

PPG DEADLINE for SEPTEMBER ISSUE AUGUST 10



AAPG Day in Tulsa

AAPG Day in Tulsa was held on April 29, 1982. John Carver, President of the Pacific Section, and Ed Frankovic, President of the Northern California Geological Society, attended this first and probably annual event. Tours were given of the national AAPG headquaters. Everyone attending was amazed at the amount of work accomplished with their small staff. Demonstrations were given on the Society's text editing equipment, the computer printing of various letters, signs, and name badges, the data retrieval system in the membership department, the electronic postage system, and the Society's reproduction facilities. If you are ever in Tulsa, it is very worthwhile to spend an hour to tour this facility and see your Association in action.

Short, informative presentations were given by the heads of AAPG's four departments. Ted Beaumont, the Science Director, was first. Presently, the AAPG conducts 26 schools and seminars and would like to expand the number of structural geology schools. 60% of the articles submitted to the *Bulletin* are accepted. More articles on fields are desired. AAPG is working with NOVA to produce a documentary on how oil is found. The AAPG Energy Resources library is available to all members. The library has 57 different geological journals and photocopies material as a member service. The AAPG has started a program to publish various trail guides; the first one to be released will be on the Bright Angel Trail.

Kathy Watson, the Convention Director, said that registration for this year's convention in Calgary was running at about 68% of the San Francisco level. Negotiations were underway with various airlines to provide reduced convention fares. Delta has pledged a 20% for Dallas, San Antonio, New Orleans and Atlanta. The 1987 convention will be in Los Angeles, 1988 in Houston, and 1989 in Denver. The high registration cost for the Calgary convention is due to the rental of the convention facilities.

Rex Blakey, the Communications Director, stated that advertising revenues from the *AAPG Explorer* now almost pays for all of the costs of his entire department. Net advertising revenues (this year) for the *Explorer* will be about $450,000 and for the *Bulletin* will be about $300,000. The AAPG provided radio stations with public service messages concerning our profession and got a total of $858,000 worth of air time donated. "Careers in Geology" is the Society's most asked for brochure.

Don O'Nesky, the Business Director, told us that the nine year, $367,000 Stratigraphic Units of North America charts project will be completed within budget by September 30. The Tetonic Map of North America, a six year, $500,000 project is proceeding well. The Grants in Aid program for graduate students has been quadrupled to $40,000 from its original level. AAPG will soon initiate a standing order program so that members will be able to automatically receive future publications for the various series without having to continually fill out order forms as each new publication is released.

The remainder of the day was spent exchanging ideas among the representatives of the local Societies and Sections and National representatives. AAPG Day in Tulsa was very worthwhile and I hope that all of the Presidents of the local societies comprising the Pacific Section will be able to attend next year.

Ed Frankovic
President, NCGS

Comments of the Alaska Oil & Gas Association on the Proposed Five-Year OCS Oil and Gas Leasing Program (47 FR – 11980)— March 19, 1982

Gentlemen:

The Alaska Oil and Gas Association (AOGA) is a trade association whose 36 member companies account for the bulk of oil and gas exploration, production and transportation activities in Alaska. AOGA's membership includes the largest and some of the smallest petroleum firms in the industry. AOGA is the Alaska Division of the Western Oil and Gas Association.

We would like to comment on the Proposed Five-Year OCS Oil and Gas Leasing Program pursuant to the Interior Department's notice published on March 19, 1982, in the *Federal Register* on page 11980. We are furnishing you comments on what we believe is extremely important to our nation, as well as to our industry, in view of the fact that the major portion of our nation's Outer Continental Shelf lies offshore from the State of Alaska. We appreciate the opportunity to comment on the Interior Department's Proposed Five-Year Oil and Gas Leasing Program.

We wish to express our strong support for the proposed leasing program. We believe that it offers the best hope of identifying and developing the nation's offshore petroleum resources in a timely manner, while adequately preserving other valuable marine resources. Moreover, we strongly support maintaining Lease Sale No. 70 as scheduled at present.

OCS leasing in the United States began some thirty years ago, and in all that time, about 3 percent of our OCS lands have been leased. At this rate, it will require hundreds of years to adequately explore all of our OCS acreage. At the same time, our OCS oil production declined over the decade 1970-1980 from more than 1½ million to just over one million barrels per day. In view of the pressing national need for more secure sources of oil and gas supplies, this situation is clearly unacceptable. The Department's proposed program of area-wide assessment and leasing is an effective way to greatly increase the discovery and production of oil and gas from OCS lands, to the nation's benefit.

Some have expressed concerns as to whether the petroleum industry has the financial, equipment,and manpower support to respond effectively to the proposed schedule. We submit that the massive increases in U.S. onshore, offshore, and foreign exploration and production since oil price decontrol in early 1981 proves that the petroleum industry can respond quickly and efficiently to new opportunities. Given attractive and predictable incentives, the industry will continue to invest sufficient capital to efficiently explore and produce the nation's OCS oil and gas resources.

We also strongly endorse the proposed use of area-wide assessments prior to area-wide leasing. Nothing in the proposed program will reduce in any way the environmental responsibilities of OCS operators. The petroleum industry's obligations, together with the stringent penalties for non-compliance, will remain the same as they currently are under the liability provisions of the OCS Lands Act and the regulations implementing provisions of that Act.

We support the Department's streamlined and accelerated area-wide approach to OCS leasing as an efficient way to expedite much needed OCS oil and gas production. This method has worked very successfully in the North Sea, in the Canadian Arctic, and the eastern Canadian offshore area. During the decade 1970-1980, for example, North Sea production rose from a negligible amount to more than two million barrels of oil per day. It should be noted that the British portion of the North Sea contains a small fraction of the OCS area of the United States, yet the British North Sea area open to exploration far exceeds our total OCS acreage leased during the past thirty years.

We believe it is logical to offer for lease any and all OCS acreage nominated by interested and qualified oil and gas operators. We can see no justification for deleting any area nominated by any operator because the most important objective of the OCS program is to discover oil and gas, and more varied approaches to exploration will result in more discoveries. Oil and gas are found by human ideas and the drill bit, not

by acreage statistics or governmental evaluations. There are many instances where major petroleum reserves have been discovered by an innovative operator after being passed over by many others. Therefore, to preclude an operator from employing imaginative exploratory ideas because he is the only applicant in an area can result in a great loss in potential reserves.

AOGA endorses the "fair market value" concept and approach in awarding bids. We believe that post-sale evaluation is totally unnecessary. It is understood that the Interior Department will henceforth accept the high bid on any OCS tract which has received three or more bids. We believe all bids are competitive and each high bid does actually represent "fair market value" on any tract bid upon. Government should therefore accept every high bid that is offered at an OCS sale when sale notices have previously established minimum cost per acre or hectare. It appears government has the impression that when an OCS tract receives no bids at all from industry that industry did not evaluate the tract. On the contrary, industry has evaluated the trace; perhaps other unattractive factors have been encountered, such as water depths, further seismic evaluation, or climatic conditons; maybe an operator simply has other leasing priorities.

We believe that "fair market value" of an undrilled lease is only what a willing buyer will pay. It should also be noted that the bid price is not buying anything but the privilege to explore a lease, and that the odds against that lease being productive are on the order of 20 to 1. The Federal Government will profit to some extent if the operator bids several million dollars on a barren tract. We are convinced, however, that we all will profit much more from taxes, royalties, and stimulated business resulting from oil and gas production than from excessive lease bids.

With respect to the OCS lease terms where government has indicated it intends to reduce the ten-year lease term to a lesser amount, AOGA strongly supports consideration being given to granting at least a ten-year primary lease term to more adequately accommodate Alaska operations. Climatic conditions and remoteness of frontier exploration areas pose real logistic problems. It should be noted that exploratory efforts by industry generally require one year of advanced planning in order to secure and transport materials and equipment to an offshore exploration site. The transportation can be further impeded by pack-ice or lack of sufficient surface access. It would not be unusual to experience delays of 12 to 20 years between the award of an Alaska OCS Lease and commencement of commercial production. It would therefore be beneficial to national energy goals to maintain the ten-year lease term.

Lastly, we strongly endorse the comments of the American Petroleum Institute, which we have reviewed and which we understand will be filed with you.

Very truly yours,
WILLIAM W. HOPKINS
Executive Director

(Editor's note: At the recent AAPG-SEPM-SEG Pacific Section meeting in Anaheim, Margaret A. Keller was voted to receive the A. I. Levorsen Memorial Award for the outstanding AAPG paper. The Levorsen Award has been given at each section meeting since 1967. Keller's paper is as follows:)

DIAGENETIC MATURITY OF THE MONTEREY FORMATION NEAR OJAI, CALIFORNIA

by
Margaret A. Keller
U.S. Geological Survey
Menlo Park, California 94025

INTRODUCTION

The Monterey Formation is a middle and upper Miocene deposit that is unusually rich in siliceous debris from diatom frustules and also contains abundant carbonaceous organic matter. In California, the Monterey Formation is a major petroleum source as well as an important petroleum reservoir. Silica diagenesis — the progression from amorphous silica (as diatom frustules) to quartz, through an intermediate crystalline phase called opal-CT — appears to enhance reservoir quality in siliceous rocks by increasing their brittleness and fracturability.

The primary objective of this study was to evaluate the diagenetic maturity of the Monterey Formation in order to place limits on its burial and thermal history. The Monterey Formation was examined at Goleta and six localities on the north flank of the onshore Ventura basin (Fig. 1). Previous work by Isaacs (1981, 1982) established the lithostratigraphy and evaluated the diagenesis of the Monterey Formation along the Santa Barbara coast between Point Conception and Elwood (Fig. 1). In terms of the lithostratigraphy, Isaacs' detailed analysis of the Monterey Formation in well-exposed outcrops provides a framework within which to examine the Monterey in the adjacent, onshore Ventura basin, where strata are generally more poorly exposed and much more highly deformed. Isaacs (1981) has also determined the relation between bulk rock composition and silica diagenesis, and thus has contributed a useful method for determining maturity of moderately buried siliceous rocks.

Knowledge of silica diagenesis in the Monterey Formation has expanded greatly since 1974 (see Isaacs et al., 1982), pioneered by the work of K. J. Murata and co-workers (e.g., Murata and Larson, 1975; Murata et al., 1977), who contributed to both understanding of the details of silica diagenesis and application of this understanding to the solution of geologic problems.

GEOLOGIC SETTING

The Ventura basin is located in the western part of the Transverse Ranges province, a problematic tectonic block with anomalous east-west structural grain, in contrast to the predominant northwestward trend of Cenozoic structures in most of California. The Monterey Formation is well exposed in a south-dipping homocline along the Santa Barbara coast between Point Conception and Goleta; to the east, however, in the adjacent area of the onshore Ventura basin — including the localities of this study between Rincon Point and Sulphur Mountain — the Monterey Formation is less well exposed on the hanging wall of the north-dipping and seismically active Red Mountain thrust fault and in a set of tightly overturned folds east of the Ventura River.

STRATIGRAPHY

In the northern Ventura basin, the Monterey Formation is underlain by marine mudstone of the uppermost

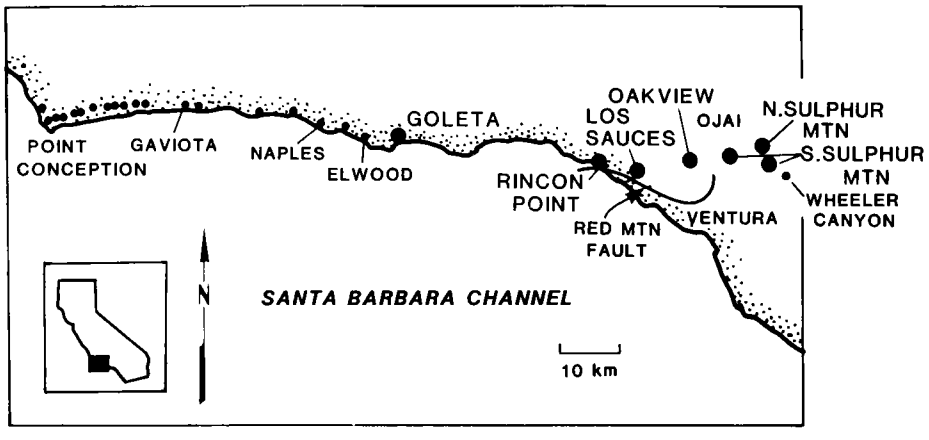


Fig. 1. Index map of localities in this study (large dots) and in Isaacs' (1981, 1982) study (small dots).

Oligocene and lower Miocene Rincon Shale and is overlain by marine shale of the Miocene and Pliocene Sisquoc Formation. Overlying these rocks are more coarsely clastic Pliocene and Pleistocene strata including the Pico, Santa Barbara, San Pedro, and Saugus formations.

The lithostratigraphy of the Monterey Formation along the trend examined in this study is similar to that in the adjacent area west of Goleta. The two areas (Fig. 1) lie along an approximately east-west line parallel to and north of the axis of the Miocene basin trough in which the Monterey was deposited (Fischer, 1976; Ingle, 1980). In nearby areas to the south, east, and north, the Monterey Formation or its equivalent, the Modelo Formation, contains abundant and locally thick sand layers, probably turbidites, interbedded with siliceous shale.

Three important characteristics aid in recognition of the lithologic sequence in the Monterey Formation in these two areas (Fig. 2). First, with the exception of the organic shale member, the Monterey as a whole is highly siliceous. Second, except for the siliceous member at the top of the sequence, Monterey strata are commonly calcareous or dolomitic; even in the siliceous member, carbonate occurs in rare nodules. Third, in contrast to the more siliceous members above and below, the organic shale member has very low resistance to erosion and commonly is poorly exposed because of its abundant carbonaceous organic matter and sparse silica; the organic shale member also contains abundant clay minerals and, commonly, abundant phosphate.

In the Monterey Formation between Rincon Point and Sulphur Mountain, Isaacs' (1981) five members (Fig. 2) are easily recognizable. Minor differences in lithology occur in the study area at the two easternmost localities on Sulphur Mountain: (1) a calcareous unit of latest Mohnian age is present at the top of the Monterey (i.e., at the top of the siliceous member); and (2) at one locality on the northern flank of Sulphur Mountain in the transition member, sand beds as much as 0.5 m thick are interbedded with siliceous shales.

To determine the regional pattern of diagenetic maturity in the Monterey Formation, samples were collected at each locality from the same stratigraphic horizon, the base of the transition member. The transition member was used as the sampling horizon because of three important characteristics: (1) lithologic diversity, which aids in precisely evaluating the diagenesis; (2) distinctive interbedding easily recognized in the field, even in structurally complex areas where enough of the sequence is exposed, and (3) a distinctive benthic-foraminiferal fauna of early Mohnian age, close in age to the stage boundary between the Mohnian and Luisian.

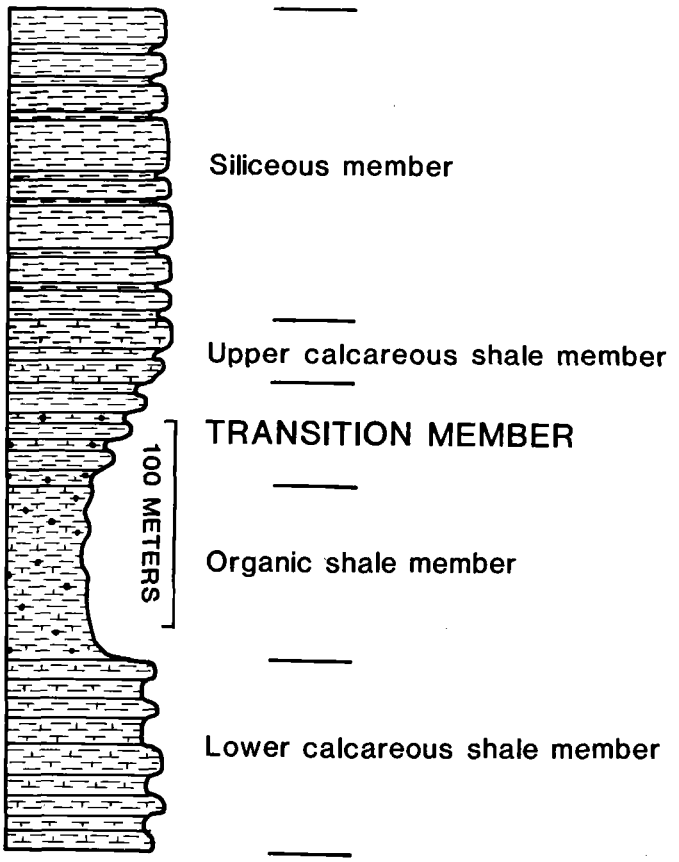


Fig. 2. Generalized lithologic column of the Monterey Formation between Point Conception and Sulphur Mountain (modified from Isaacs, 1981).

DIAGENESIS

Silica diagenesis in the Monterey Formation involves two phase changes to transform unstable, amorphous silica (diatom frustules) into stable crystalline quartz; the transformation rates are principally a function of temperature. The first silica phase transformation, from diatom frustules (opal-A) to opal-CT, is estimated to occur at about 35° to 50°C, and the final transformation, from opal-CT to quartz, at approximately 70° to 85°C (Murata et al., 1977).

As a result of erosion and complex deformation in the northern Ventura basin, the aggregate thickness of overburden originally deposited on the Monterey Formation cannot be directly determined at the sample localities. Therefore, the purpose of this investigation was to estimate the amount of overburden by an indirect and recently developed method adapted from Isaacs (1981). This method consists of evaluating by X-ray diffraction the silica in samples ranging widely in bulk rock composition. Because bulk rock composition apparently affects the temperature at which the silica phases transform, this evaluation yields a diagenetic assemblage (Fig. 3) indicating the diagenetic maturity of each locality.

The results of this study show that diagenetic maturity increases to the east into the northern Ventura basin from a minimum at Goleta (where no diagenetic silica has formed) to a maximum at the two localities on the south flank of Sulphur Mountain (where a mixed diagenetic assemblage containing both opal-CT and quartz is present). At Rincon Point (R, Fig. 3), opal-CT has formed in all but the layers richest in detrital minerals; these layers still contain opal-A. In the intermediate localities at Los Sauces Canyon, Oakview, and on the north flank of Sulphur Mountain, the silica in the transition member is all opal-CT. On the south flank of Sulphur Mountain (S, Fig. 3), at the most diagenetically mature localities, quartz has formed only in the layers richest in detrital minerals. These results provide maximum temperatures for two localities in the study area: (1) approximately 50°C at Rincon Point, where the opal-A to opal-CT transformation is in progress; and (2) about 70°C on the south flank of Sulphur Mountain, where the opal-CT to quartz transformation has occurred in a few rocks. The results of this study in combination with Isaacs' (1981) data for the coastal area between Elwood and Point Conception indicate the regional east-west pattern of daigenetic maturity illustrated in Figure 4. The most notable feature of this pattern is that Goleta represents minimum diagenesis, whereas diagenesis increases both to the west toward Point Conception, as shown by Isaacs (1981), and to the east into the Ventura basin, as shown by this study.

Figure 4 compares only the diagenetic maturity of the various localities; the burial depth at which the transformations took place depends on several conditions within

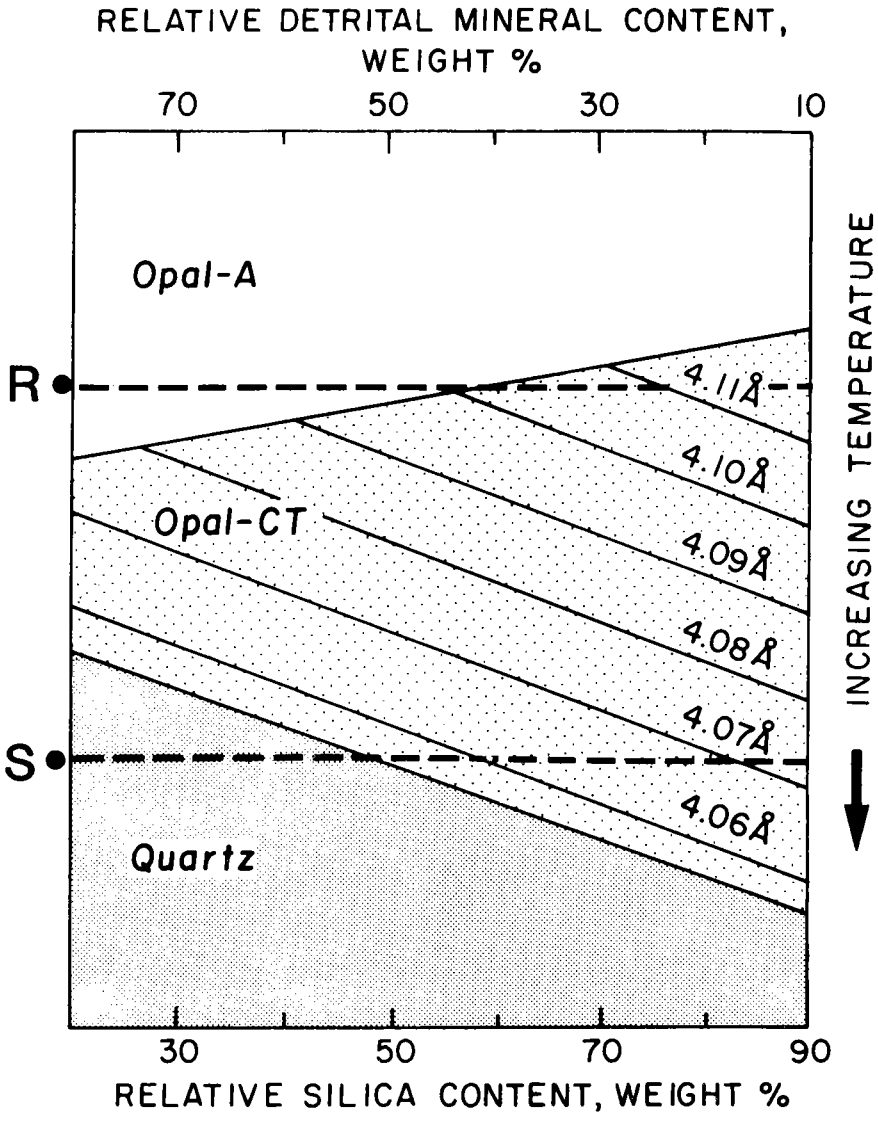


Fig. 3. Empirical relation between bulk rock composition and silica diagenesis of the Monterey Formation (from Isaacs, 1982). Dashed horizontal lines at points R (Rincon Point) and S (south flank of Sulphur Mountain) represent diagenetic assemblages at these localities. A diagenetic assemblage is characterized by the silica phase(s) present in rocks of widely varying bulk compositions, and maturity increases with increasing temperature. D-spacings of opal-CT on the right are from Isaacs (1982).

the geologic setting, most importantly the paleogeothermal gradient. Assuming a uniform east-west geothermal gradient, Figure 4 shows that Gaviota was buried to approximately the same depth as Sulphur Mountain and that Naples was buried slightly less deeply than Rincon Point (Fig. 4). Bostick et al. (1978) concluded, however, that the paleogeothermal gradient in the Ventura basin was no higher than the present gradient of about 24°C/km, which is about half the gradient just west of Point Conception at the OCS-CAL 78-164 No. 1 well (McCulloh and Beyer, 1979). Therefore, even though the diagenetic assemblages are similar at Gaviota in the west and Sulphur Mountain in the east (Fig. 1), the overburden at Sulphur Mountain was much thicker because the geothermal gradient in that area was only half as large.

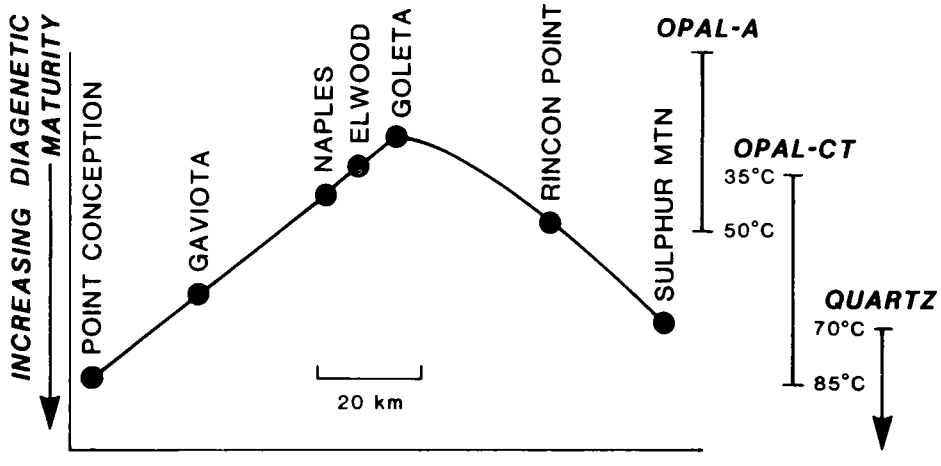


Fig. 4. Regional comparison of diagenetic maturity in the Monterey Formation between Point Conception and Sulphur Mountain. Temperatures are tentative estimates taken from Pisciotto (1981) and Isaacs et al. (1982).

Because the paleogeothermal gradient in the Ventura basin (about 24°C/km) and the diagenetic temperature (about 70°C) of the transition member are known, the maximum burial depth of the transition member at Sulphur Mountain is calculated to be approximately 2700 m (assuming a bottom-water temperature of 6°C). This estimate of the burial depth is very similar to the thickness of overburden (3000-4000 m) measured above the transition member in the Ojai Valley (Fig. 1), north of the study area; it differs markedly, however, from the thickness of post-transition-member overburden in Wheeler Canyon, just 2 km south and east of Sulphur Mountain. Estimates of the thickness in Wheeler Canyon are 6500 to 7000 m, more than twice the thickness estimated either from diagenesis or from measurements north of Sulphur Mountain in the Ojai Valley. This drastic difference in thickness supports Hsu's (1977) model for turbidite deposition in the Ventura basin, which shows rapid thinning to the north of the turbidites deposited in the deepest part of Ventura basin.

SUMMARY

Results from evaluation of silica diagenesis in the Monterey Formation between Goleta and Sulphur Mountain indicate that diagenetic maturity increases eastward from Goleta into the Sulphur Mountain area of the onshore Ventura basin. The method used in this study for evaluating silica diagenesis is useful for determining regional patterns of diagenetic maturity in the Monterey Formation. When these results are applied in a known geologic/geothermal setting, regional patterns of Pliocene and Pleistocene deposition can be determined from diagenetically derived estimates of burial depth.

A list of references is available upon request. Please contact the author or the Science Editor.

MEMORIAL TO Dr. Lowell E. Redwine 1911 – 1982

The geologic profession and the oil industry of California lost one of their foremost stratigraphers with the death of Lowell E. Redwine on March 21, 1982 at Costa Mesa. He succumbed to an "acute myocardial infarction, anterior, ruptured-thrombosis, left coronary artery". Death was instantaneous, at home, on a Sunday morning.

Lowell was born in Denison, Texas, on September 1, 1911, the son of Jack and Olive Redwine. The family moved to Arkansas for a brief period and then, in 1925, to Los Angeles where Lowell finished his secondary schooling at Jefferson High School. He received his B.A. degree in Geology from U.C.L.A. in 1935 and his M.A. degree from there in 1937. He then worked as an aide to Martin Van Couvering in the famed Kettleman Hills law suit after which he spent one year at the Scripps Institute of Oceanography. In late 1938, he joined Superior Oil Co. in Bakersfield and remained with them until 1943 when he joined Honolulu Oil Corp. In 1947, he was made District Geologist for Honolulu in Santa Barbara and remained with Honolulu until the company was sold in 1961.

During the period 1961-1964 he was a consultant in Bakersfield and Santa Barbara and also, after a thirty year respite from academia, returned to U.C.L.A. for his doctorate. This was granted in 1972 upon completion of his dissertation entitled "Territory of the Princeton submarine valley system beneath the Sacramento Valley, California". While working towards the doctorate he was employed in the research department of Richfield Oil Corp. from 1964 to 1966 and then joined the research department of Union Oil Co. where he remained until his retirement in 1976.

Lowell Redwine was a unique geologic talent — in my opinion, about as close to a true "scientist" as one might find in the oil patch. His penchant for careful observation, concise recording, detail and exactitude was well known. He often said that one of the reasons that geology was known as an "inexact science" was that geologists refused or failed to make and record accurate and detailed observations. Among his many other efforts, he carried on a continuing study of the Monterey shale for some thirty years. As a recent speaker in Ventura noted, "Lowell knew more about the Monterey than anybody".

It was my good fortune to have worked closely with Lowell for eight years. From him, I learned much. Each encounter over the past twenty years revealed his profound insight into the problem at hand. He was my friend and my mentor and I, for one, shall miss him greatly.

John F. Curran

MEMORIAL TO Claude M. "Tex" Leverett died March 27, 1982

"In the old days . . . ."

It was almost 20 years ago that I met Tex. A gravel-voiced, husky man puffing on a cigar that had to be at least two feet long and 18 inches of that was ash ready to fall. When Tex didn't have a long stogie stuck in his mouth, he would be chewing on an atrocious, gross-looking, brown thing which resembled all kinds of obnoxious, but in reality was just a stogie turned stub. This man was to be my boss for the next three years. Being a sensible female, I was crazy about him from the word go — his gruff manner and earthiness becoming endearments and a standard against which I would judge future bosses (there was never anyone better and some didn't even qualify to be measured against this man). Lord, could that man yell and when he would get mad at me (frequently), the yelling would start before he left his office, "Magi, d---- it what is this?"; "Magi, what the h--- did you do that for?". By the time he got to my room, I would either be screaming back or be rolling with laughter. Either approach would infuriate him, so we would fight for maybe five minutes; but, we could never be mad at each other for more than a half-hour at a time and quitting time would find us walking to the parking lot — he with his arm around my shoulders and me with my arm about his waist.

Tex was working as scout for Oxy when I met him, prior to that he had worked for Union, Franco Western, and Exxon (doing lease work). Before ill health forced his early retirement from Oxy in the mid-70's and during his years in the oil industry, he met and worked with many of you. I know you all have your own favorite stories and memories of this man, and that you share with me, the happiness of having known him and the sadness of hearing of his passing.

Definition of scout from "Manual of Oil & Gas Terms" by Williams and Meyers . . .

"SCOUT

A person employed by an operator to gather information about the activities of competing operators. He seeks knowledge of leasing, geophysical and geological surveys, drilling, well reports, etc. In some cases, such information is freely exchanged among operators. In others, secrecy is sought, and the scout must learn what he can without any aid from the rival operator."

"In the old days, there was a scout — one of the best, named Tex."

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NEWS RELEASE

Mission Resources is pleased to release information on two significant discoveries made in conjunction with the Mission Oil and Gas Program — 1981-II Partnership drilling program. The discoveries are located in Kern County, California and Starr County, Texas.

Robert O. McCrae, President of Mission Resources, stated that the **Dow Mission Frick #1** well on the **West Arvin Prospect, Kern County, California** was drilled to a total depth of 9,874 feet and initially flowed at a rate of 280 barrels of oil per day from two Miocene sands within the interval from 9,104 to 9,130 feet. Logs indicate an additional, potentially oil-productive sand at 8,970 feet. Mission Resources and the 1981-II Partnership have a 25% working interest in the well in a 560 acre lease block around the well. Currently, the well is shut-in waiting on surface production facilities.

Mr. McCrae also announced that the **Crux Slick Estate #1** well on the **Flores Prospect, Starr County, Texas,** flowed at a combined test rate of 2,000,000 cubic feet of gas and 42 barrels of condensate per day on a 14/64" choke. The two completion intervals are between 5,602 to 5,629 feet and 6,106 to 6,154 feet. In addition, two oil sands were logged in the well at depths of 4,740 and 5,355 feet. The well reached a total depth of 6,230 feet and was completed. The primary objective, the lower Vicksburg sands at a depth of 10,000 feet, remains untested. Mission Resources and the 1981-II Partnership have an 18.75% working interest in the well in a 1280 acre lease block. At this time, the well is shut-in waiting on a gas contract and pipeline.

Coast

There were 243 attendees at the May meeting of the CGS where Charles E. Katherman of Husky Oil Co. was the featured speaker on "Recent Developments in the Monterey Formation in the Santa Maria Basin".

CALENDAR

Friday, June 4th Spring Field Trip

Gary Nulty, with Argo in Ventura, lead a field trip in the Central Ventura Basin, examining the Sespe Formation in the Sespe field and South Mountain field areas.

Tuesday, June 15th

CGS Evening Meeting

Thesis night — featuring students from local colleges and universities.

Location: American Legion Hall, 83 S. Palm, Ventura.

Happy Hour: 6:00 PM.

Dinner: 7:00 PM.

For more information contact Ed Magdaleno (805) 654-6829.

PROFESSIONAL MOVES

Mark Dockum has joined CONOCO's staff of geologists in Ventura. He has recently received his Masters Degree from San Diego State.

Gary Jones, palynologist, after spending a year in UNION's operations group in Ventura, has transferred back to their research group in Brea, CA. Jeff Grover, recently graduated from the University of Arizona, is now working as a geologist in UNION's northern district in Ventura.

Danuta Woloszyn has transferred to EXXON's division office in Century City, CA from their district office in Ventura. Mike Bazzana has transferred from EXXON's Century City Office to the Ventura District.

George Sartor has joined SUN OIL as an associate geologist, after receiving his Masters Degree from Northeast Louisiana State.

Tom Hopps, president of the CGS, has formed a new company, Rancho Energy Company.

Sacramento

Sacramento will be the site of the 1983 Annual Meeting, AAPG, SEPM, SEG Pacific Sections. It will be held at the Red Lion Inn in Sacramento, May 18 through 21. John O'Kane of Natural Gas Corporation of Calif. is the convention chairman.

All USC Geology Alumni

Are requested to contact Jon Gaynor, Conoco (802) 642-8154 or Ed Magdaleno, Exxon (805) 654-6829 to reestablish alumni contact with the department. Upcoming Fall events include Alumni Day, Homecoming, and Football tickets.

Northern California

On Friday, May 14, 1982 the NCGS had its annual dinner meeting where there was a panel discussion concerning the issue of oil and gas leasing within the Los Padres Forest, California. Dave Bushnell of Natomas Petroleum Co. served as moderator. Panelists included: David Howell, U.S.G.S., presented resource potential (what might or might not be there). John Hooper of the Sierra Club asked Industry to leave it alone (put it in the context of leasing up diminishing recreational resources). Hollis Record of the Los Padres National Forest in Goleta argued in favor of leasing as a part of the multiple use concept.

N.C.G.S. JUNE LUNCHEON MEETING AT ELKS CLUB:

On June 23 Andy Bengtson will talk on the SCAT method of dipmeter analysis.

New officers of the N.C.G.S. for 1982-83:

President — Pete Miller (Chevron USA)

Past President — Ed Frankovic (Sohio)

Program Director — Dave Bushnell (Natomas)

President-Elect — John Kleist (Chevron USA)

Vice President — Paul Weimer (Sohio)

Secretary — Tom Dignes (Chevron USA)

Treasurer — Harry Hagen (Natomas)

Counselor — Herb Sawyer (Petro Consultants)

Counselor — Vern Stephens (Minerals Management Service)

San Joaquin

1982-83 ELECTION RESULTS

The following have been elected as officers for S.J.G.S. for 1982-83:

President-Elect:
Frank Amato — Consultant

Vice-President:
Susan Chandler Kiser — DEPCO

Secretary:
Frank Cressy — Quintana

Treasurer:
Bill Long — OXY

Mr. Jack Clare, Argonaut, was voted as "delegate" to the National AAPG (joining Mr. Don Collins, Oxy, who is and was serving as a delegate) with Mr. Leon Earnest, Getty, and Bob Horton, Consultant, elected as alternates.

. . . . and yes, Mr. Cressy, I voted for you.
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MOVES

Bravo Oil Company opened a division office, May 22nd, at 5500 Ming Avenue, Suite 135, Bakersfield, Ca., 93309. Roger Narinian, as Western Division Landman, and Harold Sugden, as Western Division Geologist, opened the doors. Both gentlemen were formerly with Buttes Resources.

Petro-Lewis Corporation, regional office, 5500 Ming Ave, Suite 250, Bakersfield, Ca., 93309, has expanded. Joining Mike Mulhern, head geologist — Western Region (formerly with Koch Exploraton), as staff geologists are Jim Dowdall (previously with Getty) and Susan Gaebe, a graduate of University of Missouri-Rolla.

UPCOMING ACTIVITIES

The S.J.G.S. fall barbeque is scheduled on Sept. 24, 1982: golf, tennis, volley ball . . . .

PUBLICATIONS

"OREGON GEOLOGY", a monthly publication by the State of Oregon, Department of Geology and Mineral Industries, is now available through subscription, to those of you interested in keeping current with Oregon geology. To order send the subscription with payment to Oregon Geology, 1005 State Office Building, Portland, Oregon, 97201.

OREGON GEOLOGY

Renewal Subscription Gift

1 Year ($4.00) 3 Years ($10.00)

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(If Gift, From:)

Mr. William King, petroleum geologist with the Department of Geology (Oregon), was kind enough to forward several copies of the March issue of this publication along with lists of other available publications to the Pacific Section. These were handed out at the S.J.G.S. May 11th dinner meeting.

"POTENTIAL SUPPLY of NATURAL GAS in the UNITED STATES" (as of December 31, 1980), a potential gas committee report, Potential Gas Agency, Colorado School of Mines, Golden, Colorado, 80401 is now available at $20.00/copy (with additional charge of $1.50 for postage and processing). A sample copy (for viewing) and order forms will be available at the May 11th, S.J.G.S. dinner meeting. (Any questions, please refer to the office of Harry C. Kent, Director — Potential Gas Agency; 303−279-4320).

Lecture:
THE OLYMPIC DAM (ROXBY DOWNS) URANIUM DEPOSIT

Mr. David E. Roberts, Senior Research Geologist, Olympic Dam Project, Roxby Management Services Pty. Limited, will present a lecture describing this newly discovered world class uranium deposit on Tuesday, August 3, 1982, at 1400 hours, in the Hearst Mining Building, University of California Berkeley campus. No formal description and very little general information have been published on this depoist yet it has come to represent a prototype exploration target because of its apparent large size and high grade. It also appears to be a new prototype with no earlier-known representatives.

Recommended Reading

GEOLOGICAL SOCIETY OF AMERICA (Publications Sales, GSA, P. O. Box 9140, Boulder, Colorado 80301)

Memoir 153: Cordilleran metamorphic core complexes, edited by Max D. Crittenden, Jr., Peter J. Coney, and George H. Davis.

$27.00

Special Paper 184: Pacific Northwest Cenozoic biostratigraphy, edited by John M. Armentout.

$26.00

ENGINEERING GEOLOGY, vol. 15, 1980

Tectonic state: Its significance and characterization in the assessment of seismic effects associated with reservoir impounding, by Robert O. Castle, Malcolm M. Clark, Arthur Grantz and James C. Savage (Pg. 53-99)

GEOLOGY, VOL. 10, no. 2, February 1982

Tectonic accretion and the origin of th two major metamorphic and plutonic welts in the Canadian Cordillera, by J. W. H. Monger, R. A. Price, and D. J. Tempelman-Lluit

GEOLOGICAL SOCIETY OF AMERICA BULLETIN, vol. 93, no. 2, February 1982

Provenance of Franciscan graywackes in coastal California, by William R. Dickinson, Raymond V. Ingersoll, Darrel S. Cowan, Kenneth P. Helmold and Christopher A. Suczek

GEOLOGICAL SOCIETY OF AMERICA BULLETIN, vol. 93, no. 1, January 1982

Tectonic geomorphology of the San Andres fault zone in the southern Indio Hills, Coachella Valley, California, by E. A. Keller, M. S. Bonkowski, R. J. Korsch, and R. J. Shlemon

CALIFORNIA DIVISION OF OIL & GAS, 1416 Ninth St., Room 1310, Sacramento, CA 95814.

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TR28 HEAVY OIL IN CALIFORNIA

Free

Ca. heavy oil occurrences, production, pumping, treating, shipping, refining, and future recovery are discussed (1981, 12 pages).

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TR27 A RESERVOIR ASSESSMENT OF THE GEYSERS GEOTHERMAL FIELD

$6.50

Production history, subsurface geology, geophysics, reservoir assessment, and drilling technology for The Geysers Geothermal field are discussed. Twenty-seven figures, 9 tables, 9 plates, 4 photos (1981, 60 pages).

NEWSLETTER
Pacific Section A.A.P.G.
P.O. Box 1072
Bakersfield, California 93302

Richard L. Hester
1911 Montecito Dr.
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DA-AM

PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

of the Pacific Section
American Association of Petroleum Geologists

SEPTEMBER 1982

PRESIDENT'S CORNER . . . Changing of the Guard

The Pacific Section operates on a fiscal year basis. At the July meeting of the Executive Committee, John Carver officially handed the gavel over to me. Thus, for the next year I have the privilege of serving as your president and filling up this corner of the newsletter.

Your new Executive Committee has inherited a smoothly running organization with well laid plans for the future and ample money in the treasury. (This has not always been true in the past). John O'Kane and his committee are well on their way towards our Spring convention in Sacramento and as the year ended we had over 1400 members.

Our thanks go to John Carver, president; Rex Young, vice-president and Dan Pasquini, Secretary, who leave the Committee. I have watched the hours of work they have put in on our behalf.

With this issue of the *PPG Newsletter* we also lose another important cog in the wheel. John Randall of Gulf in Bakersfield is retiring as editor after a 3 year stint. The quality of the newsletter during this period has been a joy to me and reflects John's dedication to the Section. Marc Traut of Occidental in Bakersfield, responsible for the science section of recent newsletters, has agreed to take over as Editor. Needless to say, he will be riding all of us to get our copy in on time.

Another missing face: The last issue of the Directory was edited by Steve Sterling. As is always the case in the oil business, just when you get someone trained, they get transferred. Steve is moving to Louisiana. He will be missed. Brian and Kay Pits have agreed to take on the job of the next Directory . . . a big one.

Obviously, as with any volunteer organization, your Executive Committee needs all the help it can get to perform the various tasks we have been charged with. If you'd like to get involved, please contact me or one of the other members. (A better business phone for me than the one in the directory is 805–484-4367).

Ted Off

PPG DEADLINE
for NOVEMBER ISSUE
OCTOBER 15

CALIFORNIA New Legislation Effecting Geologists And Geophysicists

A bill sponsored by the board was signed by Governor Brown in April which will add negligence as a violation of the Geologist and Geophysicist Act on January 1, 1983. It will be an addition to other violations such as deceit, misrepresentation, violations of contracts, fraud or incompetency in the practice of geology or geophysics.

A second bill sponsored by the board was signed by Governor Brown in July and it will also become effective on January 1, 1983, also. It permits public members to serve on committees and amends the current fee structure. Most significant changes in the fee structure will be an application fee for engineering geology certification and an automatic increase in the license delinquency fee. A fee of $40 will be charged for engineering geology application. There has not been an application or examination fee charged for certification as an engineering geologist because the original Act did not contain the authority for the board to set an application fee.

The delinquency fee for licenses will be increased from $25 to $40 for both registration as a geologist and as a geophysicist. The current renewal and delinquency fee is $105; on January 1, 1983, it will be raised to $120. The delinquency fee for the engineering geology license will not increase at this time.

DRILLING RIG PICTURE GROWS GLUMMER

By BILL RINTOUL

There's no sign of a rally in the depressed drilling picture. In fact, there's some erosion.

As of August 10, of the 181 land rigs available in California, 94 are working, or 51.9 percent. Eighty-seven are idle, or 48.1 percent.

Two weeks ago, 99 rigs were working, or five more than now. At the beginning of the year, there were 175 rigs available in California. One hundred and fifty-five were working, or 88.6 percent, and 20 were idle, or 11.4 percent.

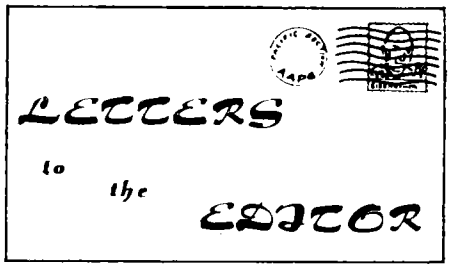
Ninety rigs are available out of Bakersfield yards. Of those, 49 rigs are working, or 54.4 percent, and 41 are idle, or 45.6 percent. At the start of the year, there were 83 rigs available. Seventy-seven were working, or 92.8 percent, and 6 were idle, or 7.2 percent.

Nationwide, the rig count has fallen to 2,671, off 34.1 percent from a year ago. The count fell 59 in one week at the end of July. The number of rigs working is the lowest since April 14, 1980.

Since the first of the year, operators have filed notices with the Division of Oil & Gas to drill 1,725 new wells in California. For the same period a year ago, the number of new well notices stood at 2,737, or 1,012 more than this year's figure.

Reworks are off too, though not nearly as badly as new wells.

Since the first of the year, operators have filed 1,547 notices to rework wells, compared with 1,614 notices for the same period a year ago.



Pacific Section, SEPM Fall Field Trip

This year's trip will focus on the Monterey Formation and associated clastic rocks of the west-central San Joaquin Valley. The trip will begin Friday evening, October 8th with dinner and a slide presentation at West Hills College, Coalinga. The trip will end Sunday, October 10th. Field trip leaders are: Steve Graham, Loretta Williams, Scott Cooley and Larry Phillips of Stanford University.

Cost of the trip is $57.00; send check payable to Pacific Section, SEPM to "SEPM Fall Field Trip", c/o Mark Filewicz, Union Oil Company, P.O. Box 6176, Ventura, California 93003.

The deadline for registration is Friday, September 24th. The trip will be limited to 175 people.

(continued on Page 6)

GEOLOGY OF THE KUPARUK OILFIELD, ALASKA

By GEORGE J. CARMAN
PETER HARDWICK
BP Alaska Exploration Inc.
San Francisco, California

INTRODUCTION

The Kuparuk oilfield is located at the northern edge of the Alaskan North Slope, approximately 260 miles north of the Arctic Circle (Figure 1). It was discovered in 1969 by BP Alaska/Sinclair Oil in well Ugnu-1 which produced oil at a rate of 1056 bbls per day from DST-1 (6158 to 6176 feet). The field's lateral extent is defined by shallow structural gradients and subtle lithology changes which necessitated the drilling of 25 appraisal wells before commitment to a development plan. In late 1981 the Kuparuk accumulation was unitized. The working interests are approximately 28.5% for BPAE, 57.0% for ARCO, 9.5% for Sohio, and 5.0% divided between Union Oil, Chevron, Exxon, Mobil and Phillips. The field was put on stream in December, 1981 with ARCO as operator, and is currently averaging about 90,000 b/d.

The Kuparuk reservoirs are contained in a unique Lower Cretaceous sand/shale sequence, derived from a local northern source at a time when the main sedimentary provenance was the Brooks Range to the south. This is important for exploration of the North Slope Basin since sediments derived from the Brooks Range during this period were largely flysch deposits and basinal mudstones lacking in reservoirs.

BASIN GEOLOGY AND STRATIGRAPHY

The principal structural features of the Alaskan Arctic Basin are the Barrow Arch and the Colville Trough (Figure 2). The Barrow Arch is a paleo-high that influenced the deposition of pre-Upper Cretaceous sediments and is now located just offshore and parallel to the present North Alaskan coastline. The Colville Trough is asymmetric with an east-west axis close to the Brooks Range. Its sedimentary -section above economic basement exceeds 30,000 feet.

The pre-Cretaceous sediments within this trough are as old as Mississippian in age and were derived from a northern provenance that probably lay beyond what is now the outer continental shelf. These strata are commonly referred to as the Ellesmerian or Lower Sequence. The overlying Brookian or Upper Sequence (Cretaceous to Tertiary) sediments were derived from the south following a plate collision and consequent uplift of the Brooks Range Mountains.

During the period when the major sediment provenance switched from the north to the south, locally derived sequences of clastic rocks were deposited adjacent to, and along the Barrow Arch. This Barrovian Sequence includes the Kuparuk reservoir which occurs in

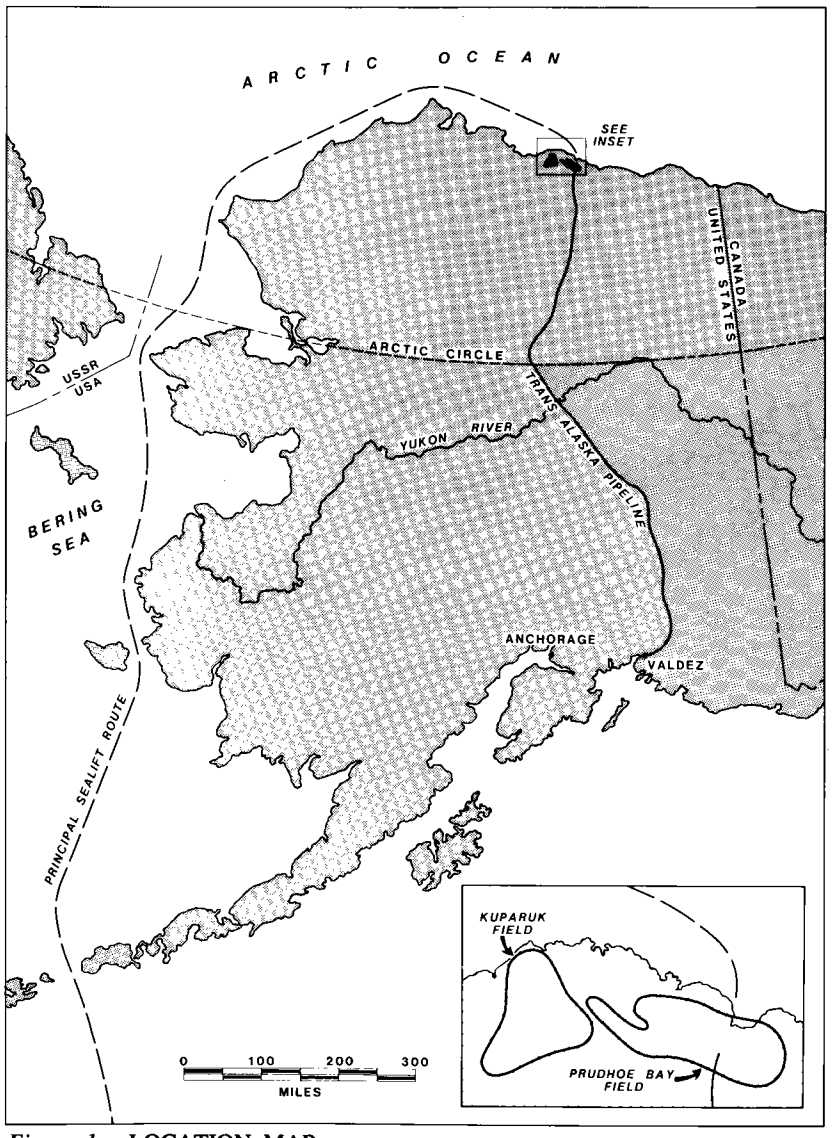


Figure 1. LOCATION MAP

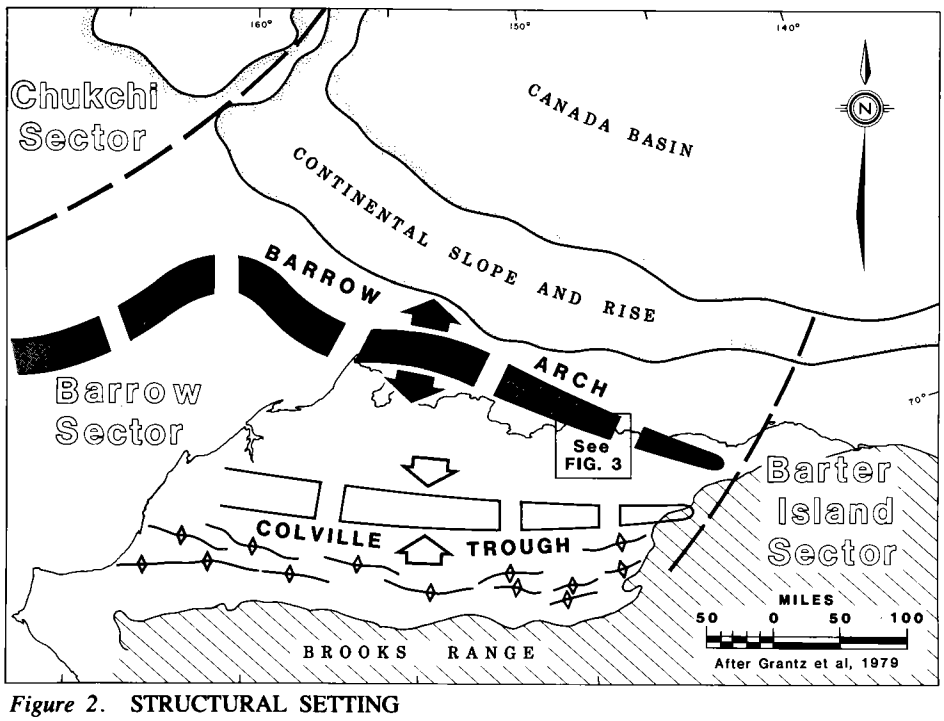
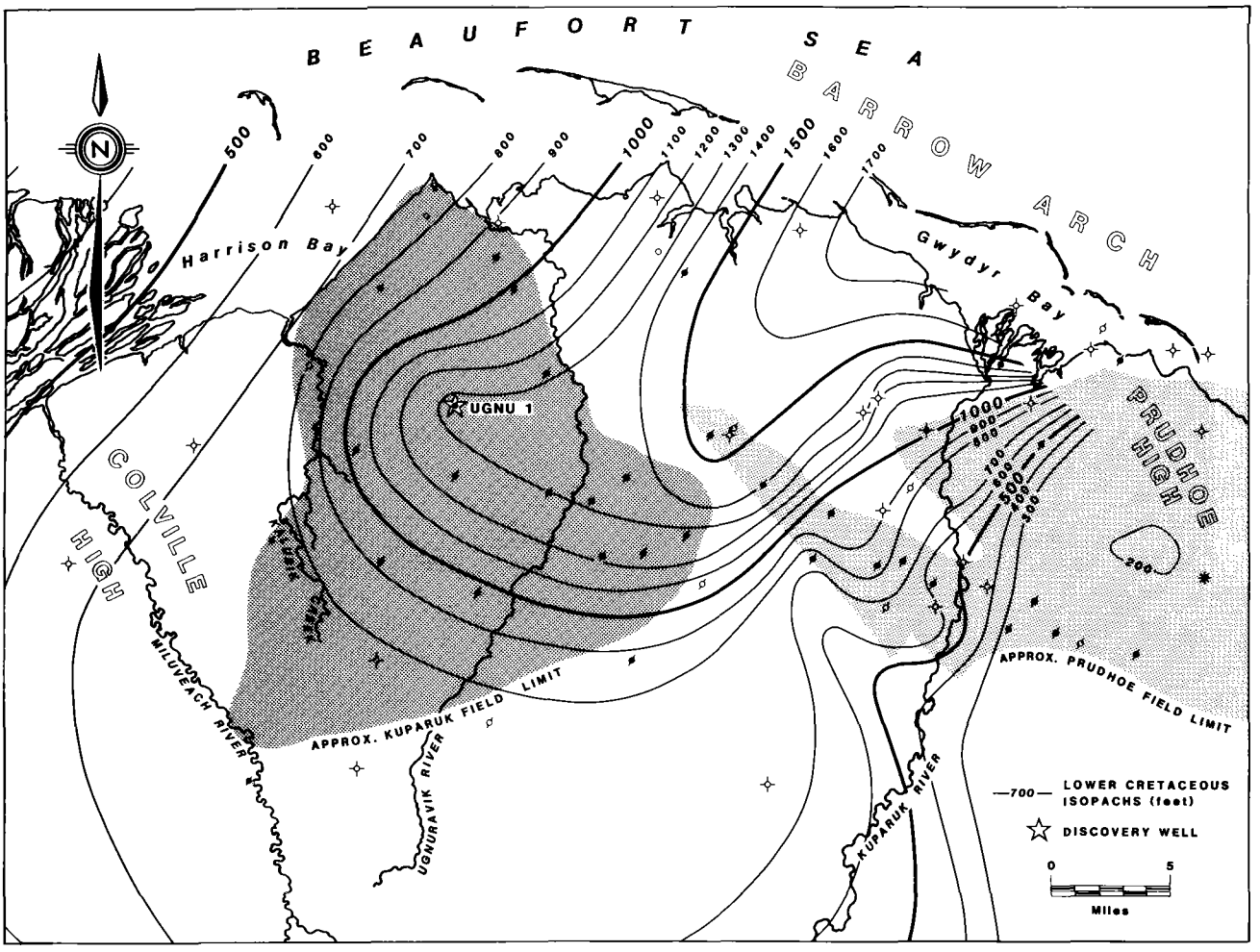


Figure 2. STRUCTURAL SETTING



an areally restricted trough called the Colville-Prudhoe Basin. The location of the Colville-Prudhoe Basin between the Colville and Prudhoe spurs of the Barrow Arch, is most evident from isopachs of the Lower Cretaceous rocks (Figure 3).

HRZ Unit

The stratigraphic sequence between 5580 feet and 5670 feet b.r.t. (1701 to 1728 m.) in the Ugnu State #1 well is a typical section for this distinctive lithostratigraphic unit. The unit is referred to as the HRZ unit, after current industry usage referring to its recognition as a Highly Radioactive Zone. Whereas its Albian to Aptian age appears to be equivalent to the lowest part of the Torok Formation to the west of the Colville High, the lithological characteristics of the HRZ unit suggest it is more probably a correlative of the Pebble Shale.

The HRZ unit is typically about 200 feet (61 m.) thick. It consists of medium grey to black mudstone with highly carbonaceous microlaminations forming a distinctive papery fissility. Source rock analyses have determined a total organic carbon content of 4% to 9% weight for these rocks.

Probably the most dominant characteristic of this unit is its exceptionally high radioactivity. Gamma Ray spectralogs from Prudhoe Bay field wells have shown this to be due to the presence of uranium and thorium which are believed to be concentrated in organic material and finely disseminated throughout the matrix.

Stable carbon isotope analyses of kerogen from the HRZ unit have yielded ^{13}C values of –27ppm to –26ppm which suggests a marginal marine environment of deposition. The HRZ unit is thought to lay unconformably beneath the Upper Cretaceous sediments in the Colville-Prudhoe Basin.

KUPARUK FORMATION

The **Kuparuk Formation** is the correlative of part or all of the Kongakut Formation to the east and part or all of the Okpikruak Formation to the south and west. However, whereas these latter two formations appear to have had a southern Brookian source, the Kuparuk Formation had a northern, Barrovian source.

The hydrocarbon reserves of the Kuparuk oilfield occur within the Kuparuk Formation. It consists of a cyclic sequence of coarse and fine-grained terrigenous clastic sediments and is informally subdivided into two members. Each member is further dividied into two lithostratigraphic units which are informally referred to as the A unit and the B unit in the lower member and the C and D units in the upper member. These units of the Kuparuk Formation are defined on wireline logs and are also distinctive in cores (Figure 4).

The upper member is locally unconformable on the lower member. This is evident from the progressive loss of section within the lower member (A and B units) to the west and south of the field (Figure 4). The distinct characters of the upper and lower members is further suggested by the differences in their fossil assemblages. Where dinoflagellates have been recovered from the upper member, they have shown a much greater abundance and diversity than those from the lower member and are indicative of a Hauterivian to Barremian age. The sparse dinoflagellate assemblages from the lower member are similar to those from the underlying formation and are thought to be diagnostic of a Valanginian to Barremian age. The break between the upper and lower members is also reflected in changes in the composition of the agglutinating foraminifera and miospore assemblages.

On the basis of the microfauna, the presence of bioturbation, glauconite and sedimentary structures, the Kuparuk Formation is thought to have been deposited in a shallow marine environment.

RESERVOIR DESCRIPTION

The reservoir quality sandstones of the Kuparuk Formation in the Kuparuk oilfield occur chiefly within the C unit of the upper member and the A unit of the lower member (Figure 4). Although oil stained sandstones are present in the intervening B unit, they are nor-

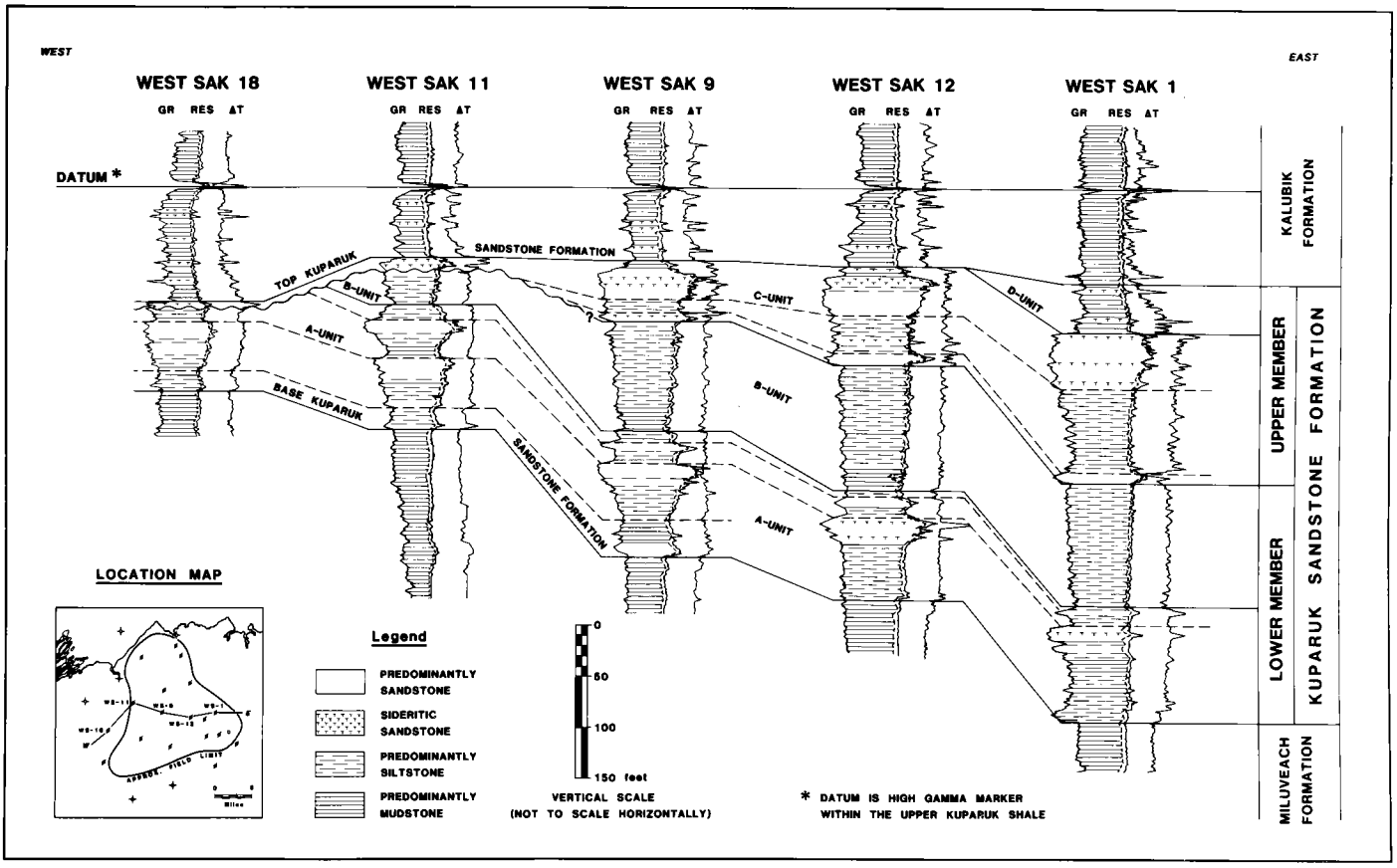


Figure 4. RESERVOIR CORRELATION

mally thin and encapsulated by mudstones and siltstones making economic production unlikely. The silty, dark-brown to black mudstones of the D unit do not contain any reservoir horizons.

The A unit consists of a heterolithic sequence of sandstones, siltstones and mudstones in a series of regressive cycles, each up to 70 feet thick. Within each cycle individual bed thickness varies from a few inches up to 3 feet but the sandstones are often amalgamated into bodies of up to 40 feet thick. The sandstones are fine to very fine-grained quartzose arenites with well sorted sub-angular grains. The sandstones exhibit ripple-cross laminations and low angle cross laminations.

X-ray diffraction analysis of the sparse (less than 5% volume) intergranular clays indicates they are predominantly kaolinite and illite.

The A unit is correlated and mapped over the entire pool area and isopachs of the unit define an axis of maximum thickness of approximately 120 feet (36 m.) striking northeast to southwest. The unit thins dramatically to the west where it is truncated by a local intra-formational unconformity at the base of the C unit (e.g., West Sak 18, Figure 4). At least four divisions (see dashed lines in Figure 4) are discernible in the A unit from wireline logs; these define depositional cycles whose sediments have coarsening upward grainsize profiles. Mapping of the individual cycles (not shown) has defined lensoid bodies approximately 10 miles wide, 25 miles or more long and 40 to 70 feet thick. Isopachs of these bodies exhibit a strike-trend similar to that of the gross A unit isopachs and, despite inconclusive dipmeter evidence, this together with the regional setting suggests the provenance was probably in the northeast or east. From core plugs, the arithmetic mean porosity is 23% and the mean horizontal permeability is 81 millidarcies. The cumulative 'pay' quality sandstones of the A unit range up to 30 feet in thickness and contain approximately 60% of the field's oil-in-place.

The lithologies of **the B unit** are very similar to those of the A unit. There is, however, significantly less sandstone which is reflected in the average bed thickness which ranges up to two inches for the sandstones and two to four inches for the mudstones. Internal sedimentary structures such as load structures together with graded beds and a "flaser and linsen" structure characterize the B unit. Towards the top of the unit these sedimentary structures are frequently obscured by varying degrees of bioturbation.

The B unit is characterized by an upward coarsening sedimentary trend which is evident in the wireline log responses (Figure 4). This feature permits a fieldwide correlation which demonstrates thinning of the unit by truncation in the western pool area (see for example the thinned B unit in West Sak 11, Figure 4). The B unit is in excess of 150 feet thick. The prevalent sedimentary and biogenic structures, together with a rich occurrence of land derived miospores suggest a shallow marine environment of deposition.

The C unit of the Kuparuk upper member consists of sandstones and siltstones with intergranular clay. The sandstones contain medium to fine, occasionally coarse-grained, quartz with locally abundant granular glauconite. The sand-grains are poorly sorted, subangular, and, in the western areas, constitute a pebble conglomerate at the base of the unit. In cores the sediments of the C unit display well defined upward coarsening grain size profiles in two distinctive regressive cycles.

Intergranular clay is present in quantities of approximately 3% by volume in the reservoir sandstones and up to 15% in the finer grained clastics. The clays have been determined by X-ray diffractometry and scanning electron microscopy to be detrital illite/smectite, authigenic kaolinite and mixed layer illite/montmorillinite. The C unit is characterized by bands of siderite cemented sandstones. They are up to 8 feet thick and sometimes form a correlatable horizon over some 10 to 20 square miles, particularly in the sandstones in the eastern pool area (see West Sak 1 and 12, Figure 4).

Within the field area the isopachs of the C unit define a distinct lobe-like geometry striking northeast to southwest, which is consistent with regional mapping trends. The maximum thickness is about 150 feet on the eastern flank. Correlation of the two regressive sequences within the C unit suggests progressive onlap with overstep towards the west. During late C unit time the sandstone extended as far west as

the West Sak 15 well and was probably deposited coevally with part of the D unit (Figure 4). The better reservoir sandstones are restricted to about 80 square miles in the eastern-central part of the pool area. From core plug measurements, the arithmetic mean porosity and permeability are 21% and 90 millidarcies respectively. Permeability however ranges from less than 1 to over 1350 millidarcies reflecting great variability. The cumulative 'pay' quality sandstones of the C unit range up to 60 feet in thickness and contain approximately 40% of the field's oil-in-place.

STRUCTURE

A structure depth map on the top of the Kuparuk Formation (Figure 5) demonstrates a broad antiform with a crest at circa. 5600 feet subsea and with flanks continuing below 7000 feet subsea. The structure has a prominent northwest to southeast axial trend which plunges gently to the southeast. The northeastern flank is severely disrupted by a series of faults trending northwest which is approximately parallel to the Barrow Arch. These are augmented by a subordinate north-south group of faults (see Figure 5). The faults have throws up to 200 feet but are more generally in the range of 50 to 100 feet with the downthrown blocks predominantly to the east. The larger faults with western downthrows are believed to provide a trapping mechanism for smaller, separate hydrocarbon accumulations downflank to the east and northeast (Figure 5). The majority of the faults are no younger than Early Cretaceous age.

The trapping mechanism of the Kuparuk pool has both structural and stratigraphic components. Stratigraphic pinchout of the C unit and truncation of the A unit reservoirs limit the pool to the south and west (Figure 4). Structural dip closure exists to the north and east (Figure 6). An oil-water contact has not been observed within a single, clean reservoir lithology because of thin beds. However, the contact has been determined to exist between approximatley –6530 feet in the south and at least –6700 feet in the north. Furthermore, observations of oil and water levels in 15 wells in the eastern field area suggest that this oil-water contact has a uniform tilt about 0.5° towards the north-northeast. However, the possibility of a step faulted contact cannot be discounted without additional data. The tilt is thought to have resulted from the inability of the reservoir fluis to equilibrate during the Tertiary-to-present-day north-eastward tilting of the Alaska Arctic Plain. The Kuparuk pool is mapped over some 300 square miles with a vertical closure of about 1100 feet (Figure 6). The seal to the trap is provided by the silty mudstones of the overlying Kuparuk D unit and, in their absence, by the marine mudstones of the Kalubik Formation.

OIL COMPOSITION

The Kuparuk oil has been classified by Magoon and Claypool (1981) as one of the Barrow-Prudhoe types which are generally medium gravity, high sulphur (greater than 0.6%) oils. The gravity of the Kuparuk crude varies about 15° to 26° API and appears to be related to its structural elevation above a tilted oil-water-contact . The average gravity of the Kuparuk field crude is about 24° API at 60°F.

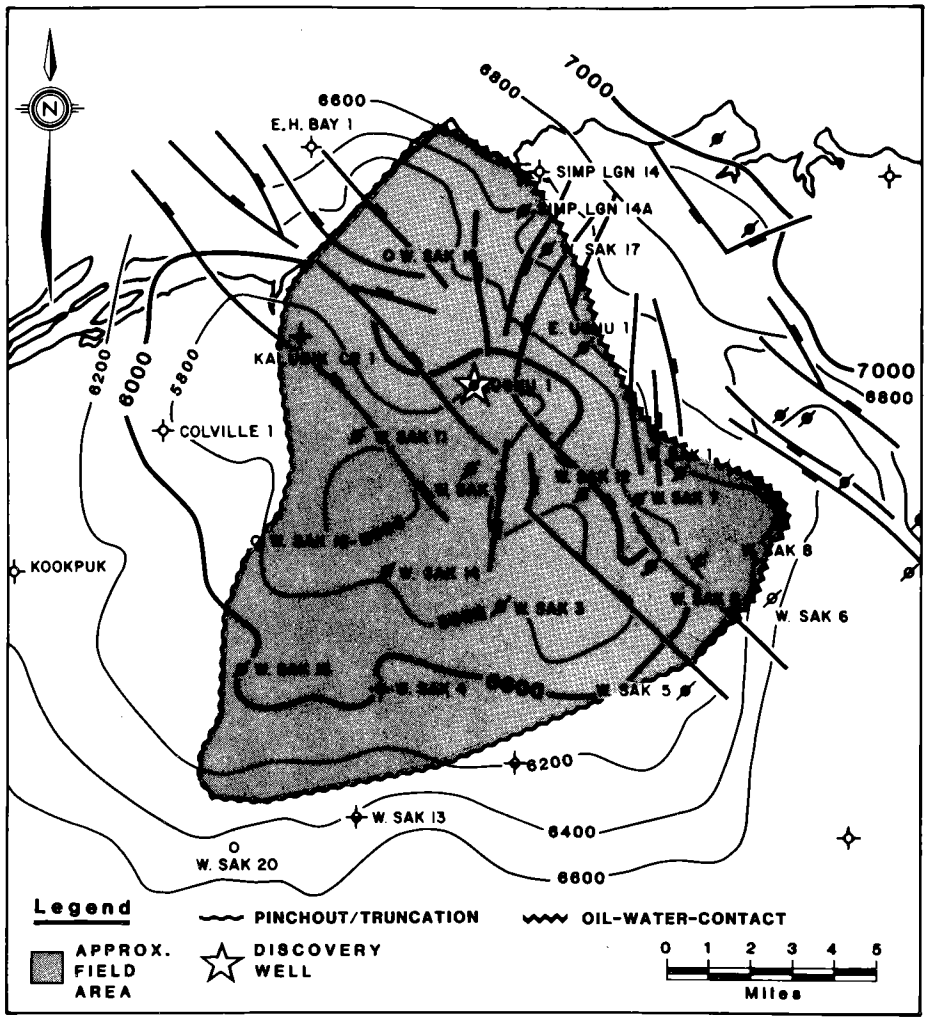


Figure 5. KUPARUK STRUCTURE MAP

The Barrow-Prudhoe oils have been attributed to a Lower Cretaceous (HRZ) origin and it is difficult to refute the consistent close association of the HRZ unit and the known hydrocarbon accumulations on the North Slope. However, these Lower Cretaceous mudstones have been buried to only 6000 feet in the Colville-Prudhoe Basin and about 7500 feet at Prudhoe and are thought to be immature. Using biological marker chemistry, Seifert et al (1979) concluded that the Prudhoe-Kuparuk crudes were cosourced from the Lower Sequence Shublik Formation (Triassic), Kingak Formation (Jurassic) and deeply buried HRZ mudstones (Early Cretaceous).

DEVELOPMENT PLAN

The proposed development area of the Kuparuk field is approximately 200 square miles, and the cumulative productive interval is at least 90 feet thick. The current estimate of moveable oil-in-place within this area is 4.4 billion stock tank barrels. Reservoir simulations performed by BPAE suggest that the potential waterflood reserves range from 1.0 to 1.5 billion s.t.b. which makes Kuparuk one of the largest oilfields in the United States.

The present production of 90,000 b/d under solution gas drive, is being obtained from one facility in the eastern part of the field. There are plans for two additional facilities to be installed for field-wide development (Figure 6). Each facility will gather oil from 40 to 50 drill pads with well spacing of 320 acres or less and 700 to 900 wells will ultimately be drilled. Assuming successful waterflood, a plateau production of 250,000 b/d is targeted for 1986.

CONCLUSIONS

The recognition of Lower Cretaceous sediments derived from a local northern source, the Barrow Arch, during the early stages of development of the continental margin, is important for oil exploration in this lightly explored basin. Similar sequences can be expected to be preseved elsewhere on the flanks of the Barrow Arch and should provide further attractive exploration plays of the Kuparuk type.

ACKNOWLEDGEMENTS

The writers thank the management of BP Alaska Exploration Inc., Sohio Alaska Petroleum Company and the Atlantic Richfield Company for permission to publish this paper. This is an abbreviated version of a paper presented at the AAPG Convention in Calgary, 1982, and to be published in the AAPG Bulletin. The consent of the AAPG to publish is gratefully acknowledged.

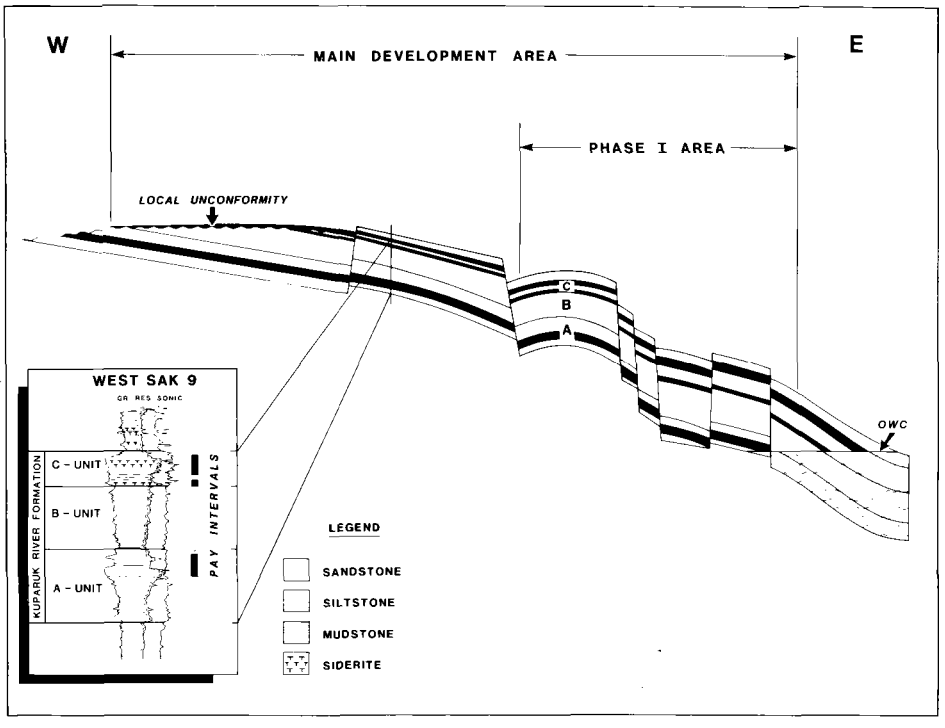


Figure 6. KUPARUK FIELD CROSS-SECTION

ENVIRONMENTAL NOTES

By TOM WRIGHT

Your correspondent represented the California Section of AIPG at the California Coastal Commission's April 7 hearing on the 5-Year OCS Leasing Plan. Our testimony emphasized that the new program will give explorationists a much greater freedom of choice in offshore prospecting, but will not substantially increase the amount of leasing or accelerate the pace of OCS sales. Only the pace of discovery will be increased.

Explorationists in the gas country have been struggling to fend off crippling restrictions which Colusa County would impose on vibroseis surveys. Although prior studies have shown that vibroseis has minimal impact on roads, wells and agricultural drains, county supervisors wanted these studies repeated in Colusa County, at a cost — paid by industry — of $50,000. Failing in that approach, they are proposing permit fees and conditions so onerous as to prohibit future surveys. Many other valley and delta counties are watching the process and a serious "domino effect" is threatened.

One aspect of the Interior Department's recent streamlining and consolidation of its offshore and royalty management functions is causing concern to geologists, especially those in the USGS. The new Minerals Management Service (MMS) has not only absorbed the Conservation Division of the USGS, but is absorbing an as-yet-undetermined portion of the Marine Geology Branch of the Geologic Division. A greatly weakened USGS which lacked an effective program in marine geology would not be in the best interests of the nation or our science. A marine geology program administered by accountants would soon wither. Also, past USGS appraisals of offshore geohazards and undiscovered resources have been provided independently by the Geologic Division and thus have gained widespread acceptance. If this work is done under MMS in the future, a problem of credibility may develop.

The latest bugaboo raised by our "no-oil" opponents (specifically, at Pacific Palisades and Long Beach Harbor) is the possibility of subsidence and induced seismicity. It's of little use explaining that the problem of oil-field subsidence due to fluid withdrawals can be recognized long in advance, and prevented by pressure maintenance. Or that the "mini-earthquakes" which have been produced by production and/or injection in oil fields are too small (0 to 2 on the Richter Scale) for people to feel.

PAC SECTION CONTRIBUTIONS

During the 1981-82 fiscal year, the Pacific Section, through its Executive Committee, made the following contributions to further the geology profession:

1. For Maintenance of the Core Repository at California State College, Bakersfield: $2000
2. For the National AAPG Tectonic Map Project: $2000
3. Towards publication of a GSA Symposium on the Geology of Washington State: $1000
4. Towards publication of well correlation sections in western Washington State by Weldon Rau: $ 500

58th MEETING OF PAC-SECTION ANNOUNCED

The 58th Annual Meeting of the Pacific Section AAPG - SEPM - SEG will take place May 18-21, 1983, in Sacramento, California, at the Red Lion Inn. The theme for this year's meeting is "Capitalizing on Energy." Program Chairman David McGeary and his staff are emphasizing petroleum and geothermal exploration/development in the western United States. Papers are presently being requested for the above topics.

SCWLS ANNOUNCES '82-'83 OFFICERS

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Meetings are held every fourth Tuesday of the month at noon at Steven's Steak House, City of Commerce (5332 Stevens Place).

The first meeting of the season is to be held on September 28th on **Log Responses in the Monterey FM,** speaker Jeff Morrow, Schlumberger. For reservations call Maria Zrupko (213) 944-0311.

The SCWLS also extends an invitation for new members to join for the yearly dues of $5.00. With every subscription, the new member will get the *Engineer of California,* free.

Alaska

A.G.S. officers for 1982-83 are as follows:

President . . . . . John Lawrence, Arco
President-Elect . Bob Jones, Marathon
Vice-President
Don Blasko,
U.S. Bureau of Mines
Secretary . . George Stadnicky, Union
Treasurer . . . . Coleen Rutledge, Arco
Board of Directors:
Travis Hudson
U.S. Geological Survey
Robin Broomfield . . . . . Arco
James Riehle
U.S. Geological Survey
Jim Dyess . . . . . Marathon

Gulf has reopened an Anchorage office for minerals and oil and gas exploration. Gulf previously had an Alaskan office, but it was closed when Tom Lewis retired and moved to Conroe, Texas. Bill Smith is transferring to Anchorage from Bakersfield to head up the oil and gas exploration.

Phillips is keeping the score even by announcing the closing of their minerals office in Anchorage. Their oil and gas exploration office will remain open under the direction of Bob Swetnam who has become a permanent fixture in Anchorage.

The A.G.S. has recently completed a guidebook entitled *"Guide To The Bedrock Geology Along The Seward Highway North Of The Turnagain Arm"*. Ernie Lian has a bunch of these that he would like to unload at six bucks a throw. For the braver sports, a new A.G.S. photo directory is also available at eight bucks a throw plus a buck and a half for postage. Send the loot to: Alaska Geological Society, P.O. Box 1288, Anchorage, AK 99510.

Coast

COAST GEOLOGICAL SOCIETY
P.O. Box 3014
Ventura, California 93303

July-August 1982 News, CGS

The Coast Geological Society officers for 1982-83 are: President, Bill Stanton, Conoco; Vice-President, Gary Nulty, Argo; Secretary, Roger Brown, Conoco; Treasurer, Tricia Young, Argo. The outgoing officers wish to thank everyone who helped make the 1981-82 year a success. Special thanks to the Union cooks for their excellent meals.

The Fall Barbeque will be held Saturday, September 18th, at the Lagomarsino Ranch in Ojai.

Personnel News

Union has hired three geologists from Oregon State University. They are: David White, Joe Holliday and Hans Schwing. Several transfers are taking place at Union. Bill Reay is transferring to Indonesia, Jane Ellis to Bakersfield, Steve Sterling and Bob Estill to Lafayette.

Sun recently hired Ken Brooks as an associate geophysicist from San Diego State.

Los Angeles

President — Keith Yenne
Consultant
Vice-President — Bonnie Bloeser
Texaco
Secretary — Darlene Condra
Texaco
Treasurer — Bill Goth
Union

its staff: MR. GUY L. BURGE as Exploration

The Los Angeles Basin Geological Society will hold its next meeting on August 26th, at Taix Restaurant in Los Angeles. The speaker will be Charles Katherman, Husky Oil, on "Recent Developments of the Monterey Formation in the Santa Maria Basin." Upcoming speakers will be announced. The treasurer of the L.A.B.G.S., Bill Goth (Union), has been transferred from Los Angeles to Ventura. His L.A.B.G.S. duties will be taken over by Jerry Maloney (Union, L.A.) for the rest of the year.

San Joaquin

S.J.G.S. OFFICERS

The San Joaquin Geological Society officers for 1982-83 are:

President — Jack Kappeler
President-Elect — Frank Amato
Vice President — Susan Chandler Kiser
Secretary — Frank Creasy
Treasurer — Bill Long

BAR-B-QUE

The S.J.G.S. Annual Bar-B-Que is scheduled for September 24th at the Kern River Picnic Area. In addition to the traditional golf and tennis tournament, this year's bar-b-que will also feature a volley-ball tournament.

Charimans for this year's event are:

Bar-B-Que Chairman:
Sue Kiser — DEPCO (805 834-6844)
Tennis Tournament:
Buzz Delano — Schlumberger (805 327-3762)
Golf Tournament:
Rick Hoffman — NOMECO (805 397-8748)
Volleyball Tournament:
Mike Maquire — Getty (805 832-4010)

PERSONNEL

MR. E. C. "GENE" TRIPP has a new business address with Challenger Minerals, Inc., 5531 Business Park South, Suite 200, Bakersfield, CA 93309. Gene left Depco to accept the position of District Exploration Manager on August 1, 1982.

Petro-Lewis, 5500 Ming Ave., Bakersfield, CA 93309 has made the following additions to its staff: MR. GUI L. BURGE as Exploration Manager, MS. DAWN MILLER, exploration geologist and MR. MIKE FANELLI, exploration geologist.

Bravo expanded its geological staff with the hiring of MR. PAUL HACKER, previously with ARGO in Ventura.

MR. WES FRANKLIN was transferred by Tenneco, Inc. to San Antonio, Texas, as Exploration Manager – Southwestern Division.

Northern California

The Northern California Geological Society will be kicking off its 1982-83 activities with its first fall luncheon on September 15th at the Elk's Club in San Francisco, at 11:30 AM. The speaker will be Dr. Amos Nur of Stanford University, addressing the topic "Allochthonous Terranes: Western North America and Elsewhere." Visitors are most welcome. For reservations, call Sara Christensen at (415) 680-3657 by September 10th.

The Society's 1982-83 membership drive is also underway. All members should have received their renewal cards through the mail by now. If you've been ignored, please write or call: Tom Dignes, Secretary, N.C.G.S., Chevron USA, Inc., P.O. Box 8100, Concord, CA 94524, (415) 680-3220. Interested new applicants and current members who'd like to coax colleagues to join should contact the same individual. Just $3.00 can bring you into the fellowship of more than 300 Northern California earth scientists for 1982-83, with luncheons, lectures, and field trips.

Cranston Introduces Bill To Limit Offshore Leasing In California Until Year 2000

Sen. Alan Cranston (D-CA) has introduced a bill which would impose a moratorium on oil and gas leasing in certain areas off the California coast until the year 2000. The bill, S. 2786, would affect both Northern and Southern California.

Recommended Reading

SPECIAL

Professional Paper 420-D: Geology of the northern Santa Ana Mountains, Calif. by J. E. Schoellhmer, J. G. Vedder, R. F. Yerkes and D. M. Kinney. 1981 $11.00

Professional Paper 1250: The 1980 eruptions of Mount St. Helens, Washington. Edited by Peter W. Lipman and Donal R. Mullineaux. 844 pages, 1981 $35.00

U. S. GEOLOGICAL SURVEY

P 680-G: Fossil corals from Midway Atoll, by J. W. Wells $2.25

P 1227: The oilspill risk analysis model of the U. S. Geological Survey, by R. A. Smith, J. R. Slack, Timothy Wyant and K. J. Lanfear. (Supersedes OF 80-687) $3.25

P 1235: Erosion and sedimentation in the Kenai River, Alaska, by K. M. Scott $3.25

B 1514: Mineral resources of proposed additions to the Salmon-Trinity Alps Primitive Area, California, by P. E. Hotz and R. C. Greene (USGS) and T. J. Close and R. K. Evans (USBM) $4.25

C 844: The U. S. Geological Survey in Alaska: Accomplishments during 1980. W. L. Coonrad, editor Free

C 854-A: Seismic engineering program report January-April 1980 Free

Maps:

GQ 1555: Geologic map of the Raymond quadrangle, Madera and Mariposa Counties, California, by P. C. Batemen, A. J. Busacca, D. E. Marchand and W. N. Sawka $3.00

MF 1192-A: Geologic map of Salmo-Priest Wilderness Study Area (Rare E6-981 Al-981), Pend Oreille County, Washington, and Boundary County, Idaho, by F. K. Miller $1.25

MF 1244-A: Geologic map of the Mount Moriah Further Planning (Rare II) Area, eastern Nevada, by R. K. Hose $1.25

MF 1365-A: Geologic Map of the east part of the Raymond Peak roadless area, Alpine County, California, by R. A. Armin, D. A. John, and W. J. Moore, with Quaternary geology by J. C. Dohrenwend $1.25

MF 1207: Map showing environmental geology of Gulf of Alaska coastal area, Glacier Bay National Monument, by B. F. Molnia and M. C. Wheeler $1.25

HA 0645: Dissolved-solids concentrations of ground water in the Sacramento Valley, California, by R. P. Fogelman $3.00

BOOKS:

Earthquakes and young volcanoes along the Eastern Sierra Nevada at Mammoth Lakes, 1980, Lonepine, 1872, Inyo and Mono Craters, by C. Dean Rinehart and Ward C. Smith, 1982. Mono Co. Friends of the Library, P. O. Box 1468, Mammoth Lakes, CA 93546. 64 pages (paper cover). $5.95

Mono Lake Guidebook, self-guided tour, by David Gaines and the Mono Lake Committee. 1981. Mono Lake Committee/Katsaui Books, P. O. Box 29, Lee Vining, CA 93541. 113 pages (soft cover). $5.59

Energy at the surface of the earth, an introduction to the energetics of ecosystems, International Geophysics Series, Vol. 27, by David H. Miller. 1981. Academic Press, Inc. Publishers, 111 Fifth Avenue, New York, NY 10003. 516 p. (hard cover). $49.50

California Coastal access guide, by the California Coastal Commission. 1981. University of California Press, 2223 Fulton St., Berkeley, CA 94720. 240 p. (soft cover). $7.95

Geotectonic development of California. Rubey Volume no. 1. Edited by Gary Ernst. 1980. Prentice Hall, Inc., New Jersey. 760 pg.

PACIFIC SECTION — AMERICAN ASSOCIATION PETROLEUM GEOLOGISTS

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Recommended Reading ..... LUCY E. BIRDSALL (213) 688-2850

NEWSLETTER of the Pacific Section – American Association Petroleum Geologists is published bimonthly by the Pacific Section.

Material for publication, requests for previous copies and communications about advertising costs should be addressed to MARC W. TRAUT, 5000 STOCKDALE HWY., BAKERSFIELD, CA 93309.

CHANGE OF ADDRESS, subscription, and membership inquiries should be directed to: MEMBERSHIP SECRETARY, PACIFIC SECTION AAPG, P.O. BOX 1072, BAKERSFIELD, CALIFORNIA 93302.

PUBLICATIONS COMMITTEE: Pacific Section American Association of Petroleum Geologists, P.O. Box 927, Camarillo, CA 93010.

Annual Meeting

PACIFIC SECTION

AAPG – SEPM – SEG

MAY 18 – 21, 1983

RED LION INN
Sacramento, CA

Watch mail for first registration packet — mailout mid-February.

NEWSLETTER
Pacific Section A.A.P.G.
P.O. Box 1072
Bakersfield, California 93302

Richard L. Hester
1911 Montecito Dr.
Glendale, CA 91208

DA-AM

PACIFIC PETROLEUM GEOLOGIST NEWSLETTER

of the Pacific Section
American Association of Petroleum Geologists

NOVEMBER 1982

PRESIDENT'S CORNER . . .

According to the Pacific Section Constitution the Executive Committee is composed of the elected officers, our newsletter editor and a representative from each cooperating geological society. There is another group of individuals who show up at our periodic meetings. These are the ones who hang in there doing much of the work . . . the heads of the Standing Committees. You should know who they are: Sue Kaiser, Finance; Don Hallinger, Planning; Tom Wright, Legislation and Public Relations; Dick Williams, Publications; Brian and Kay Pitts, Directory; Bob Hindle, Membership with Betty Bean as Membership Secretary; John Kilkenny, Honors and Awards; and Don Zieglar, our National Advisory Council Representative.

A lot has happened on the Convention front: Tom Hopps closed out the books on the '82 convention and distributed the surplus. The Pacific Section's share was a tad under $10,000 ($9998.06 to be exact). Congratulations to all concerned.

John O'Kane, Convention chairman for next year's Sacramento meeting was suddenly transferred to San Francisco. I received the bad news initially from Ben Cahill of Energy Log and past president of Sacramento Geological Society. Ben told me that if he couldn't find anyone else, he'd take the job and he has. It's people like Ben who keep these organizations going. And thank you John for your initial work on the organization.

With joy, the Executive Committee has accepted John Minch's **offer** to put on the 1984 Pacific Section Convention in San Diego. Tentative dates are April 18-20th at the Sheradan Harbor Island Hotel.

And looking further into the future, the Alaska Geological Society has agreed to host our 1985 Convention in Anchorage!

Elsewhere in this issue is an announcement of a new publication: Tom Baldwin's "40 Years . . . the Education of a Geologist". Before the Pacific Section agreed to underwrite the printing (a long fun story with Dick Hester in the background), I **had** to read the book. It ruined two nights sleep. Buy it. It is one of the best geologic books I have ever read. Tom has made a real contribution to the profession.

I lost a good friend the other day. Andrew J. (Andy) Vidos of Rustin, Washington, died quietly October 14th in Ventura at the age of 61. With the exception of the last 5 years spent working for the U.S. Bureau of Mineral Management Service, Andy was an exploration geologist.

After attending Stanford, he worked for a couple of years for Pacific Islands Engineers (looking for water on Guam as I remember). Then from '48-'55, he was a geologist with Amarada and then Humble. As a maverick, that was enough working for others and he became a consultant . . . associated closely with Newhall Land and Farming Company for the first few years. Most of his working life was spent in the Ventura Basin and Salinas Valley although he did work a year or so in Malaysia where he contacted hepatitis that was to haunt him the rest of his life.

When Jack Wood and others reorganized Pyramid Oil Company in the early 70's, Andy was elected vice-president. He served in this capacity for 2½ years.

Andy leaves many friends. I think he would like to be remembered as an oil finder.

Ted Off

1983 MEMBERSHIP DIRECTORY

The new 1983 AAPG–SEPM–SEG Membership Directory will be available at the 1983 Pacific Section Convention in Sacramento. If you have Directory changes from your 1982 Membership Application, fill out the form in back of your current Directory or write on a piece of paper and send the information to Ms. Betty Bean, Membership Chairman, P. O. Box 1072, Bakersfield, California 93302. No changes will be accepted after January 1, 1983.

If you are not attending the Convention, you may obtain your Directory after May 21, 1983, from Betty Bean or Publications.

Retain your present Directory binder for use with the new Directory.

BRIAN and KAY PITTS
Membership Chairmen

GEOLOGICAL EVENTS CALENDAR

HELP! I am compiling dates and data for a Geological Events Calendar. Births and deaths of famous geologists. **Dates** of volcanic eruptions, earthquakes, landslides, etc. Discovery dates of major oil fields and most California oil and gas fields will be included. What I need is the discovery dates of some of the oldies — Kern River, Santa Fe Springs, Los Angeles, Wilmington, etc. I'm sure the information is buried in company files and can be made available.

The Lord willing and the creek don't rise, I can have the Calendar completed for 1983 — or by Convention time. If there is enough interest in the project we may print the Calendars through the Pacific Section — but it's too early for that commitment. Please send any bits of information of geologic events: **Dates** (not just month and year) to: S. E. Karp, Geology Dept., Bakersfield College, 1801 Panorama Drive, Bakersfield, CA 93305. Graduation dates and wedding anniversaries will not be accepted.

ED KARP

CORDELL DURELL GEOLOGY FUND

University of California, Davis has established the "Cordell Durell Geology Fund" to honor Professor Cordell Durell for his past contributions as chairman of the geology department and his continuing active interest in the field. The annual income from this Fund will be devoted to supporting undergraduate and graduate student field research and departmental field activities and programs. Donations to the Fund may be made by check, payable to the Regents of the University of California.

SPE OF AIME Announcement

The Society of Petroleum Engineers of AIME announces T. Don Stacy as the 1983 president of the Society of Petroleum Engineers, assuming office September 28 at the SPE Annual Technical Conference and Exhibition in New Orleans, and succeeding W. Clyde Barton, Jr.

PPG DEADLINE
for JANUARY ISSUE
DECEMBER 15

EVOLUTION OF PULL-APART BASINS AND PUSH-UP RANGES

by
Atilla Aydin
Department of Geosciences
Purdue University
W. Lafayette, IN 47907
and
Amos Nur
Department of Geophysics
Stanford University
Stanford, CA 94305

INTRODUCTION

Strike-slip faults operate at divergent and convergent plate boundaries as well as in broad belts of transform plate boundaries. Many geological and geophysical features of these tectonic regimes can be understood in terms of interaction among numerous faults or fault strands which make up these regimes. For example, pull-apart basins and push-up ranges are produced at regions of extension and compression, respectively, associated with strike-slip systems. Pull-apart basins and push-up ranges which include en-echelon anticlinal folds form potential geothermal, gas and oil reservoirs. The increasing interest in these basins and ranges are therefore well justified.

KINEMATICS OF STRIKE-SLIP FAULTS

Strike-slip systems are made up of numerous parallel and subparallel faults. The faults themselves are discontinuous, consisting of many discrete segments. Individual segments or strands of strike-slip faults are remarkably straight. Horizontal slip on such a single segment or a fault will induce extension in two quadrants and compression in the other two quadrants in the horizontal plane (figure 1a). Structures reflecting the extension (e.g. cracks and normal faults) and compression (e.g. pressure solution surfaces, folds, and thrust faults) are sometimes observed in the proper quadrants (figure 1b) in the field. When strike-slip faults are arranged in en-echelon pattern, the extensional or compressional quadrants of the neighboring faults partially overlap, thereby enhancing either extensional or compressional deformation. For example, right lateral strike-slip faults with right and left steps produce pull-apart basins (figure 1c) and push-ranges (figure 1d), respectively. Similarly, left-lateral strike slip faults with left and right steps generate basins and ranges, respectively. While two bounds of a basin are portions of the strike-slip faults that have significant normal slip components, the other two sides are defined by normal faults trending diagonally to the general direction of horizontal shear (figure 1c). A push-up range is bounded on two sides by portions of strike-slip faults that have considerable reverse-slip components and by diagonal reverse or thrust faults on the remaining two sides (figure 1d).

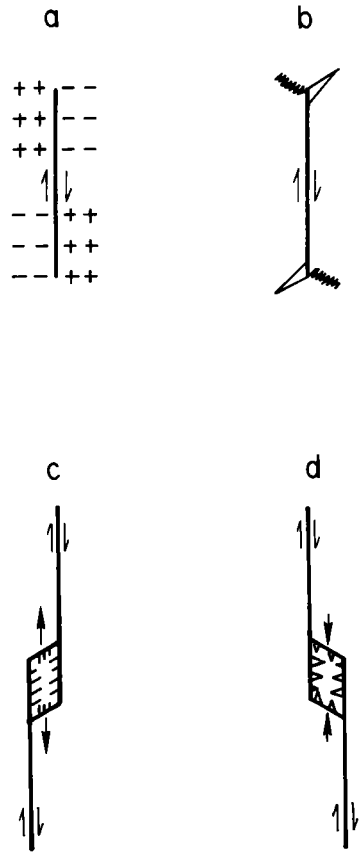

Figure 1. Kinematics of strike-slip faults: (a) Extensional (minus) and compressional (plus) quadrants around a right-lateral strike-slip fault: (b) tail cracks (open) in the extensional quadrant and pressure solution surfaces or folds (zig-zag line) in the compressional quadrants; (c) pull-apart on a right stepover bounded by normal faults (barbs on downthrown side) and strike-slip fault segments with normal-slip components; and (d) push-up on a left stepover bounded by reverse or thrust faults (teeth on upthrown side) and strike-slip fault segments with reverse-slip components.

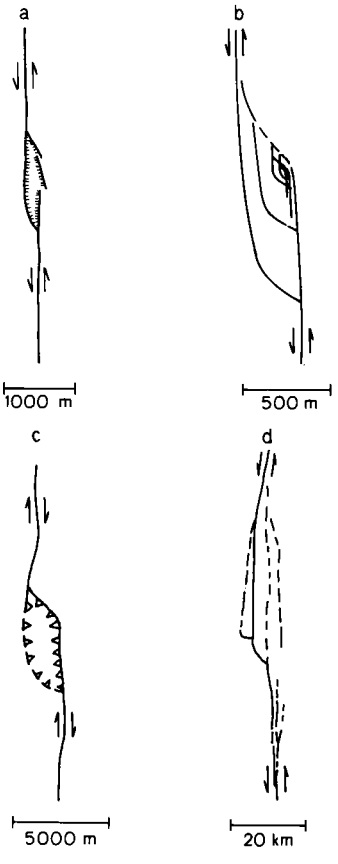

Figure 2. Examples of pull-apart basins in various scales and one push-up range, (a) A pull-apart associated with the Dead Sea fault, Israel; (b) Pull-apart basins associated with the Olinghouse fault, western Nevada; (c) A push-up range at Ocotillo Badlands, southern California; and (d) Koehn Lake pull-apart basin on the Garlock fault, southern California.

DIMENSIONS AND EVOLUTION OF PULL-APARTS AND PUSH-UPS

We examined more than 70 pull-apart basins and push-up ranges associated with the San Andreas system and the Olinghouse fault in the western United States, the Dead Sea fault and other faults in Israel, the North Anatolian fault in Turkey, the Dasht-e Bayaz fault in Iran, the Polochic and Motagua faults in Guatemala, the Bocono, El Pilar and Victoria faults in Venezuela and the Hope fault in New Zealand. These pull-apart basins and push-up ranges occur in a broad range of sizes from small sag ponds of several meters in length to huge basins of more than one hundred kilometers in lenght. We measured the length and width of the relatively well-documented basins and ranges and plotted them against each other, as shown in Figure 3. The data show that (1) pull-apart basins and push ranges become wider as they grow longer; (2) a great majority of the ratio of length to width falls between 2 and 5 defining a statistical average of 3.2 obtained from linear regression.

The widths of pull-apart basins and push-up ranges are defined by the spacing of faults or fault segments. The lengths appear to be controlled by horizontal displacement across strike-slip faults. If horizontal displacement increases across the en-echelon faults while the spacing of faults or fault segments remains roughly fixed, the length to width ratio should have increased as illustrated in Figure 4. This would have given a widely scattered length to width ratio value which is inconsistent with our observations of a well-defined range of ratios. This contradiction can be resolved if processes leading to widening of the pull-apart basins and push-up ranges occur. We propose two models for the evolution of pull-aparts and push-ups, which can account for the widening of basins and ranges as their length increases. The first model (figure 5a) is based on the coalescence of pull-apart basins associated with a series of en-echelon strike-slip faults into composite structures. The Gulf of California, The Gulf of Elat, Koehn Lake basin along the Garlock fault and Elsinore Lake depression, along the Elsinore fault are examples of such composite pull-apart basins. The second model (Figure 5b) involves more random coalescence and interaction processes. Initially smaller pull-aparts and

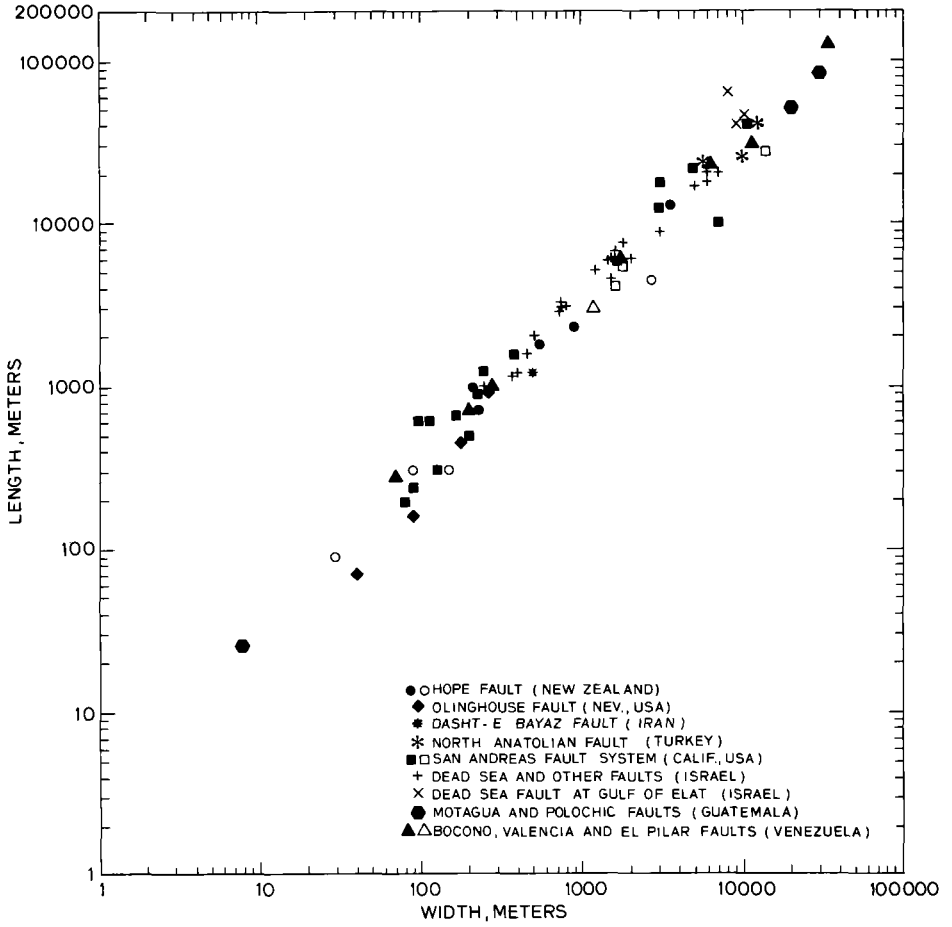

Figure 3. Log length versus log width for 71 pull-apart basins and push-up ranges associated with major strike-slip faults of the world. Full symbols pull aparts and empty symbols push-ups.

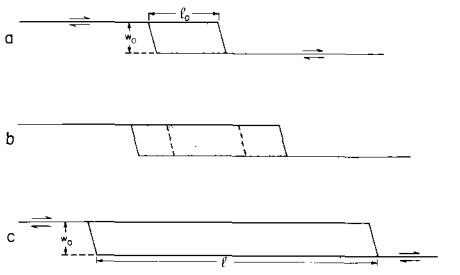

Figure 4. A simple model illustrating increasing length (from l_o to l) with increasing fault offset. The width (w_o), which is initial spacing of the faults, is constant.

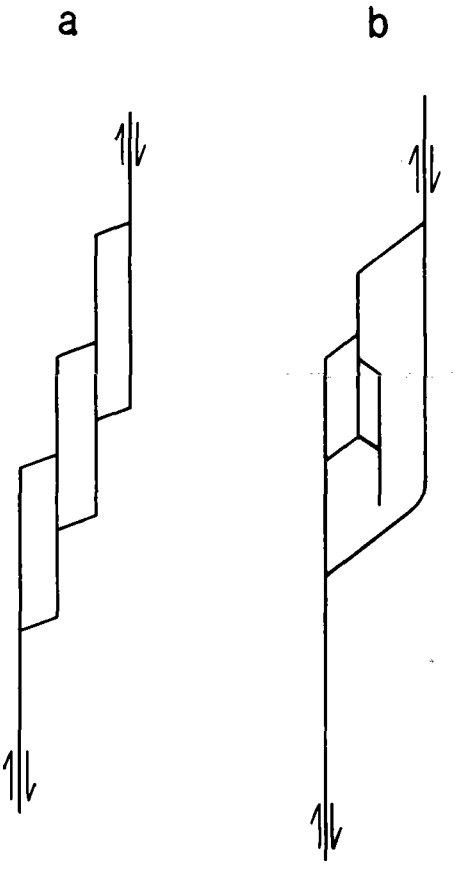

Figure 5. Two models showing increasing width with increasing lenght, (a) coalescence of adjacent pull-apart basins; and (b) formation of a wider and longer structure as interaction between farther away faults occur.

push-ups are produced by interaction among closer and longer faults strands. Then, faults that are further away grow longer as more slip is accommodated, and new strands form to promote further interaction and coalescence resulting in the formation of longer and wider complex basins and ranges as shown in Figure 5b. An excellent example of this type of composite basins occur along the Olinghouse fault, a left-lateral strike-slip fault in western Nevada.

The two processes described above may operate separately, or they may operate more or less simultaneously at the same site complementing each other. Large structures, such as the Imperial Valley, California exhibit not only coalescence of neighboring basins, but also a more intricate composite of basins within basins, ranges within basins, and perhaps basins within ranges. The overall pattern of these tectonics is that strike-slip faults together with connecting normal and reverse or thrust faults divide the region into blocks or domains or terranes, which, while moving in the general direction of horizontal shear, also rise or subside depending on the nature of the interaction between the discrete fault segments that make up the system.

CONCLUSIONS AND IMPLICATIONS

The correlation between the width and length of pull-apart basins and ranges associated with strike-slip systems suggests that smaller basins coalesce into bigger ones as slip continues to take place. This conclusion has important implications for our understanding of (1) fault systems and (2) the formation of basins. The two mechanisms suggested for the growth of basins and ranges provide a view of strike-slip faulting as an evolutionary process. This view offers an explanation for the various sizes of basins and ranges along a given strike-slip fault system. This variety is expected if the interaction and coalescence processes leading to the formation of the basins and ridges occur in a long time span.

Faults that are traditionally classified into different groups such as strike-slip, dip-slip normal, and reverse or thrust, and which are believed to have distinct environments, can occur next to each other in the same tectonic environment under the same remote stress condition. Normal and thrust faults associated with active strike-slip faults should be recognized as potential active faults.

The processes of coalescence and interaction imply that the width of the fault system itself must also grow with time, incorporating old and new fault strands as well as a complex arrangement of basins and ranges. These broad zones, which are broken by faults, are likely to be mechanically weaker than normal crust. The presence of a weak, brittle upper crust around major faults limits the shear stress level that can be supported by such faults. This limitation may account for the low stresses inferred, for example, from in situ stress measurement around the San Andreas fault system.

(continued on Page 4)

The dimensional and geometric features of the basins and ranges described in this study, together with the nature of deformation in these tectonic domains, can be used to interpret ancient basins and ranges in terms of strike-slip tectonics. The fact that pull-apart basins become wider as they grow longer may provide a mechanism for the initiation and the enlargement of sedimentary basins. Sedimentary basins and back arc basins probably develop as a result of crustal stretching followed by the rise of hot and light mantle material. As this material cools, the surface above it subsides, creating a basin that is usually filled with sediments. The most viable process for crustal stretching is a pull-apart basin, which must be large enough (tens of kilometers in width) to interact with the upper mantle. Our observations suggest that a large pull-apart basin can develop from small ones if the associated fault displacements are large enough and the fault strands are numerous enough.

Note: References for this paper can be found in a longer version entitled "Evolution of pull-apart basins and their scale independence", published in *Tectonics*, Vol. 1, No. 1, p. 91–105.

40 YEARS — The Education of A Geologist

"40 Years — the Education of a Geologist" by Thomas A. Baldwin, is an annotated collection of papers detailing local geology of California, including paleontology; plus papers of global scope. Utilizing updated information, Baldwin has interjected technical dissertations throughout the volume. This exciting publication, combining 40 historical years of hard labor, fun, data and 1982 personal comments by Baldwin, was recently completed, with assistance of the Pacific Section and L. A. Basin Geological Society and is available through the Pacific Section Publications Committee.

John Randall

FOR SALE

I have an extra copy of the **GEOLOGIC ATLAS OF THE ROCKY MOUNTAIN AREA** (never used). Originally sold for $54.75 in Calif. (incl. postage and tax). Long out of print and RMAG declares 2nd printing will be priced at $200.00 plus postage & tax. I will sell for $48.00 (postpaid, no tax).

Also have several copies of **Bulletin 140** of Calif. Div. of Mines & Geology, "The Geology of the Telsa Quadrangle, Calif." (out of print). I will sell for $2.50/copy (postpaid).

For either of above, write Art Huey, 1126 La Dera Dr., Long Beach, CA. 90807.

FEIS Now Available for OCS Lease Sale #70

The Minerals Management Service (MMS) has announced availability of a Final Environmental Impact Statement (FEIS) for proposed OCS Lease Sale #70 in the St. George Basin of Alaska. The sale is tentatively scheduled for February 1983.

California Crude Oil Production Increased By 80,000 BPD In 1981

The Conservation Committee of California Oil Producers said in a recently released report that in 1981 there was an increase in California crude oil production by some 80,000 barrels per day (bpd). The Committee stated, in its Annual Review of California Crude Oil Production for 1981, that the average crude rate for the year was 1,054,000 bpd, up 8.0 percent from 1980.

WOGA Annual Meeting

The Western Oil and Gas Association Annual Meeting will be held Thursday, December 9, 1982 at the Hyatt Regency, Los Angeles, offering a day-long program of current energy issues of particular interest to the West Coast petroleum industry.

Enhanced Oil Recovery

The report, "1982 Annual Heavy Oil/EOR Contractor Reports — Proceedings" (CONF–820712), is a compilation of 27 reports prepared by West Coast contractors conducting EOR research for DOE and presented during the contractors' sixth annual meeting in San Francisco, CA. Single copies of the report are available free from the Bartlesville Energy Technology Center, Attention: Bill Linville, P.O. Box 1398, Bartlesville, OK 74005.

Several thermal projects are described in the report, including field tests such as "Williams Holding Lease, Steamflood Demonstration Project, Cat Canyon Field, Santa Barbara County, Calif." by Santa Fe Energy Co., and the "Bodcau **In Situ** Combustion Project, Bellevue Field, LA" by Cities Service Co.

Chairman Appointed for Pyles Boys Camp Barbeque Committee

Barbara Bradshaw, of Marlin-West Drilling of Bakersfield, CA, has been appointed chairman of the 1983 Pyles Boys Camp Barbeque Committee in Kern County. She is the first woman to hold the position since the event began more than 25 years ago.

House Committee Clears OCS Lands Act Amendments; Further Action Unlikely

The House Committee on Merchant Marine and Fisheries has completed action on H.R. 7076, a bill to amend Title II of the Outer Continental Shelf (OCS) Lands Act. The bill now goes to the House Committee on Interior and Insular Affairs, which is not expected to consider it during the current session of Congress.

The bill would require that OCS lessees and permittees give "processed" and "analyzed" information to the Department of Interior, but would repeal an existing provision requiring submission of interpreted data.

Other provisions would modify conditions under which lease operations could be suspended and lease terms extended, accelerate the issuance of licenses and permits, establish an interest-bearing account for bonus monies, modify penalties for non-diligence, streamline procedures for the refund of royalty over-payments, decrease some criminal penalties and repeal provisions requiring a continuing review of OCS oil and gas resources and an annual report on shut-in or flaring wells.

Point Arguello Discovery – Santa Maria Basin

The announcement by Chevron U.S.A. Inc. and Phillips Petroleum of a new oilfield discovery located offshore California with estimated reserves of 100 million barrels has prompted statements that this may be part of the biggest U.S. oilfield discovery since the 1968 Prudhoe Bay discovery.

The Chevron U.S.A. Inc. "OCS P-0450" 1 reported rates of 1013 BOD, 295 MCFD (32/64″ bean) from interval of 7950-8205′; and 1765 BOD, 580 MCFD (56/65″ bean) from interval of 7690-7920′ with gravities of 30°±. The OCS P-0450 lease is the most expensive parcel ever to be purchased in OCS history. Chevron and Phillips paid $333 million for the lease in 1981 at Sale 53.

The "OCS P-0450" discovery well is located just north of the "OCS P 0315" discovery announced by Texaco earlier this year and northwest of the "OCS P 0316" discovery announced by Chevron in 1981. All three of the discovery wells appear to be located on the same anticlinal structure.

Chevron expects to have a drilling platform built during the first half of 1985 from which they anticipate an eventual recovery of 160,000 B/D for the field.

Los Angeles

The Los Angeles Basin Geological Society will hold its next meeting, Thursday, October 28, 1982 at Taix Restaurant in Los Angeles. Dr. Robert Douglas, U. S. C. will present "Miocene Oceans Revisited".

November 18, 1982, Thursday, A.A.P.G. Distinguished Lecturer, Dr. Wayne Pryor will give a talk "Shales: Their Sedimentology and Geology".

The Los Angeles Basin Geological Society "FIRE and ICE" dinner dance will be held Saturday, November 20, 1982 at the Woodland Hills Country Club. For additional information, please call Darlene Condra (213 739-7264).

Jack Sheehan has accepted the position of Exploration Manager – Western District with Santa Fe Energy. He was previously with Champlin Petroleum, Long Beach.

Coast

COAST GEOLOGICAL SOCIETY
P.O. Box 3014
Ventura, California 93303

President	Conoco	Bill Stanton
Vice-President	Argo	Gary Nulty
Secretary	Conoco	Roger Brown
Treasurer	Argo	Tricia Young

The annual fall picnic was held Saturday, September 18th, at the Lagomarsino Ranch in Ojai. Approximately 80 CGS members and spouses attended the bar-b-que. The Society wishes to thank Union's Bill Ballog and crew for their excellent meal at this event and to thank the Lagomarsinos for the use of their facilities.

CGS dinner meetings will be held the third Tuesday of each month at the American Legion Hall in Ventura.

Personnel News

Union in Ventura has announced two transfers: Gary Beckerman is transferred to their Bakersfield office and Dave Jenkins is transferred to Indonesia.

San Joaquin

S.J.G.S. dinner meeting, November 9, 1982, will feature Charles Katherman, Husky Oil, who will present "Recent Developments of the Monterey Formation in the Santa Maria Basin".

The Christmas dinner meeting will be held at Matia's on December 14, 1982.

The S.J.G.S. Annual Bar-B-Que (Sept. 24, 1982) was enjoyed by a crowd of approximatealy 150, despite the rain. S.J.G.S. appreciates and thanks Rick Hoffman, as Chairman of the golf tournament, and Buzz Delano, as Chairman of the tennis tournament, for their very successful efforts. Winners for the tournaments were:

TENNIS:

A–Winners	First	Frank Amato
	Second	Dale Hankins
	Third	Buzz Delano
B–Winners	First	Bill Dahleen
	Second	Viet Truong
	Third	Bud McNeil

GOLF:

Low Gross	First	Ray Finch
	Second	Pat Mullholland
	Third	Joe Morgan
Low Net	First	Pat Mullholland
	Second	Rob North
	Third	Bob Anderson

Highest Gross: Larry Sanek
Closest to Hole: Mark Shields
Longest Drive: Pat Mullholland

ARCO's recent reorganization resulted in transfers to Denver (ARCO Exploration Company, ARCO Tower, 707 – 17th Street, Denver, P.O. Box 5540, Denver, CO 80217) for the following: Bill Bazeley, Exploration Manager-California Province; geologists – Robin Byers, Thom Davis, Linda Jarvis, Paul Lillis, Laura Merrill and Lynn Schuetter; geophysicists – Joe Austin and Kirk McIntosh; landman – Steve Abbey; and exploration technician – Rick Smith. Remaining in Bakersfield with ARCO Exploration Company are Norm Church, senior geologist, and Mozelle Pollok, senior scout. ARCO Oil and Gas Company's California District headquarters remains in Bakersfield with the following: Robert Flaherty, Vice-President; David Woltz, District Exploration Manager; Wes Reeves, District Land Manager; Ken Wainwright, Senior Associate Geologist; Bill Dahleen, Senior Area Geologist; Chuck Rhinesmith, Senior Geophysicist; Bill Broomfield, Senior Landman; Mary Pauly, Landman; Bernadette Mata and Debbie Unfried, Land Representatives.

Jane Ellis and Garry Beckerman, recently transferred from UNION OIL COMPANY's Southern District in Ventura to the Northern District in Bakersfield.

DEPCO, Inc.'s, position of West Coast District Exploration Manager has been filled with Rex E. Olsen, formerly with Sotrana-Texas in Houston.

Personnel changes at Gulf Oil include Ed Mercado, Manager Frontier West Coast Area, who is transferring to Houston, where he will serve as technical advisor of U. S. Exploration. Recent college graduates reporting for exploration duties at Gulf are: Ken Turner, M.S. in geophysics from Penn State; Christopher Hollister, geophysicist with a B.S. from U.C.L.A.; Gary Huftile as geophysicist with a B.S. from U.C. Davis; Lynn Moses with a M.S. from U.C. Davis as geologist; and Frank Muramoto with a M.S. from U.C. Riverside as geologist. Also, transferring from Texas to a position as new area production geolotist is J. R. Minner.

Northern California

Northern California Geological Society will be holding its November luncheon on the 17th at the Elks Club in San Francisco, 456 Post Street at 11:30 A.M. The speaker will be Dr. Wayne Pryor, A.A.P.G. Distinguished Lecturer, addressing the topic: "Shales: their sedimentology and geology". Visitors are welcome. For reservations call Sara Christensen at (415) 680-3657.

Alaska

The Alaska Geological Society held its annual fall barbecue on September 16 with 85 people attending. This event was partially subsidised by the AGS which accounts for the number of interested persons who showed up to gorge themselves with hamburgers and to swill beer.

The AGS currently has over 675 members, mostly in the Anchorage area. For those on the OUTSIDE who would be interested in joining, send your request for an application to: Alaska Geological Society, P.O. Box 1288, Anchorage, AK, 99510. Annual dues are five bucks and this also brings you nine issues of the AGS NEWSLETTER. This Publication hasn't won any Pulitzer Prizes, but it does contain current information of a geological note sufficiently edited for sending through the mail.

The membership of the AGS recently voted to invite the Pacific Section AAPG to hold their 1985 annual convention in Anchorage. Arlen Ehm has been appointed as a special coordinator for this activity.

BEAUFORT SEA-OCS LEASE SALE 71 — RESULTS

High Bid Tract — # 191	$ 227,173,250.00
Total Apparent High Bids	$2,067,604,785.65
Total Bonus Offers	$4,589,972,518.20
Tracts Offered	338
Tracts Receiving Bids	125
Bids Rejected	4

Although Sale 71 set a new record for Alaska, with high bids of $2,067,604,785.65, the total bid fell below expectations and did not set new OCS records on a national scale.

Of the 338 tracts offered 125 received bids. Most of the tracts that were bid on were located in Harrison Bay, an area featuring the same reservoir, source rock, and geological history as that of Prudhoe Bay.

Tract 191 captured the high bid of $227,173,250,00 by the Sohio group (Sohio Alaska - 47%, Mobil Oil – 33%, BP Alaska – 20%). The Texaco group (Texaco, Inc. – 38%, Diamond Shamrock – 37%, Placid Oil – 15%, Amerada Hess – 10%) won tract 206 with second high bid of $219,117,312.00. Of the total high bids of $2 billion over $700 million of that was offered for the top fifteen tracts.

With 24 companies participating in the lease sale, Sohio's group put close to one-half of the high bid cash total on the table. The Shell, Amoco, Union and Koch group had the largest number of apparent high bids, bidding on close to half of the 125 tracts that received bids.

Four of the 125 apparent high bids were rejected as falling below Interior Department's estimated value.

Rejected tracts were:

Tract 324	$2,126,000.00	by Shell-Amoco-Murphy-Amerada Hess
Tract 173	$1,327,450.00	by Sohio Alaksa-Mobil-Tenneco
Tract 187	$4,512,000.00	by Shell-Amoco
Tract 217	$3,007,000.00	by Chevron-Phillips-Getty

Hopeful projections anticipate potential production from new discoveries in lease sale area 71 coming on in the mid-1990's. With estimates of 500 million barrels to 5 billion for reserves, the new (as yet undiscovered fields) are expected to rival and/or exceed those of Prudhoe Bay.

Top fifteen tracts in OCS Sale 71

Tract	Bidder	Apparent high bid $	Bid/acre
191	Sohio 47%, Mobil 33%, BP 20%	227,173,250	39,901.96
206	Texaco group	219,117,312	38,486.97
207	BP 55%, Mobil 29%, Sohio 16%	193,579,570	34,001.38
204	Texaco group	168,118,272	29,529.22
190	Sohio 68%, Mobil 32%	148,871,130	26,148.54
205	Sohio 58%, Mobil 30%, BP 12%	136,637,450	23,999.75
192	Shell 90%, Koch Exploration 10%	113,456,000	19,928.03
58	Exxon 100%	73,250,000	12,865.22
189	Sohio 50%, Mobil 40%, Tenneco 10%	71,793,250	12,610.16
221	Sohio 100%	60,753,370	10,671.02
220	Texaco group	57,116,160	10,032.20
219	Chevron 43%, Phillips 32%, Getty 25%	47,542,000	8,350.54
208	Amoco 55%, Shell 35%, Koch 10%	45,754,000	8,036.48
57	Exxon 100%	44,250,000	7,772.31
218	Chevron 43%, Phillips 32%, Getty 25%	35,115,000	7,381.85

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A.W.W.A., INC. — NEW FACILITY

Anderson Worldwide Associates, Inc. opened a new office on June 1st, at 3720 Easton Drive, Unit 4, Bakersfield, CA 93309. Alan R. Hershey has been named as the manager of the new facility of the biostratigraphic consulting firm, whose main office is located at 11526 Sorrento Valley Road, San Diego, CA 92121. Richard E. Anderson, the president of AWA, has expanded the operation of the Company in order to provide faster service for clients in the area. The telephone number of the office is (805) 323-8518, and the San Diego phone remains the same, (714) 755-1524.

NEWSLETTER
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