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Hackberry Oil and Gas Fields in Southeast Texas: Channel/Fan Depositional Systems and Structural Controls

Deep-water sandstones of the Hackberry Formation (Oligocene) host significant quantities of oil and gas. They remain one of the most important deep exploration targets in southeasternmost Texas; new fields producing from the Hackberry have been discovered at a steady rate from 1946 to the present.

The Hackberry contains two hydrocarbon plays. The updip play is relatively shallow, oil-rich, and lies near the updip limit of deep-water deposition. Some of the fields in this play actually produce from shallow-water Frio sandstones of Hackberry age rather than from Hackberry sandstones. The downdip play is gas rich and generally geopressured. The reservoirs lie either within or on the flanks of major channel systems and are often bounded updip by small growth faults. The discontinuous distribution and complex lithofacies of these channel and fan sands demand a careful understanding of the component depositional environments in order to discover and efficiently produce hydrocarbons.

The Hackberry Formation is a wedge of sand and shale with bathyal fauna that separates upper Frio sandstone and shale from middle and lower Frio shale and sand. The main sandstone lies atop a channeled unconformity at the base of the formation; some sandstones are also found locally within the shale wedge. Sandstones in a typical sand-rich channel evolve upward from a basal channel-fill sand to more widespread valley-fill deposits of interbedded sand and shale. Topmost are proximal to medial fan deposits with slightly meandering channels and overbank turbidites. This sequence suggests that the Hackberry sands were laid down by an aggrading, onlapping submarine canyon-fan complex that eroded headward into the contemporaneous Frio barrier bar-strand plain. Regional mapping and seismic interpretation outlines a network of partly sand-filled channels extending from the strand plain toward the southeast. The downdip limits of lower Hackberry sand are not defined by available well data.

The early structural history of the area is obscure, but Vicksburg-age faulting associated with continental slope sedimentation is possible. Small growth faults displace the Hackberry section less than 500 ft (150 m) and extend upward into the Miocene strata. Isopach and isolith maps indicate that the Orange, Port Neches, and Fannett salt domes were active uplifts during Frio and Anahuac deposition. Near Spindletop dome, however, only a north-south trending salt-cored ridge was present. The Hackberry channels are somewhat influenced by salt activity, but major channel axes extend across the uplifts.

The genesis of the deep-water Hackberry embayment is obscure. Middle Frio strata underlying the Hackberry are neritic shelf deposits to the west but may include deeper water shales in the central and eastern parts of the area. The embayment may have formed by subsidence of a large part of the Frio-Vicksburg continental shelf with consequent canyon erosion. Alternatively, the Hackberry canyons may be analogous to canyons currently forming on the flanks of the Niger delta in an entirely deep-water regime.

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Tectonic Map of Texas—A Progress Report

The Bureau of Economic Geology is compiling a new Tectonic Map of Texas—a detailed, up-to-date display at 1:500,000 of surface and subsurface structural history for the entire state and adjoining areas of Mexico and the continental shelf and slope. This is the first comprehensive structural mapping of Texas since E. H. Sellards' "Structural Map of Texas" some 40 years ago. A companion illustrated text is also being compiled to systematically describe and summarize the tectonic evolution of the state from Proterozoic to Holocene.

Deformed Precambrian crust is exposed in the Llano uplift and in western Trans-Pecos Texas. It is subdivided by the tectonic setting of the sedimentary rocks and the timing of intrusion and deformation. The late Paleozoic basins and the intervening fault-bounded basement uplifts of west Texas are shown by 200-m and 100-m contours on the top of Precambrian or the top of Ellenburger, depending on the nature of well control. The principal features of the buried Ouachita Overthrust belt are displayed, along with a more detailed rendition of the exposed Ouachita rocks in the Marathon region. The East Texas, Maverick, and Sabinas basins and the inner Gulf coastal plain are shown by contours on the Edwards Limestone and the Austin Chalk; features due to salt tectonism, growth faulting, and Cordilleran deformation are prominent. Seaward of the Cretaceous shelf margin, the growth-fault trends of the Gulf Coast are shown with contours on the Tertiary formations most affected. Available offshore data have been integrated to provide a picture of the shelf, slope, and a corner of the Sigsbee abyssal plain. In the multiply deformed Trans-Pecos region, the surface expressions of structures related to Laramide folding and thrusting, middle Tertiary volcanism, and Miocene to Holocene basin and range faulting are shown, in addition to the Precambrian and Ouachita-Marathon structures, where exposed.

The final edition will be multicolor, with colors emphasizing subsurface contour horizons and depths, tectonic units in deformed or volcanic areas, salt domes, igneous bodies, faults, and axial traces of folds. Faults will be identified, where possible, by their age. Inset maps will include basement age and lithology, gravity, magnetics, and topography. The map and text will provide a valuable summary of Texas structural geology and suggest new approaches to the search for energy resources.

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Tectonic Analysis of a Viking Graben Border Fault

The Viking graben is interpreted as an aulacogen on a passive continental margin. Rifting started in the Late Permian and continued periodically throughout the Mesozoic. The main tectonic events occurred in the Late Jurassic and Early Cretaceous, namely the late Kimmerian phases. Toward the end of the Cretaceous, the taphrogeny ceased and the graben became part of a rigid continental margin.

The Tertiary basins had their depocenters close to the Viking and the Central graben axes, but the outlines of these smooth and rounded basins were independent of the graben border faults. However, in the central part of the North Sea, a Viking graben border fault was reactivated in the Paleocene/Eocene. This rejuvenation resulted in such features as flower structures and normal faults along the old Cimmerian Viking graben border fault.

Tensional features are found along one border fault "dog-leg" trend, and the compressive features are found along another. This may be explained as a response to strike-slip reactivation of the old fault.

These transient movements coincide with the incipient seafloor spreading in the Norwegian-Greenland Sea and may be