ABSTRACTS OF PAPERS

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GIANT NEOGENE PECTINIDS OF EASTERN NORTH PACIFIC—CHRONOSTRATIGRAPHIC AND ZOOGEOGRAPHIC SIGNIFICANCE

Giant pectinids—taxa that regularly attain more than 90 mm in diameter—appear at or near the base of the "Vaqueros Stage" and coeval units of the Pacific coast megainvertebrate chronology. Similar giant forms appear in lower Miocene strata in Europe (Aquitanian Stage). Recognition of this evolutionary event in these widely separated provincial sequences, together with diversity trends in the Pectinidae as a whole and certain foraminiferal correlations, argues for placement of the Paleogene/Neogene boundary at the base of the "Vaqueros Stage" of the Pacific coast sequence.

The early Miocene of Pacific coast basins is characterized by abundance and taxonomic diversity of giant pectinids (*Amussiopecten, Lyropecten, Macrochlamis,* and *Vertipecten*). Of these, only *Vertipecten* is present in underlying Oligocene strata, and the few Oligocene species are only of medium size. Taxonomic diversity was greatest during the middle Miocene (*Amusium, Amussiopecten, Lyropecten, Patinopecten,* and *Vertipecten*), but decreased sharply during the late Miocene (*Fortipecten, Lyropecten,* and *Patinopecten*) and Pliocene (*Leopecten, Lyropecten,* and *Patinopecten*).

The giant pectinids can be separated into a southern group (*Amusium, Amussiopecten, Leopecten, Lyropecten, Macrochlamis,* and *Nodipecten*) and a northern group (*Patinopecten* s.s., *Parionopecten* [*Lituyapecten*], and *Fortipecten*). The survivors of these two groups, *Nodipecten* and *Patinopecten*, have mutually exclusive modern geographic ranges and are restricted, respectively, to warm-water and temperate- to cool-water molluscan provinces along the Pacific coast.

Taxonomic diversity trends and migrational patterns of these pectinids reflect climatic amelioration during the early and middle Miocene, followed by cooling during the late Miocene and Pliocene.

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POLYCYCLIC HYDROCARBONS IN OIL SHALE—ORIGIN AND GEOCHEMICAL FATE

A series of pentacyclic triterpenes of the hopane type is present as the main components of the polycyclic hydrocarbon fraction of the Messel oil shale, a terrestrial sediment of Eocene age, from near Darmstadt, Germany. The series ranges from C_{27} to C_{32}, and the members differ only by the length of the side chain on the 5-membered ring. The C_{27}, C_{31}, C_{32} compounds, which have never been detected in nature, probably arise from geomicrobiological degradation and alkylation reactions of a C_{30} precursor taking place in the first stages of sedimentation. Pentacyclic triterpenes usually have been considered as paleoecologic makers indicating a higher plant origin of part of the organic matter of sediments and petroleum. Recent studies, however, on the chemistry of bacteria and blue-green algae have shown that these sources do contain pentacyclic triterpenes, commonly in significant amounts, and that these triterpenes are of the hopane type. These results, combined with analysis of the olefinic and oxygenated polycyclic fractions of the shale, seem to indicate a prokaryotic origin of the triterpenes isolated from the Messel oil shale. Moreover, analysis of the polycyclic hydrocarbons isolated from several recent and ancient sediments, as well as from crude oils, shows that triterpenes of the hopane type are widely present in these sources, and suggests that a significant proportion of the triterpenes found in sediments and oil in general could be of prokaryotic origin.

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OIL FIELD SUBSIDENCE—SUSCEPTIBILITY AND MONITORING TECHNIQUES

The possibility of oil-field subsidence is an important environmental consideration in both urban and rural areas. Current policies of various agencies require a subsidence-susceptibility appraisal prior to drilling operations. A hostile environment for oil-field operations can mean the Los Angeles and Santa Barbara areas as well as north of the Arctic Circle. Estimations of subsidence susceptibility are divided into two basic methods—the comparative-empirical and the analytic. The comparative-empirical method is considered best when undeveloped areas are examined. In this method, the geologic history, structure, and competency, of the area are compared with known subsiding areas. In the analytic method, core compressibility data, estimated stress changes, and sometimes, structural configuration, are applied mathematically to the estimation of reservoir compaction and subsidence. Many of the necessary data are not available until field development is well under way. Some combination of these methods should be used wherever possible.

Monitoring techniques include precision leveling, horizontal movement measurement, in-zone compaction measurements by collar logging, mechanical extensometers for shallow zones, tide gages, and special seismograph installations. Operational monitoring of casing derangements might also be important to locate compacting intervals.

Application of these and other techniques pertaining to the geologic aspects of environment will be increasingly important in the future.

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DATA COLLECTION AND PROCESSING TECHNIQUES FOR INCREASED SIGNIFICANCE OF AIRBORNE GAMMA-RAY SPECTROMETRY

Although relations between radioactive elements and both mineral deposits and petroleum accumulations are indicated by many published investigations, the exploration effectiveness of the gamma-ray survey generally remains in doubt. Increased effectiveness of gamma-ray surveys is possible through increased accuracy of collected data and improved data interpretation. Increased data accuracy is accomplished through adequate detector capacity and the correction for environmental variables. Improved data interpretation involves the use of the geologist-statistician-programmer team to reduce a vast amount of data to a manageable number of geologically significant values.

To attain geologic significance, gamma-ray spectrometer data must be integrated with other types of geologic and geophysical data. To test this premise, a set of gamma-ray data covering complex metamorphic and igneous geology of the Duchess area, Queensland, Australia, was processed as a function of mapped surface geology, and statistical methods were used to identify statistically significant anomalous records relative to the background of each rock type, rather than for the entire survey area. Design of the data-presentation format allowed quick screening of anomalous values from the large total number of records. Examination of statistical parameters indicated the possibility of using the gamma-ray data to map surface geology without the aid of photogeology or field mapping. Stacked profiles of U, Th, K, and their ratios were analyzed for obvious "breaks," and the units thus defined were correlated by computer processing. Results indicated that surface mapping by this procedure is feasible.

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POROSITY AND PERMEABILITY IN SILURIAN CARBONATE ROCKS OF ANADARKO BASIN, OKLAHOMA

Ninety Hunton cores have been studied, from which 37 Silurian samples from 21 wells were tested for porosity and permeability. Each sample was examined in thin section and was analyzed chemically for $CaCO_3$, $MgCO_3$, and HCl insolubles. The specimens range from limestones and calcareous mudstones having less than 1% $MgCO_3$ to crystalline dolomites with more than 43% $MgCO_3$. Porosity ranges up to 21%, and permeability to 305 md. Rocks with appreciable porosity and permeability have a circumscribed range in texture and composition: specimens with more than 5% porosity are confined to crystalline dolomites with more than 35% $MgCO_3$ (65% dolomite), and those with more than 10% porosity to dolomites with more than 37% $MgCO_3$ (80% dolomite). Much of the pore space is in the form of fossil molds and vacuities in the matrix surrounding oolites. The fossil molds were formed by leaching, and the porous oolites probably result from a primary porosity increased by dissolution. Not all dolomites have high porosity, and several specimens with more than 35% $MgCO_3$ have less than 1% porosity; the latter condition appears to result from preservation of the fossils by calcspar and dolospar rather than as molds. Leaching of fossils and preservation by spar are confined to crystalline dolomite, thus indicating a genetic relation to dolomitization. A suggested sequence of events in the development of porosity is dolomitization and leaching, followed by some secondary cementation of pore space by spar.

Present information indicates a geographic concentration of these porous Silurian dolomites in the north-central and western parts of the Anadarko basin (data on the deeper parts of this basin are lacking).

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TECTONICS AND DEPOSITIONAL HISTORY OF ROCKY MOUNTAIN INTERMONTANE BASIN

In the Uinta basin of northeastern Utah, the Uinta and Duchesne River Formations are composed of extremely diverse fluvial sedimentary rocks. The rock units overlie extensive lacustrine deposits of Lake Uinta and provide a sensitive record of late Laramide (latest Eocene) tectonic events in this part of the Rocky Mountains. The fluvial deposits are dominantly heterogeneous, laterally discontinuous sandstone lenses and varied amounts of conglomerate and poorly stratified, fine-grained rocks.

Uplift of the Uinta Mountains changed geographic conditions and drainage patterns in the Uinta basin and strongly influenced the characteristics of contemporaneous sedimentary deposits. Important features of the stratigraphic sequence are (1) the oldest major body of sediment (early Duchesnean) produced during uplift of the Uinta Mountains is considerably younger than the youngest preserved deposits of Lake Uinta (middle Uintan); (2) lower (early Duchesnean) and upper (late Duchesnean) conglomeratic rock units record two major episodes of uplift, each composed of several smaller events; and (3) thick volcanic ash deposits, now altered, accumulated during the quiescent period (middle Duchesnean) between major uplifts. This sequence of events imposes some constraints on inferred geomorphic development of the region. The deposits also demonstrate that the latest Eocene (about 40 m.y. ago) was a time of major differential movement of the Uinta Mountains and the Uinta basin, and was not a time of tectonic quiescence in northeastern Utah.

Because of the great distance of the Rocky Mountains from the North American continental margins, detailed knowledge of local tectonic timing affords the best opportunity for plausible speculations relating plate tectonic mechanisms to Laramide events and to early development of the Colorado Plateau and the Basin-Range province.

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SUBTLE SURFACE MAPPING KELSH PLOTTER TECHNIQUES

Studies indicate that the Kelsh stereoplotter is capable of locating subtle surface anomalies using high-altitude photos and ground control.

Petroleum explorationists in the early 1950s used the Kelsh plotter to map in detail known geologic surface structures in order to determine the amount of structural closure and fault throws. In the early 1960s, with the advent of high-altitude photographic coverage over much of the United States, a new role developed for the plotter. The large, 40-sq-mi/print, lateral stereoscopic coverage allows a much wider look at large areas, and thus a new system of geologic reconnaissance mapping with extremely accurate results. Tip and tilt, inherent in all aerial photographs, can be removed. An enlargement factor of 5, together with vertical ground controls for each stereo pair, makes possible dip-magnitude readings of 1/2 degree and accurate structural elevation work. Using the Kelsh plotter to evaluate larger geologic provinces, many previously undiscovered subtle nosings, faulted noses, and independent surface closures become apparent. Cross-section work and measurement of the thickness of formations also may be accomplished. A newly developed system of polarized light makes possible the use of color aerial photographs with the same accuracy as conventional black and white prints.

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OXYGEN ISOTOPE COMPOSITION OF RECRYSTALLIZED CARBONATES ASSOCIATED WITH SUBMARINE VOLCANIC ROCKS

Recrystallized carbonates from the contact zone between sediments and apparently intrusive basalt, and from calcareous xenoliths in eruptive flows in several Deep-Sea Drilling Project cores, are depleted in O^{18} by not more than a few per mil relative to the estimated isotope composition of the original sediment. If this depletion were the result of isotope exchange to equilibrium with seawater in a closed-pore water-sediment system, then the upper limit of the temperature of recrystallization was 100°C, and probably less for most of the samples analyzed. If isotope exchange occurred in an open system, where seawater could readily circulate through the recrystallizing carbonate, the upper temperature limit would be even lower. The possibility that retrogressive isotope exchange or kinetic isotope effects were responsible for the observed isotope fractionations is considered unlikely. The fact that bulk carbonates from the deepest parts of long Deep-Sea Drilling Project cores show only minor effects of diagenesis and apparently have retained their original oxygen-isotope composition suggests that burial and a concomitant moderate temperature increase are not the only factors involved in carbonate remobilization in the deep sea. It is concluded tentatively that chemical changes in the pore water-sediment system resulting from the interaction of seawater with volcanic material may play an important role in the alteration and lithification of carbonates associated with deep-sea basalts and pyroclastic material.

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CHEMICAL COEFFICIENTS FOR IRON, MANGANESE, LEAD, ZINC, AND COPPER IN RIVER WATER AND SUSPENDED LOAD, AND MINERALOGIC COMPOSITION OF SUSPENDED LOAD OF SELECTED KANSAS RIVER SYSTEMS