# GEOLOGIC CONTROLS ON THE HYDROCARBON SOURCE POTENTIAL OF YOUNG SEDIMENTS

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## ABSTRACT

This study was carried out as part of the broad study of the continental slope environment in the northern Gulf of Mexico. It is based on analyses of samples from 36, 1000-foot core holes. The primary objectives of this geochemical study of young sediment sequences was to obtain fundamental knowledge of the composition of the organic matter and of the processes involved in the origin and accumulation of petroleum, and to relate these to their geologic controls.

Organic matter incorporated in slope sediments differs from the organic matter in nearshore sediments in several respects which suggest that the organic matter had been reworked by marine bacteria before it was incorporated in the slope sediments.

The presence of slope basins is important to the accumulation and preservation of organic matter as a result of reductive decomposition. This process of sapropelization, or creation of amorphous organic matter from structured organic materials, not only favors preservation of organic matter but also produces a product more prone to generate hydrocarbons at lower maturation levels.

The geochemical source characterization of the Gulf slope sediments was based primarily on analyses for total organic matter, total heavy ($C_{15+}$) extractables (bitumen), total heavy ($C_{15+}$) hydrocarbons, and light, gasoline-range ($C_4$-$C_7$) hydrocarbons, and on microscopic examination of kerogen. These geochemical data were integrated with geology to determine source controls.

Throughout the Gulf there is a single gross organic, deep-water shale facies that can be recognized in units as old as Miocene. This facies represents initial deposition on the continental slope and has source potential. Although immature because of inadequate depth of burial, it contains significant amounts of heavy ($C_{15+}$) bitumens that could generate petroleum if exposed to greater depths and temperatures for longer times.

On the Gulf slope, biologic lipids appear to be an adequate source for the generation of heavy hydrocarbons. Light hydrocarbons, however, arise from thermal cracking of heavier molecules during maturation.

The light hydrocarbon content of the immature sediments is usually very low, with only the lightest components present. However, in cores taken on domal structures, a few units contain all of the gasoline-range hydrocarbons in relatively large amounts. These anomalies, combined with salinity anomalies noted in waters from the same cores, suggest that light, liquid hydrocarbons have been generated in the slope sediments (probably at depths greater than the core-hole penetration) and that some of these hydrocarbons, along with compaction water, are moving upward through the overlying sediments.

The controls on the hydrocarbon source potential of young sediments are: 1) association with nutrient-rich areas of high productivity, either off deltas or in zones of upwelling; 2) bottom morphology, i.e., slope basins or troughs, which enhance the transformation and preservation of organic matter; 3) maturation, which during burial integrates the time $x$ temperature exposure of the sediments and leads to generation of light hydrocarbons and additional heavy hydrocarbons; and 4) migration. Faults and piercement salt structures are focusing the compaction-water loss; these waters are carrying some hydrocarbons upward from the source-zones in which they matured.

In view of the conclusions drawn in this study, petroleum evaluation techniques should take into account either the maturation of young sediments with time and deeper burial, or the present maturation state of their downdip lateral equivalents.

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