geopressure is related to structure and a high shale/sand ratio. Low isothermal surfaces in the down fault blocks accompanied by anomalous high temperatures in the upthrown blocks indicate vertical leakage of fluids along growth faults from underlying geopressured aquifers. The association of low salinity fluids (less than 60,000 ppm) with leakage zones affirms structural control of fluid movement through the Anahuac and Frio formations (Oligocene) at Kaplan field.

The Frio Formation core samples from 16,700 to 19,600 ft (5,090 to 5,974 m) of depth, representing channel and channel-edge turbidite sandstones, were examined petrographically and by SEM. The arkosic composition of late stage diagenesis sandstones at Kaplan field suggests an original arkose or lithic arkose composition (classification of McBride). Nonferroan calcite cementation, chlorite rims and cement, and quartz overgrowths characterize early diagenesis. At a middle stage of diagenesis secondary porosity is developed by dissolution of unstable grains and calcite cement. Samples flushed by geopressured waters from greater depth show kaolinite pore-fill and quartz overgrowths, chlorite (polytype IIb) and illite cement, and feldspar overgrowths in the late diagenetic stage. Premetamorphic textures are apparent in the deepest section at 338°F (170°C).

The low permeability of sandstones with extensive early chlorite cement (channel-edge sandstones) precludes development of extensive secondary porosity. In contrast, sandstones with little early chlorite cement develop and maintain secondary porosity through the late diagenetic stage. Restriction of fluid movement by early chlorite cement has ramifications for migration of hydrocarbons or geothermal waters, and for gas production at Kaplan field.

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Catalytic Effect of Smectitic Clays in Hydrocarbon Generation

Smectites or three-layer expanding clays promote the thermal decomposition of long-chain aliphatic hydrocarbons to produce hydrocarbons of lower molecular weight. Smectites are believed to act as acid catalysts through the dissociation of water, thus promoting carbonium ion reactions. When sedimentary organic matter, isolated as kerogen from suspected petroleum source rocks, is pyrolyzed in the laboratory, long-chain aliphatic hydrocarbons are in the pyrolyzate, commonly in abundance. When the source rock contains smectite and is pyrolyzed, the pyrolyzate has significantly less high molecular weight aliphatic hydrocarbons and more lower molecular weight hydrocarbons.

Mixtures of kerogens with quartz, silica, alumina, calcium carbonate, kaoline, or illites not containing smectite-illite mixed layer clay, yield pyrolyzates more similar to those of the kerogen alone, i.e., the range of hydrocarbons in the pyrolyzates is broad including those of high molecular weight. This is interpreted to be due to a lack of catalytic activity of these minerals as compared with the catalytically active smectite. The catalytic effect of smectite is observed particularly when the concentration of sedimentary organic matter in the source rock is relatively low, amounting to less than about 2% total organic carbon. Smectites in sediments with a modest or low amount of organic matter are critical regarding the type petroleum generated, exemplified by the gas condensates of the northern Gulf of Mexico basin and Indonesia. Consequently, it is concluded that smectitic argillaceous sediments containing less than approximately 2% organic carbon are poor sources of oil, although they may be productive of gas and gas condensate.

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Sediment Gravity Flow Deposition on a Modern Carbonate Slope Apron: Northern Little Bahama Bank

Carbonate sediment gravity flow sedimentation north of Little Bahama Bank is initiated along a "line source" consisting of numerous small slope gullies on the upper slope and results in deposition of a wedge-shaped lower slope apron of coarse sediment. This broad (over 100 km; 62 mi) smooth apron (30 km, 19 mi, wide) parallels the adjacent carbonate bank margin and lies between 20 and 50 km (13 and 31 mi) seaward of the platform. The apron is marked by a relatively abrupt decrease in slope and ranges from 2° to $^1/_2$° between depths of 850 and 1,400 m (2,789 and 4,593 ft). This apron is composed of a variety of medium to coarse-grained sediment gravity flow deposits of variable thicknesses, interbedded with an equal proportion of fine-grained pelagic ooze. Based on texture alone, ancient slope aprons could easily be misinterpreted as lower slope or inner fan/braided suprafan environments of a submarine fan, which operates as a "point source."

A detailed piston core study utilizing X-radiography, grain-size analyses, and standard petrographic techniques revealed 36 sediment gravity flow deposits displaying a spectrum of depositional characteristics. Single-layer deposits are either: (1) muddy, poorly sorted (debris flows); (2) clean, massive to inversely graded (grain flows); or (3) normally graded (turbidites). Double-layer deposits are composites of single-layer types resulting from flows that occur in two phases. They consist of either: (1) normally graded overlying muddy, poorly sorted, or (2) normally graded overlying clean, massive to inversely graded deposits. A ratio of 3:2:1 exists among debris flow, turbidity current, and grain flow deposits respectively.

Debris flow deposits, up to 5.6 m (18 ft) thick, display a downslope transition from mud to grain-supported fabrics. This transition is interpreted as a progressive downslope loss of muddy matrix due to turbulence. Grain flow deposits, up to 5.2 m (17 ft) thick, occur close to the slope break and represent deposition from flows of high concentration. Turbidites, up to 1.4 m (5 ft) thick, are ubiquitous on the apron. Typically they are simple graded "basal turbidites", lacking upper Bouma-sequence laminated intervals. Some exhibit multiple-graded sequences suggesting pulsating flows.

The sediment gravity flow deposits lack shallow-water sediment, but contain resedimented intraclasts derived from submarine cemented upper slope deposits (nodules) along with lithified layers and deep-water corals from the lower slope. Although textures and structures appear similar in both terrigenous submarine fan and carbonate slope apron environments, sedimentation models differ radically. Knowledge of those differences should aid in the recognition of ancient carbonate slope apron deposits.

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Hardground Petrography and Carbonate Microfacies: Paola Limestone (Upper Pennsylvanian), Southeastern Kansas

The Paola Limestone (Missourian) of the Mid-Continent region is the basal carbonate member of the Iola Formation (Kansas City Group). The Paola is a thin (1 to 3 ft; .3 to .9 m) massive layer of bioturbated, fossiliferous (algae, crinoids, and foraminifers) calcilutite containing abundant phosphatic nodules. This distinctive limestone is, according to previous investigators, correlative from Nebraska, southward, into northeastern Oklahoma. The Paola Limestone is overlain (in ascending order)