maps are made partially palinspastic by a limited restoration of rocks along the San Gabriel and Big Pine faults to the positions occupied during the time represented by each map. The maps show that the area was divided into two depositional basins by the northwest-trending San Rafael highland. Fluvial deposition occured in both basins during the Oligocene. In the northeastern Cuyama-Soledad basin, Oligocene-Miocene marine deposits transgressed eastward over a large delta. In the southwestern Ventura basin, marine transgression was from the southwest. In the late early Miocene the ocean breached the San Rafael highland and created a strait between the remaining San Rafael peninsula and the newly formed Ynez island. During the medial Miocene, marine transgression continued, further connecting the two basins into one and shrinking the size of Ynez island. Slight marine regression in the southeast at this time was caused by tectonic uplift in the region of the present-day Simi Hills. During the latest middle Miocene, movement occurred on the San Gabriel fault, thus isolating the Soledad basin and creating an inland lake. With continued fault movement, this lake moved southward during late Miocene and merged with the ocean creating a large estuary. Marine transgression continued in the southeast during the late Miocene, while marine regression occurred in the northwest.

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Internal Breccias near Early Geosynclinal Platform Margins

The Triassic and lower Jurassic limestones of the island of Hydra (Greece) were deposited on the Pelagonian platform, near its western edge which strikes north-northwest-south-southeast. In this region, five main breccia horizons are recognized. Internal breccias are characterized by mutual fitting of clasts, indicating relatively small displacement. Transitions downward into fissures and almost undisturbed rock sections, and upward into mass flows, provide important clues as to their origin. The clasts are generally monomictic and consist of shallow-water, slope or basin ridge limestones. The matrix is derived from above and consists of basin sediments which are commonly red.

Each of the five breccia horizons represents a sequence of: (a) platform buildup; (b) tilting caused by unequal subsidence; (c) deposition of basin sediments on top of the platform carbonates; and (d) brecciation of the platform limestones and absorbing of the overlying basin sediments. In many places, early lithification and repeated brecciation also occur. These main breccia horizons correlate very well with major tectonic phases in the early geosynclinal history of the northern and eastern Alps.

Although submarine breccias are commonly related to faults, there is no evidence for this in the Triassic and Jurassic sequences of Hydra. We suggest that the breccias were produced by large migrating flexures, and that such flexures are a tectonic alternative or substitute for faults in the early stages of Tethys formation. The study of brecciation of the type discussed may provide more precise information on the configuration and evolution of early geosynclinal platform margins and shelf-to-slope breaks.

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Origin of Casing Annulus Gas in Cognac Field and Significance of Marine Sediment Hydrocarbon Surveys

Data clearly demonstrate that a near-surface geochemical anomaly over the Cognac field, offshore Louisiana, is either the result of upward migration along well-defined paths (faults) or is a false anomaly.

A pre-sale (1974) hydrocarbon survey in the Cognac area was discussed at the 1978 annual AAPG convention. Analysis of 6 ft (2 m) deep sediment samples resulted in the delineation of hydrocarbon anomalies that included the discovery well of Cognac field. A part of this survey included the determination of methane δC^{13} values (δC_1) on three sediment samples having anomalous concentrations of hydrocarbons. The δC_1 values (−38.1, −39.2, and −37.3 ppt PDB) plus the methane/ethane ratios (C_1/C_2 = 7 to 15) are excellent evidence for thermal hydrocarbons.

Later, during the drilling of developmental wells, gas pressure buildup was encountered in the casing annulus of several wells. This gas probably enters the casing annulus at casing shoes located about −2,000 and −4,000 ft (−610 and −1,220 m; subsea). The casing annulus gas is nearly pure methane (98.3 to 99.6%), with a C_1/C_2 ratio of nearly 2,000 and δC_1 values around −68 ppt PDB. Thus this gas is of low temperature, bacterial origin. It is probably related to gas shows found between −2,200 and −3,500 ft (−671 and −1,067 m) in these wells.

Thus if the near-surface gas anomaly is the result of leakage from a deep reservoir, the leakage must have developed along well-defined migration paths (faults), so that it did not become mixed with the shallow bacterial gas. Diffusional migration would have resulted in a mixing of bacterial gas and thermal gas.

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Enhanced Oil Recovery Site Selection Using Reflection Seismology

Eight lines of 2-D high resolution seismic data were acquired at a proposed enhanced oil recovery site in Montague County, Texas. Areal extent of the producing field is roughly 200 acres (80 ha.), of which 35 acres (14 ha.) were selected for the experiment. The producing formation is a Pennsylvanian sand, 40 ft (12 m) thick and 1,800 ft (549 m) deep. High-frequency broadband data (50 to 175 Hz) were collected using both shallow (10 ft or 3 m deep) and subweathering explosives. Additionally, a detailed vertical seismic profile was conducted to tie sonic logs to the seismic data. Results confirmed an area of good reservoir continuity while eliminating others owing to small-scale faulting and changing sand thickness.

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Tectonic History and Progressive Development of Fold-Thrust Belt in Eastern Gulf of Alaska

The geology of the Gulf of Alaska, east of Kayak Island, records the temporal variation of three fundamentally different tectonic settings that developed owing to the interaction between plates along the western margin of North America. A late Meosozic to early Tertiary convergent margin setting is indicated by nearly contemporaneous plutonic belts, forearc-basin sequences, and accretionary terranes. In contrast, the middle Tertiary continental margin in the eastern Gulf of Alaska was relatively stable and is characterized by sedimentation in a subsiding basin with local extensional tectonism. The present tectonic setting was probably initiated during the

Miocene and reflects a combinatyion of dextral strike-slip motion and oblique convergence. The proposed tectonic model suggests that most of the eastern Gulf of Alaska is underlain by early Tertiarty and older oceanic crust and that large-scale lateral displacement of the Yakutat block may not be necessary.

Late Tertiary convergence in the central Gulf of Alaska, or Yakataga district, has controlled the structural evolution of a complexly deformed, fold-thrust belt consisting of numerous subparallel folds and north-dipping thrust faults. Moving from north to south, deformation in this belt becomes progressively younger and less intense; most of the structures in the offshore part of the Yakataga district are late Pliocene to Pleistocene in age. Industry leased a number of these relatively young structures in April 1976, and subsequently drilled ten dry holes. The drilling results suggest that geopressures, resulting in part from tectonic stresses, low geothermal gradients, and poor sand development appear to be characteristic of these structures and contributed to the lack of success.

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Field Appraisal with 3-D Seismic Surveys, Offshore Trinidad

The Southeast Coast Consortium block offshore eastern Trinidad contains four structures in each of which hydrocarbons have been discovered. Field appraisal to date had included two 3-D seismic surveys: the Pelican structure was surveyed in 1977 and, following its success, the Ibis 3-D survey was conducted in 1978.

The 3-D migrated data over both the Pelican and Ibis structures exhibit significant enhancement in the deeper part of the section and also improved fault resolution relative to previous 2-D control. On the north flank of the Pelican structure, primary dips have been recognized for the first time. As a consequence, estimated reserves have been increased by approximately 20%, thus substantially affecting development economics. Furthermore, the interpreted position of reserves in the minor reservoir sand has shifted from one fault block to another as a result of the revised fault interpretation. The acoustic nature of the stratigraphic boundary which may delimit this reservoir has been clearly demonstrated using seismic logs. Also the extent of this boundary has been manned from Seiscrop™ sections. The major change resulting from interpretation of the 3-D data at Ibis has been the definition of a much more complex fault pattern affecting all the reservoirs. This will have a significant impact on future field development plans. The 3-D seismic surveys are a useful tool for prospect evaluation in this area offshore Trinidad and should be considered prior to commitment to expensive offshore development programs.

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Lithofacies and Depositional Environments of Monterey Shale, California

The Miocene Monterey Formation records the deep basinal phase of a major late Tertiary cycle of basin formation and filling associated with wrench fault tectonism. Over much of coastal California, Neogene facies show a progression from Oligocene nonmarine and neritic rocks to Miocene basinal shales and siliceous rocks and then to upper Miocene to Pliocene turbiditic and neritic clastic rocks. In many places the Monterey consists of a basal calcareous facies, a middle transitional phosphatic facies, and an upper thick siliceous facies composed of diatomaceous rocks and their diagnetic equivalents (cherts, porcelanites, etc). Hydrocarbon-producing turbidite sandstones occur in these basinal rocks in the southern San Joaquin Valley and in redeposited pelletal phosphorites in the central Coast Ranges.

By analogy with modern environments of phosphate formation off South America and Africa, Monterey phosphatic shales probably represent phosphatization of shelf-slope-basin muds near the boundaries of the oxygen minimum zone. Nodular and pelletal phosphorites may also have formed near the boundaries of the oxygen minimum zone, but on sediment-starved bank tops and shelves. The widespread siliceous facies represents rapidly deposited diatom ooze that records high plankton productivity spawned by late Miocene climatic deterioration and intensified upwelling. Abundant organic matter, ecologic inferences from faunal data, and sedimentary structures such as alternations of massive and laminated cycles indicate that these siliceous rocks also formed as basin, slope, and shelf deposits within or near the fluctuating boundaries of a well-developed oxygen minimum zone—a depositional environment similar to the present Gulf of California and western margin of South America.

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Diagenesis and Methane Generation in Upper Cretaceous Gammon Shale, Northern Great Plains, United States

In the northern Great Plains, isotopically light methane is entrapped at shallow depths in marine rocks of Late Cretaceous age. Products of early diagenetic decomposition of organic matter in the Gammon Shale support the view that the gas is biogenic and formed at shallow depths early in the burial history of the sediments. This interpretation implies widespread gas occurrence and is consistent with a larger gas resource figure than alternative interpretations suggest.

The Gammon Shale was deposited offshore during a major regression of the Late Cretaceous epeiric sea. The sediment-water interface was oxygenated, and soft-bodied organisms burrowed the silt-clay sediment. Organic matter was sufficiently abundant for oxygen depletion at shallow depths. Bacterial sulfate reduction occurred quickly and resulted in the formation of framboids and octahedra of pyrite. Abundant concretions and discrete crystals of siderite began forming within tens of meters of the sediment surface. Interstitial waters became saturated with methane, and a free gas phase, held in siltstone layers by capillary forces, inhibited silicate diagenesis. Methane generation probably continued to burial depths of hundreds of meters. At the maximum burial depth (1,200 to 1,500 m), interstitial waters contained their maximum dissolved methane, and silt layers still contained free gas. Cenozoic uplift and erosion permitted gas exsolution. Exsolved gas combined with free methane already in the reservoirs to form the gas being currently explored and extracted.

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Plate Tectonic Evolution of Southern South America–Scotia Sea–Antarctica Area

Jurassic, Cretaceous, and Tertiary stratigraphy is analyzed