are more sensitive indicators of reefal equilibrium than the measured environmental characteristics in overlying bottom waters.

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"Carrillo Puerto Formation" of Northeastern Quintana Roo, Mexico

The "Carrillo Puerto Formation" of the eastern Yucatan Peninsula is a biostratigraphic unit containing fossils ranging in age from Miocene to Holocene. Recent field work suggests the "formation" can be divided into several genetic units. Each unit was deposited during high stands of the Caribbean Sea, which have periodically inundated portions of the peninsula, and each is capped by a subaerially weathered crust (caliche) formed during low stands of sea level. Similar Quaternary caliche beds have been recognized in Florida, the Bahamas, and Barbados. Comparisons between these zones and those of the Yucatan Peninsula provide new information on the recent geologic history of the eastern platform margin.

At least five marine transgressions of late Tertiary to Holocene age are recorded in the rocks of eastern Quintana Roo. Along the coast, Holocene sediments and reefs overlie calichified upper Pleistocene (Sangamon Interglacial) beach-plain grainstones and coral-reef limestone. Underlying the upper Pleistocene limestone and cropping out farther inland is another Pleistocene(?) grainstone. Underlying this and exposed still farther inland is a unit of mollusk wackestones, packstones, and grainstones with coral boundstones. Still farther inland, the oldest unit exposed in Quintana Roo is a highly leached coral-head and mollusk wackestone.

The onlap of successive units has decreased with each transgression resulting in a seaward shift of platform grainstones, wackestones, and reefal limestones. "Carrillo Puerto" limestones of eastern Quintana Roo built progressively upward and outward over a block-faulted continental shelf margin during the late Tertiary and Quaternary.

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Outer Deep-Sea Fan Depositional Lobe Sequence from Jackfork Group of Southern Arkansas

Sediments accumulating on the lower parts of the continental slope and the adjacent rise have been shown to contain significant organic materials and are regarded as important prospective hydrocarbon source beds. It is likely that future technologic developments will result in important production from these environments. A search for stratigraphic traps will require an understanding of depositional processes on deep-sea fans, gained partly from study of ancient examples exposed on land. The Carboniferous sequences of the Ouachita Mountains of Oklahoma and Arkansas provide an outstanding opportunity for examination of sediments from these environments.

The outcrops of Jackfork Group turbidites (Pennsylvanian) exposed in the walls of the spillway at De Gray Dam, Arkansas, have been described by R. C. Morris. This sequence shows a rhythmic alternation between turbidite units with high sandstone/shale ratios (facies C of E. Mutti and F. Ricci-Lucchi) and units with low sandstone/shale ratios (facies D). Facies C is interpreted as material deposited on active fan lobes, and facies D consists of lobe-fringe and interlobe sediments. A pattern of frequent lobe shifting can be recognized analogous to the way the main distributary system switches from side to side of a delta. Individual lobes range in thickness from 3 to 70 m, with a mean of about 25 m. This association is characteristic of the outer fan environment of A. Bouma and T. Nilson.

The upper part of the De Gray section contains massive sandstones and pebbly sandstones interpreted as deposits of a major distributary channel. It is possible that buildup of the fan sediments had brought the area into the middle-fan environment by this time.

Many of the critical characteristics of these sediments would be recognizable on well logs, and the De Gray section is a good example of one association that might be drilled on the continental rise.

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Importance of Secondary Leached Porosity in Lower Tertiary Sandstone Reservoirs Along Texas Gulf Coast

Secondary leached porosity is common to dominant in near-surface to deep-subsurface lower Tertiary sandstone reservoirs along the Texas Gulf Coast. This secondary porosity is in the form of leached feldspar grains, volcanic rock fragments, carbonate cements, and carbonate-replaced grains. Leached porosity occurs in sandstones with compositions ranging from volcanic litharenite and lithic arkose to quartzose sublitharenite and quartzose subarkose.

A generalized diagenetic sequence indicates that leaching is a multistaged phenomenon occurring at or near surface, at burial depths of 4,000 to 6,000 ft (1,200 to 1,800 m), and at burial depths of 7,000 to 10,000 ft (2,100 to 3,000 m). Feldspar grains are dissolved during the first stage, whereas grains, cements, and replacement products are dissolved during the last two stages. Intensity of leaching in each stage varies in different formations and in different areas.

Plots of secondary porosity as a percent of total porosity versus burial depth show that secondary porosity is dominant beneath 10,000 ft (3,000 m) ranging from 50 to 100% total porosity. Above 10,000 ft nearly all samples have some secondary porosity, which is the most common porosity type in more than half of the samples. Similarly, individual plots for the Wilcox, Yegua, Vicksburg, and Frio sandstones all demonstrate the predominance of secondary leached porosity.

Primary porosity is destroyed by compaction and cementation with increasing depth of burial. If this were the only porosity type, no deep, high-quality reservoirs would exist. Leaching, however, resurrects reservoirs after primary porosity has been reduced. Most productive lower Tertiary sandstone reservoirs, especially deep reservoirs, along the Texas Gulf Coast exist only because of secondary leached porosity.

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Eocene-Oligocene Boundary in Southwest Alabama

The stratigraphic position of the Eocene-Oligocene boundary in southwest Alabama, based on macrofossils, differs from that based on planktonic foraminifers. To resolve the dilemma, the Yazoo and Red Bluff Clays and the associated foraminifers were studied at St. Stephens Quarry, Washington County, Alabama. On the basis of planktonic foraminiferal vertical distribution at this locality, the Eocene-Oligocene boundary is at the top of the Shubuta Member of the Yazoo Clay. *Cribrohantkenina inflata* (Howe), *Hantkenina alabamensis* Cushman, *Hantkenina longispina* Cushman, and the *Globorotalia cerroazulensis* group became extinct, and *Globigerina ampliapertura* Bolli and *Globigerina gortanii* (Borsetti) first appear near this horizon. This planktonic foraminiferal vertical distribution allows assignment of the upper Yazoo Clay to the *Globorotalia cerroazulensis* (s.l.) Interval Zone and the Red Bluff Clay to the *Cassigerinella chipolensis–Pseudohastigerina micra* Interval Zone.

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Facies Distribution of Hosston Sand, Central Texas—Implications to Low-Temperature Geothermal Waters

Electric-log patterns indicate that the Hosston Formation of central Texas consists of four principal facies: (A) massive sandstones greater than 80 ft (24 m) thick, (B) distinct sandstones 10 to 80 ft (3 to 24 m) thick interbedded with sharply defined shale breaks, (C) sandstones less than 10 ft (3 m) thick intercalated with shale and siltstone beds, and (D) thin calcareous (dolomitic?) beds with interbedded shale and siltstone. Facies A shows characteristics of fluvial sands, B of either deltaic or strand associations, C of interdistributary and overbank mud and silt deposits, and D of shallow intertidal to supratidal low-energy environments.

Cross sections show facies A and B to be concentrated on and north of the San Marcos platform, whereas facies D is present farther downdip. Distinctive sequences of facies B with superposed facies D occur between these two belts. Facies C is somewhat erratic in its distribution.

Warm waters are currently being produced from the A and B facies. The nature and distribution of the C and D facies probably preclude their use as a geothermal resource.

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Field Relations and Petrology of Catahoula Formation in Parts of Lavaca, Gonzales, and Fayette Counties, Texas

The Catahoula Formation is unique in that it records the last significant influx of volcanic detritus supplied to Gulf Coast sediments. The study area is situated on the northeast flank of the San Marcos arch in Lavaca, Gonzales, and Fayette Counties, Texas. The Catahoula Formation was mapped and subdivided into a basal Chita Sandstone Member (fluvial channel facies) and an overlying and/or laterally contiguous Onalaska Clay Member (floodplain and levee facies). The basal unit of the Chita sandstone is typically a channel deposit of light-gray, conglomeratic sandstone lying unconformably on limonitic claystones and very fine-grained sandstones of the upper Eocene Whitsett Formation. The basal Chita sandstone unit consists of graded to poorly laminated beds containing lag deposits of silicified wood and/or mudstone clasts. Chita sandstone units grade laterally and vertically into tuffaceous, very fine-grained sandstone, siltstone, and claystone units of the Onalaska Clay Member which is conformably overlain by channel deposits of upper Miocene Oakville Sandstone. The Oakville Sandstone is comprised of lenses of coarse-grained calclithite beds (sandstone containing an abundance of carbonate rock fragments). The Oakville calclithite beds record an episode of early Miocene uplift of the Edwards plateau along the ancestral Balcones fault zone.

Chita units consist of well-sorted to poorly sorted, silty fine-grained to pebbly coarse-grained, lenticular sandstone exhibiting fining-upward cycles of festoon cross-beds, plane beds, and ripples. A volcanic provenance contribution is suggested by (1) abundant volcanic quartz (22% of total quartz); (2) lithic fragments consisting mostly of silicic shards, felsite clasts, and tuffaceous clay clasts; (3) fresh sanidine (sanidine/orthoclase ratio = 1.2); and (4) a heavy-mineral suite dominated by euhedral, elongated zircons. Onalaska clay units consist of tuffaceous mudstone and clay-ball litharenite beds.

Differing heavy-mineral suites and quartz-feldspar-lithic modes in the Catahoula Formation and coeval Gueydan Formation support the hypothesis that the San Marcos arch was a drainage divide in middle Tertiary time. In the study area north of the San Marcos arch Catahoula sandstones contain a mean Q:F:L ratio of 80Q:5F:15L and a zircon-tourmaline-rutile index of 90%. South of the San Marcos arch (data from Lindemann and McBride) Gueydan sandstones contain a mean Q:F:L ratio of 31Q:28F:41L and a zircon-tourmaline-rutile index of 33%.

Abundant Ca-montmorillonite, reworked biomicrite clasts, montmorillonite rim cement, caliche beds, and wood replaced by length-slow chalcedony in the Catahoula Formation all support an alkaline diagenetic environment. Pervasive opal and chalcedony pore-filling cements are restricted to surficial outcrops and reflect Pleistocene and/or Holocene leaching of volcanic ash under alkaline conditions. It is likely that leaching of volcanic ash in the Catahoula Formation could result in uranium mineralization in Catahoula channel and overbank facies.

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