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Oil Source Bed Distribution in Upper Tertiary of Gulf Coast

Effective oil source beds have not been reported in Miocene and younger Gulf Coast sediments and the organic matter present is invariably immature and oxidized. Crude oil composition, however, indicates origin from mature source beds containing reduced kerogen. Oil distribution suggests extensive vertical migration through fracture systems from localized sources in deeply buried, geopressured shales.

A model is proposed in which oil source beds were deposited in intraslope basins that formed behind salt ridges. The combination of silled basin topography, rapid sedimentation, and enhanced oxygen-minimum zones during global warmups resulted in periodic anoxic environments and preservation of oil-generating organic matter. Anoxia was most widespread during the middle Miocene and Pliocene transgressions and rare during regressive cycles when anoxia occurred primarily in hypersaline conditions such as exist today in the Orca basin.

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Stratigraphic Applications of Geologic Analysis System

The Geologic Analysis System is a multipurpose data-management and applications software package designed to graphically integrate massive amounts of data to help solve oil and gas exploration and research problems. The Geologic Analysis System includes: (1) TECH/SYS, a technical file-management system that can accommodate multiple files, (2) PICS, a user-friendly geologic mapping and contouring system, and (3) applications programs, which retrieve, manipulate, list, and display a wide variety of rock sample analytical data.

Benefits to the stratigrapher include: (1) publication- or report-ready graphic displays, (2) database edit routines, and (3) both graphically and statistically displayed outcrop sections and cores that objectively define the stratigraphic character of a rock sequence.

The utility of the Geologic Analysis System is demonstrated by a case study involving the Lower Cretaceous (Albian) Blackleaf Formation in southwestern Montana. A TECH/SYS database was created for a composite stratigraphic section of the Blackleaf Formation near Lima. Analysis of the database reveals 4 Blackleaf lithofacies units: (1) lower transitional clastic unit, (2) lower shale unit, (3) upper clastic unit, and (4) upper volcaniclastic unit. To define lithofacies variation objectively, stratigraphically variant data items are graphically displayed and analyzed. These data items include textural elements, porosity, mineralogy, lithology, paleontology, paleocurrent direction, and diagenetic features. Where applicable, bivariate plots, ternary diagrams, and multivariate statistical routines, such as discriminant function analysis and cluster analysis, are used to define the lithofacies variation.

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Role of Geologic Studies in Reservoir Modeling and Enhanced Oil Recovery

Detailed geologic studies have become increasingly important especially for secondary- and tertiary-recovery projects. Success or failure of such projects is strongly dependent on a proper understanding of reservoir heterogeneity. In virtually every case, the reservoir has been found to be more complex than originally envisaged. In some reservoirs, complexity has cast serious doubts on viability of the project as initially formulated.

With development of modern computers capable of handling much larger numbers of grid blocks, different scales of heterogeneity can be simulated realistically. It is possible to simulate complex fluvial channel architecture over an interval of several hundred feet, as well as the effect on reservoir performance of crossbedding of meter scale or less.

Today's reservoir geologist is faced with the challenge of quantifying his conceptual sedimentologic models more precisely. At higher levels of reservoir heterogeneity, probabilistic techniques to predict reservoir configuration between available wells appear promising. Reservoir modeling of individual sandstone bodies is dependent on modern analogs or outcrop-derived prototypes. Textural criteria should be taken into account in the selection of prototypes, as grain size ultimately controls shale barrier distribution and sedimentary structures. Cementation is an important form of reservoir heterogeneity commonly neglected in reservoir modeling. In the case of small-scale reservoir heterogeneity as manifested in cores, carefully planned core analysis programs are required to measure the potential anisotropy caused by sedimentary structures and to determine accurately in-situ properties resulting from clay-mineral diagenesis or overburden stress.

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Geomorphic Features off Southern California as Seen by GLORIA Side-Scan Sonar System

Approximately 165,000 km^2 of the sea floor off southern California was mapped during May 1984, as part of a USGS/IOS cooperative program to study the newly proclaimed Exclusive Economic Zone (EEZ) of the United States Pacific margin. The area was insonified using the Geological Long-Range Inclined Asdic (GLORIA), a long-range side-scan sonar system. Images were corrected for water-column velocity anomalies, for along-track distortions caused by variations in ship speed, and for slant-range distortions caused by acoustic ray travel paths. A photomosaic of the overlapping sonographs has been compiled at a scale of 1:375,000.

The basins of the inner California continental borderland are characterized by both sinuous channel and fan complexes and by feathery acoustic patterns indicating active sediment transport. In contrast, outer borderland basins appear to be more sediment starved, exhibit large areas of sediment failure, and show significant structural influence.

West of Patton Escarpment, the sonographs are dominated by acoustic patterns showing volcanic ridges and seamounts and by deposits of the Monterey and Arguello Fans. Arguello Fan, for example, exhibits multiple sinuous channels that have transported sediment 60 km south from the canyon mouth. These channels coalesce into a single 100-km long, westward-meandering channel that terminates in a 600-m deep box canyon. A zone of sediment failure is identifiable on the north levee of an upper fan channel. Tectonic trends associated with oceanic basement are highlighted by the terminus of the west-trending Murray Fracture Zone and by the prevailing northeast trend of volcanic ridge and seamount chains.

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Effect of Differential Subsidence in Growth-Faulted Regions on E-Log Patterns and Preservation Potential

Detailed electric log correlation, supplemented by cores, in the Eocene Wilcox Group and the Oligocene Frio Formation of the Texas Gulf basin contradicts a commonly held notion that changes in log character across growth faults exclusively reflect changes in environment. An invariable consequence of growth faulting is thickening of a depositional unit in the downthrown block, reflecting a greater subsidence rate. The growth ratio (downthrown or upthrown) varies from just over 1:1 to as much as 10:1.

Analysis and mapping of log character indicate that the basic unit of both deposition and physical correlation is regressive coarsening-upward sequences. In Wilcox deltas, prodelta shales pass up into delta-front sandstones while in Frio barrier-bar or standplains, shelf and lower-shoreface deposits pass up into upper-shoreface sandstones. Regressive packages grade downdip in environment from delta plain and bay or lagoon to offshore marine. Growth faults had no significant surface expression and did not separate contrasting environments.

A marked change in log character (e.g., from smooth to serrated) across a growth fault in a regressive shoreface sequence appears to indicate that the subsidence rate of the downthrown block exceeded a threshold value, enabling preservation of low-energy muddy layers and possibly episodic waning-flow storm deposits that were largely destroyed by fair-weather wave reworking on the upthrown block.

This concept has implications both to regional stratigraphy and reservoir properties. Correlative units can abruptly change log character across growth faults, impeding correlation. Sandstones in the down-