the natural relationship of many associated trace fossils.

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Hydrocarbon Exploration in Western Oregon and Washington

Recent discovery and successful development of a gas field near Mist, Oregon, have conclusively demonstrated the presence of commercial quantities of hydrocarbons in western Oregon and Washington. Understanding of the source and reservoir facies of this discovery may help develop additional exploration targets.

Reservoir sandstones of the Mist area occur in the Cowlitz Formation of middle Eocene age (Narizian Foraminifera Stage). The Cowlitz Formation of northwest Oregon and southwest Washington consists of nearshore-marine and brackish-water deposits of massive arkosic sandstone, shale, subbituminous coal, and interbedded basalt. It was deposited as part of a broad marine-deltaic system that extended from southern Oregon to northern Washington during middle Eocene time.

The feldspathic-quartzose sandstone of the Cowlitz Formation has porosities ranging from 14 to 41%, averaging approximately 25%. Permeabilities range from 46 to 8,500 md, averaging approximately 200 md.

Marine shale outcrops of the Cowlitz Formation in Washington contain dominantly terrestrial derived organic matter and have total organic carbon content averaging approximately 0.75%. Vitrinite reflectance values average approximately 0.45% for rocks inferred to have been buried to a depth of approximately 10,000 ft (3,000 m).

Traps, including the Mist gas field, appear to be structural-stratigraphic with reservoir sandstones thinning against plunging basement noses. These traps are complex and masked beneath several unconformities, underscoring the importance of geophysical exploration.

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Tectonics of Monterey Salient, Sierra Madre Oriental, Northeastern Mexico

The Monterey Salient formed as a result of uplift in the Mesa Central of Mexico and consequent gravitational sliding of the detached cover to the northeast during the Laramide orogeny. The salient is located south of Monterrey where the Sierra Madre Oriental orogenic belt abruptly from an east-west to a north-south direction. It is composed of a series of arc ed, doubly plunging, en echelon anticlines, most of which are overturned to the north. Exposed in the area are Upper Jurassic carbonates and terrigenous rocks, and Lower Cretaceous carbonates. The salient also contains a few outcrops of Upper Jurassic evaporites which have flowed to the surface along fault planes. These evaporites, recognized as the Minas Viejas Group, are believed to be the decollement above which the deformation occurred.

A crustal shortening of 50% is calculated in the Monterey Salient. Most of the shortening is attributed to folding, in as much as surprisingly few major thrust faults have been observed. Field work also demonstrates that structural trends are directly related to buttressing effects of paleohighs and thick sedimentary basins. On the basis of these structural trends and recent stratigraphic studies, the Mesozoic Coahuila peninsula is found to extend in the subsurface farther to the south than has previously been assumed.

Both the stratigraphy and structural style make the Monterey Salient a classic example of a gravity-induced orogenic belt.

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Evolution of a Fore-Arc Basin, Luzon, Philippines

The Tertiary Central Valley of Luzon is a remarkably well-exposed fore-arc basin, with both the trenchward and arc flanks uplifted and disected. A study of outcrop geology, drilling results, and seismic reflection records determined the changing geometry of the basin through time, facies distributions, sediment-distribution patterns, and hydrocarbon potential for the basin. The uplifted western flank exposes an ophiolite sequence, pelagic deposits, and deep-sea to shallow-marine clastics that document the emplacement and uplift of the seaward side of the basin. The eastern flank shows non-marine and shallow-marine volcanioclastic aprons shed off the arc, overlain by reeds, shallow-water clastics, and a progressively deepening slope/basin turbidite sequence.

Basin geometries and detrital mineralogy suggest that the Central Valley formed as an elongate geomorphic feature in the middle Miocene and progressively subsided and filled into Pliocene time. Over 35,000 ft (10,668 m) of sediment accumulated prior to a westward jump of the fore-arc basin to a site nearer to the Manila Trench. The positions of shelf/slope boundaries and prograding deltas can be documented from seismic-stratigraphic analysis. The history of basin formation and relative positions of possible source and reservoir rocks suggest that the Central Valley has undiscovered hydrocarbon potential.


Destin Dome and Western Florida Shelf

The U.S.G.S. has acquired a network of 1,280 km (800 mi) of common-depth-point seismic data connecting eight wildcard wells north of the latitude of Tampa and tied to the Destin dome area in the northeastern Gulf of Mexico. Line layout facilitates ties to onshore and offshore wells and to the regional multichannel net of the University of Texas. These lines reveal the structural growth of the salt-related Destin dome and a salt pillow with Jurassic and Early Cretaceous growth 30 km (20 mi) south of the Destin structure. Elsewhere in the West Florida Shelf, numerous low relief anticlines are present above basement highs.

Destin dome is a large, west-northwest trending anticlinal structure off northwest Florida. The dome is more than 80 km (50 mi) long and 30 km (20 mi) wide and has relief of a kilometer (3,000 ft) on Lower Cretaceous rocks. The dome appears to be the result of a salt swell that was uplifted during the Late Cretaceous and early Cenozoic. In 1973, 32 tracts (184,320 acres) constituting the eastern half of this structure were leased for $728,000,000. The highest bid lease (near the crest of the anticline) was purchased for $211,997,600 ($36,805/acre). Leases were not offered on the western half of the dome as it lies within a bombing range administered by the U.S. Department of Defense. Structural crests of Lower
Cretaceous and Jurassic strata within the bombing range are more than 150 m higher than in the leased area to the east. Nine dry holes have been drilled in the vicinity, seven of them concentrated on a structural high in Upper Cretaceous strata on the eastern flank of the dome.


Exploration History, North U.S. Atlantic Margin

The Baltimore Canyon Trough is the site of 26 exploration wells and two stratigraphic tests. As of November 1981, six dry holes had been drilled on the Great Stone Dome. This structure appeared to be the largest and most promising in the basin. Seventeen wells have been drilled along the edge of the continental shelf with significant hydrocarbon shows reported from five wells. Combined daily flow rate is 90 mcm. This flow is approximately one-half the amount required to warrant construction of a production platform and pipeline.

Georges Bank basin is characterized by an older thick carbonate and evaporite sequence (0 to 8 km) of Late Triassic–Early Jurassic age; a middle sequence of interbedded limestone, sandstone, mudstone, and red shale of Middle Jurassic to Early Cretaceous age (0 to 2.5 km); and a thin sequence (middle Cretaceous and younger) of transgressive shelf limestone and regressive claystone and siltstone (0.5 to 2 km). Elevated patch reefs beneath the shelf and a massive reeflike carbonate buildup under the slope form potential hydrocarbon traps. The patch reefs, which are elongate to circular and as much as several kilometers across, have caused a broad arcing of younger strata. They may be built on salt swells or elevated basement blocks. A two-dimensional, finite-difference simulation of the main basin's thermal history of crustal stretching and subsidence suggests that some of the oldest sedimentary sections over the seaward part of rift-stage crust and extending out to oceanic crust are thermally mature for oil generation.

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Stability of Natural Gas at High Temperatures, Deep Subsurface

The components of natural gas are reactive in the deep subsurface and may not survive under all conditions. The stability of natural gas in reservoirs of various lithologies is studied using a combined theoretical and experimental approach.

A computer program uses real gas data to calculate equilibrium in multicomponent (up to 50), multiphase (up to 30) systems simulating subsurface conditions to 12 km (40,000 ft). This program predicts the stability of hydrocarbons in sandstone reservoirs by first considering clean sands and then sequentially adding feldspars and clays, carbonate cements, and iron oxides. In all examples, equilibrium compositions have been computed for low, average, and high geothermal gradients; hydrostatic and lithostatic pressures; and with and without graphite. Graphite is present when deep gases are generated by the cracking of oil but is absent in reservoirs originally filled with dry gas. Similar calculations have also been made for limestone and dolomite reservoirs with various combinations of clays, iron minerals, anhydrite, and sulfur, again with and without graphite. Natural gas shows considerable stability in sandstone reservoirs under most conditions, but its concentration in deep carbonates is more variable and tends to a hydrogen sulfide-carbon dioxide (H2S-CO2) mixture except when an appreciable concentration of iron is present. Hydrogen is present at the 1 to 2% level for most lithologies.

A multicolumn gas chromatograph is used to analyze inorganic and organic gases released by crushing rock samples in a Teflon ball-mill. Gas samples from deep wells in the Anadarko basin and southern Louisiana have been analyzed and the compositions compared with those predicted from the computer program.

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Problems Facing Geophysical Industry Today with Suggested Solutions to These Challenges

No abstract.

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Phayles Sandstone (Upper Cretaceous) Deltaic and Shelf-Bar Complex, Central Wyoming

Outcrop and subsurface studies of Phayles Sandstone (basal Mesaverde Group), southeastern Wind River basin, indicate rapid deltaic progradation and subsequent formation of a shelf-bar complex. Net sand distribution determined from 175 well logs indicates a major deltaic lobe with maximum thickness of 45 m prograded at least 20 km basinward from exposures of deltaic and shoreface deposits. The West Poison Spider field is located approximately 8 km southeast and downdrift from this deltaic lobe. Study of 33 logs and 13 cores from this field indicates the reservoir is associated with elongate shelf sandbars. The bar complex is at least 10 km long, 8 km wide, and 15 m thick; bar-axes are oriented N40°W. Study of shoreface sandstones in outcrop suggests the paleoshoreline trended N50°W. Several distinct sandstone bodies are stacked within the complex. Three component facies are recognized: (1) cross-stratified medium-grained sandstone; (2) parallel-bedded (hummocky cross-bedded?) fine-grained sandstone; and (3) bioturbated fine-grained sandstone. These sandstones occur in repetitive successions with facies 1 capping the sequence and facies 3 forming the basal member. Log-response compares favorably with core descriptions permitting detailed facies correlations. Within the field, individual bars range from 3 to 8 m in thickness and pinch out both seaward and landward interfingering with bioturbated and rippled shelf siltstones. Sedimentary structures, stratigraphic relations, and petrography suggest the bar complex was derived from sands reworked from the deltaic lobe. The shelf bars migrated shoreward and stacked during a major transgression resulting in the deposition of the Wallace Creek Tongue of the Cody Shale. This shale overlies and forms an updip seal for the reservoir facies.

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Carapebus Member (Eocene), Campos Basin, Brazilian Offshore: An Example of Deep-Sea Fan Turbidites Winnowed by Bottom Currents

The Carapebus Member (Eocene), Campos basin, offshore