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GULF OF ALASKA PETROLEUM EXPLORATION; PAST, PRESENT, AND FUTURE

(No abstract submitted)

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ATLANTIC FLOOR PROFILE (MOVIE)

(No abstract submitted)

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EFFECTS OF STACKING MISALIGNED CRP TRACES

Maximum effectiveness of the CRP method can be obtained only when the reflections to be stacked are in perfect time alignment on all traces. Unavoidable misalignments due to inexact datum and normal moveout corrections usually can be determined by visual or machine correlation within the common-point collection groups. The question then becomes, "Are the observed variations sufficiently large to justify reprocessing with refined corrections and how much improvement could be so obtained?"

The reductions in effectiveness for various degrees of common coverage are derived for two hypothetical signals; a continuous sine wave, and a symmetrical Ricker wavelet. Two separate cases are considered for each signal. In the first case the signals of a suite are linearly distributed through a maximum time difference. In the second case a hyperbolic distribution, such as would be found because of an error in total moveout, is used. The results of all four cases are presented in normalized form, and can be applied universally to records of any frequency.

The range of error values which is investigated is sufficiently large to indicate the degree to which multiple reflections can be attenuated with large amounts of excess moveout.

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THE LAW OF GEOTHERMAL RESOURCES

The legal principles that will govern exploration for and utilization of geothermal resources are in their early development. Analogies with oil and gas laws and with mining laws are helpful, but novel characteristics of geothermal resources will require answers in addition to those found in these existing bodies of law.

Private land owners have encouraged geothermal ventures by signing "geothermal leases" with operating companies. These are patterned after oil and gas leases with added provisions to deal with minerals in solution and other problems unique to geothermal resources. The geothermal lease seems to be working, and to date the only commercial geothermal ventures in this country are on privately owned lands taken under such leases.

Existing federal law does not provide adequately for development of geothermal resources on the federal public domain. The need for specific legislation is recognized by both government and industry, but there is no agreement on the form this legislation should take. Pending the enactment of legislation, the Interior Department in 1967 made a controversial "executive withdrawal" of 1,051,000 acres of land having potential value for geothermal resources.

State geothermal leasing laws have been enacted in California and New Mexico. The active geothermal exploration and development in California will help set important patterns for development of geothermal resources on publicly owned lands.

The geothermal operator's obligations and liabilities are only partly defined by existing laws and regulations. Are geothermal exploration and production extrahazardous activities which will make operators strictly liable for damages, or is a negligence standard applicable? These are but two of many questions yet to be answered.

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SUPPORT OPERATIONS, VESSELS AND AIRCRAFT, FROM OWNER'S POINT OF VIEW

(No abstract submitted)

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GEOTHERMAL DEVELOPMENTS IN THE GEYSERS AREA, CALIFORNIA

The Geysers area is about 90 mi north of San Francisco. The rocks in the area are Jurassic-Cretaceous Franciscan graywacke, sandstone, shale, greenstone, serpentine, and extrusive rocks belonging to the Clear Lake volcanic series of late Pliocene to late Pleistocene age. Volcanic activity is believed to be the cause of the abnormal high heat flow.

Drilling was started by Magma and Thermal Power Companies in 1955 and Pacific Gas and Electric's first plant of 12,500 kilowatt-hours (KWH) electrical generating capacity went into operation in 1960. The power output was more than doubled in 1963 and again in 1967 for a total of 55,000 KWH. A fourth plant of 27,500 KWH is under construction and new generating units of 55,000 KWH each are being planned.

To date Magma-Thermal have drilled 42 wells in three producing areas comprising a total of 300 acres. The wells range in depth from 1,500 to 5,000 ft. Steam capable of generating about 150,000 KWH is actually developed. The reservoir is a fractured sandstone and the occurrence of thermal alterations in a linear trend have led many to conclude that the fracturing is associated with faulting. The fluid exists in the reservoir as superheated steam with a pressure of about 500 lb. Successful stepouts drilled by Union, Signal Oil and Gas, and by Geothermal Resources International have expanded significantly the potentially productive area and the early estimates of 600,000 KWH power potential for the area may be conservative.

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REVIEW OF OUTER 1,000 KILOMETERS OF EARTH
(No abstract submitted)

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EVALUATION OF GEOTHERMAL STEAM RESERVES

Early evaluation of geothermal steam reserves is a key step toward rapid and proper development of such reserves. The term "reserves" indicates the quantity of geothermal fluid which can be produced at an acceptable rate and for a period of time sufficient to make the development investment reasonable and profitable. Unfortunately, there has been a general belief among technologists that reservoir-engineering methods developed in oil and gas production are not applicable to geothermal fluid production. Although some modification of existing reservoir-engineering methods is necessary, basic principles are to a large extent applicable.

Many geothermal fluid reservoirs currently being produced are believed to be dominated by fracturing and to be in communication with aquifers recharged by surface water. Many such oil and gas reservoirs have been recognized, and methods for forecasting their behavior have been developed in the last two decades. One very useful body of literature exists in connection with oil and gas well test analysis. The effects of fractures, production limits, fluid sources, and other pertinent reservoir features have been thoroughly documented. Such tests and their interpretations can be utilized, much more than has been appreciated, in geothermal wells.

The heat transmission involved in geothermal fluid production is a complication not commonly involved in reservoir engineering. However, the development of processes involving the subsurface combustion of crude oil and the displacement of crude oil by steam and hot water injection led to important literature concerning reservoir and well-bore heat flow. Application of existing and new reservoir engineering techniques to geothermal fluid production should lead to better understanding of this class of reservoirs and to more rapid development of this significant resource.

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GEOLOGY OF WYNOOCHEE VALLEY QUADRANGLE OF SOUTHWEST WASHINGTON

In the Wynoochee Valley quadrangle of southwest Washington, a sedimentary sequence of Tertiary rocks approximately 15,000 ft thick overlies the middle Eocene volcanic rocks of the Crescent Formation. These strata range in age from late Eocene to at least late Miocene and include unnamed beds of late Eocene age and the Lincoln Creek, Astoria(?), and Montesano Formations. At least three major periods of deformation are recorded: (1) post-Crescent and pre-late Eocene; (2) post-Astoria and pre-Montesano; and (3) following Montesano deposition. A few major strike-slip faults trending northeast and several associated normal faults trending northwest are the result of pre-Montesano deformation. Post-Montesano deformation is confined mainly to moderate folding and limited faulting.

Potential source rock for petroleum is represented by the thick Lincoln Creek Formation and possibly by parts of the Astoria(?) Formation. Widespread sandstones of the Montesano Formation and some parts of the Astoria(?) Formation are possible reservoir rocks. Several major anticlines and several other smaller folds, together with conditions for stratigraphic as well as fault traps, are present in the Wynoochee Valley quadrangle.

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ORIGIN OF *Pseudohastigerina* IN PALEOCENE AND LOWER EOCENE STRATA OF CALIFORNIA

In the analysis of planktonic Foraminifera, true phylogenetic lineages are difficult to assess because of the small number of morphologic characters and convergence due to similar ecologic stress. However, the development of the planispirally coiled genus *Pseudohastigerina* is well documented in Paleocene strata from California. The origin of *Pseudohastigerina* has been traced in the type Lodo Formation section at Lodo Gulch. In the lowermost Lodo Formation (*Heliolithus riedeli* Zone), *Globorotalia chapmani* gives rise to a form transitional with typical *Pseudohastigerina* in the overlying strata (*Discoaster multiradiatus* Zone). This lineage transition involves the migration of the extraumbilical-umbilical aperture onto the spiral side of the test with further development of bilateral symmetry. A similar lineage transition has been observed in the upper Santa Susana Formation of the Poison Oak Canyon section from Simi Valley. Typical *Pseudohastigerina wilcoxensis* specimens, which show a more perfect planispirality and a more nearly equatorial aperture, occur in the middle of the Lodo Formation (lower *Discoaster tribrachiatus* Zone).

In the Paleogene, other genera of the Hantkenininae evolved from *Pseudohastigerina*, all serving as important biostratigraphic indicators. The first occurrence of *Pseudohastigerina*, the so-called *Pseudohastigerina* (or *Globanomalina*) datum, is a useful criterion for distinguishing lower Eocene from upper Paleocene in strata from California and throughout the world.

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NEW PETROLEUM PROSPECTS, SHALLOW AND DEEP BERING SEA

Recent geological and geophysical investigations by the United States Geological Survey and cooperating institutions have outlined three areas of possible interest for petroleum prospecting in the Bering Sea: (1) intrashelf basins, (2) an outer-shelf sediment-draped basement high, and (3) a continental borderland, Umnak Plateau, seaward from the continental slope.

1. Although the possibility of subshelf oil deposits has long been recognized in the thick sequence of Cenozoic sediments underlying Bristol Bay, published geophysical data seemed to indicate that elsewhere the shelf is underlain by only a thin blanket of Cenozoic sedimentary deposits overlying a basement of crystal-