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STRATIGRAPHIC FRAMEWORK OF INNER SHELF STORM-DOMINATED SAND RIDGES, ALABAMA EEZ: IMPLICATIONS FOR SEQUENCE STRATIGRAPHY, GLOBAL CLIMATE CHANGE, AND PETROLEUM EXPLORATION

David J. Davies and Steven J. Parker
Coastal Geology Section, Geological Survey of Alabama, Tuscaloosa, AL

ABSTRACT

The Alabama Exclusive Economic Zone contains an abundance of orthoquartzitic shelf sand ridges that are elongate in a northwest-southeast orientation diagonally from the shoreline. Local topographic relief can be greater than 4 meters. They are found most commonly in water depths of <15 m, with many being shoreface attached, although they are found in all water depths of the inner Alabama shelf. Ridges are abundant on the Alabama Eastern Shelf, but rare on the West Shelf due to high muddy sediment flux from Mobile Bay. They average 6 km in length and range from 1.7 to 11 km long with an average width of 1.6 km (the range in width is 1 to 3 km).

Soft-sediment peels from 59 vibracores from the Alabama inner shelf permit detailed description of sand ridge sedimentary structures, fabrics, and eight seafloor sediment types. These overlie the pre-Holocene sequence boundary and early Holocene transgressive sediments. Cross-sections utilizing the peels detail internal facies relationships. The ridges and inter-ridge troughs are embedded in a blanket shelf sand sheet representing widespread deposition of reworked palimpset orthoquartzites following Holocene transgression.

In general, the ridges are capped by coarse stacked, graded shelly sands, echinoid sands, and clean sands deposited well above storm wave base. The graded shelly sand microfacies, the most common sediment type, is inferred to represent shelf storm deposits; its graded nature, sharp base, and variable thickness (0.1 to 4 m) is typical of tempesites. Often, graded shelly sands are found as stacked storm deposits on upper ridge flanks, with only the basal, graded shelly portions preserved. The orthoquartzite facies is also found on the ridge crests and upper flanks, as well as on the sand sheet proper. The echinoid sand microfacies is a background, agitated water deposit that forms on sand ridge crests as well as low relief parts of the sand sheets. It is compostionally very similar to the orthoquartzite microfacies, but it contains very recently dead parautochthonous echinoid hash. Thus, it is restricted to surficial deposits in sandy areas of high concentrations of echinoid colonies.

The inter-ridge troughs receive quieter water, fine-grained sediment between storms; thin stacked shelly washovers may be deposited during storms. Where clean sandy units are correlative from ridge to swale, they often thin into the swales. Therefore, the ridges contain thicker sequences of coarse, reworked Holocene sediments than do the surrounding swales; they represent positive build-ups of Holocene sediment above the pre-Holocene surface.

There is considerable patchiness of facies on a single sand ridge, even with close (c. 1 km) core spacing. Often, "muddy" vs. "sandy" sediment can be correlated seaward (i.e., parallel to ridge axis) in a general manner; however, specific "muddy" or "sandy" microfacies grade laterally. The internal facies pattern does not indicate lateral migration of the ridges; there are no obvious differences in facies patterns of Gulf-facing versus shoreline-facing ridge flanks. The facies patchiness may result from the interplay between relict sediment distribution, present hydrodynamics (especially helical storm flow parallel to the ridge axes), the local differences in preserved shell content. Sand ridge distribution is not controlled by the paleotopography of the pre-Holocene unconformity; ridges are apparently Holocene in origin, with their location, morphology and internal facies geometry controlled by the present hydrodynamic regime. Due to the microtidal regime of the Alabama EEZ and the prevalence of the graded sands on the ridge crests, the ridges are interpreted to be dominantly storm-wave in origin. This type of coarse, clean sandy deposit is a poorly studies yet important possible model for many shelf sand petroleum reservoirs.