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The Subsurface Upper Frio Formation of Southeastern Louisiana and Correlations to the Paynes Hammock and Catahoula Formations in East-Central Mississippi

The Frio Formation of the eastern Gulf coastal plain within southern Mississippi and southeastern Louisiana is characterized by calcareous and siliciclastic interbedding and small accumulations of hydrocarbons. Regional and local controls on reservoir quality sediments, the importance of carbonate deposits, and correlation to outcrop are addressed.

Regional Frio Formation structure and isopach maps suggest that outer shelf carbonate banks influence the orientation of siliciclastic trends and formed the east-west-trending Florida Parishes Frio embayment. The banks form during early transgressive system tract deposition and are commonly lepidocyclinid packstones. Late in Frio deposition, the embayment was infilled and is presently the location for new biogenic gas discoveries.

The upper Frio Formation appears to be correlative to a minimum of 3.5 ft (1.4 m) of the lower Paynes Hammock Formation outcrop in Wayne County, Mississippi, using a modified version of the graphic correlation method. The method identifies and integrates chronostratigraphic surfaces from electric logs. The surfaces are the upper parts of resistive carbonate lithofacies zones that are verified by conventional core analyses.

Measured section data spanning the lower Catahoula, Paynes Hammock, and Chickasawhay Formations from Wayne County, Mississippi, are presented that aid interpretation of Gulf Coast subsurface and outcrop relationships of the Chickasawhay Group. The data presented suggest that the lower Catahoula Formation contact is diachronous and that the upper Frio Formation occurs above the contact in the western Gulf Coast and below the contact in the eastern Gulf Coast.

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Fabric and Origin of Gypsum Sand Crystals, Laguna Madre, Texas

Gypsum sand crystals of Laguna Madre are crystals of selenite of lens-like, discoidal shape that poikilotopically enclose dominantly terrigenous sand. They occur over a 90-km length of the lagoon as inferred from their presence in spoil islands formed during the excavation of the intracoastal waterway. Sand crystals are most abundant around the region known as the sand bulge, where clean host sand in the lagoon is Holocene wind-blown or storm-washover sand from Padre Island.

Gypsum sand crystals show a spectrum from single crystals (rare) to clusters ("rosettes") of more than 80 contact-twinned crystals, the latter of which may have either a random orientation of crystals or an irregular radial array. Clusters reach 50 cm in length and weigh up to 11 kg. Single crystals and small clusters commonly grew with the largest crystal perpendicular to or at a high angle to bedding, whereas large crystal clusters grew with their long dimension in the plane of bedding. In most sand crystals gypsum grew passively and merely filled pores; these samples have from 41 to 48% cement. Where gypsum precipitated rapidly, it was displacive; these samples have from 50 to 70% "cement," and some centimeters-thick domains are completely free of sand. Growth of gypsum displaced rinds of micrite cement from their sand grain nuclei. SEM examination of sand grains and mollusk fragments from leached sand crystals reveals no evidence of grain corrosion or replacement. If the gypsum cement were to dissolve during further burial, no textural clue to its original presence will exist. Sr isotopic values (< 0.7084) of gypsum cement are below that expected for modern sea water, suggesting either the presence of some meteoric water in the brine

or release of nonradioactive Sr from volcanic rock or carbonate rock detritus in the sediments.

If Laguna Madre became hypersaline only 200 years ago, if gypsum sand crystals are very young and they must have grown years to tens of years. The presence of sand crystals to a depth of at least 4.5 m indicates the gypsum formed subtidally, and the increase in size with depth suggests they formed by seepage reflection of lagoonal brine.

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Geologic Framework and Hard Mineral Resources of Petit Bois Pass and Adjacent Inner Shelf, Mississippi-Alabama

Approximately 200 line-km of high-resolution seismic profile data, 24 vibracores, and several C^{14} samples form the database to delineate the geologic framework and potential hard mineral resources of the Petit Bois Pass area. Petit Bois Pass is a natural tidal inlet system located between Petit Bois and Dauphin Islands at the Mississippi-Alabama state line. The inlet is 8.2 km wide with the main inlet channel located to the east adjacent to Dauphin Island. The inlet throat depth is 6.7 m below mean low water (MLW). The morphology of the main tidal channel is mixed energy, which is reflected by the absence of a flood-tidal delta and a moderately developed ebb-tidal delta. The largest percentage of sediment occurs directly between Dauphin and Petit Bois Islands. More recently, however, a secondary tidal channel and associated ebb-tidal delta are developing to the west of the main tidal inlet channel. On the adjacent inner continental shelf, several shoreface sand ridges occur and are oriented at about 40° in relation to the barrier shoreline. The axes of the sand ridges have azimuths of about 120° . The origin of these ridges may be related to the evolution of Petit Bois Pass and other inlets in the area.

Tidal inlets are naturally occurring, concentrated sinks of sediment captured from longshore transport. In transgressive barrier island settings, available mechanisms for concentrating sediment are restricted almost exclusively to tidal inlet systems. However, the preservation potential of the tidal inlet system during transgression is limited except for the lower part of the tidal inlet channel and the ebb-tidal delta. The remainder of the inlet system eventually is removed by shoreface erosion as the coastal system translates landward. Therefore, tidal inlets and the adjacent transgressed shore areas are primarily locations for potential hard mineral resources. In the study area, primary hard mineral resource targets include tidal inlet channels, flood-tidal deltas, ebb-tidal deltas, shoreface sand ridges, and fluvial channels.

Petit Bois Pass appears to be located in an antecedent topographic depression that is cut into underlying pre-Holocene deposits. Pre-Holocene deposits form the eastern core of Dauphin Island where they are subaerially exposed. The pre-Holocene surface dips to the west, providing a platform for the narrow, elongated Holocene spit of Dauphin Island, and crops out on the shoreface at the western end of Dauphin Island to -8 to -9 m below MLW. Farther to the west, core data from the main inlet channel of Petit Bois Pass indicate only Holocene sediments occur suggesting that the pre-Holocene surface is > 11 m below MLW. This > 11 m trend continues under western Petit Bois Pass. It appears that Petit Bois Pass may occupy the eastern side of an antecedent Pascagoula River valley.

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Hinge-Line Growth Faults and the Expanded Frio Formation of the Coastal Bend Area of Texas

Southern parts of the coastal bend area of Texas from southeastern Calhoun County to southern Aransas County are well south and east

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