New Biostratigraphic and Paleoecological Strategies for Defining and Identifying the Basinward "Edges" of Ancient Continental Shelf Systems

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EXTENDED ABSTRACT

Knowing how to recognize the seaward limits of ancient shelf systems, i.e., the paleo-shelf edge has long been critical in considering where to drill. Nevertheless, framing a precise universal definition of the continental shelf edge is virtually impossible because the character of the boundary between the continental shelf and continental slope varies dramatically from one geologic province to another. Even within a relatively small ocean basin like the Gulf of Mexico shelf edges vary considerably in character depending on a variety factors, including sediment type, grain-size, eustasy, isostasy, the competency of underlying strata, exposed relict morphology, and regional tectonism. Today, northern Gulf of Mexico shelf edges are of two main types. From Texas to the Florida Panhandle shelf edges record the gradual break in slope where deltaic clinoform beds deposited during the last glacial low sea level stand (at ca. -120 m) gradually increase their seaward dip. These relict features are cloaked by a thin (typically <2 m thick) drape of sediment deposited during the Holocene transgression and current highstand. If we expand our view of the margin, and extend it deeper into the subsurface (Fig. 2), it is apparent that the ~19 ka MIS–2 shelf-edge delta (Fig. 1) reflects a landward shift of about 2 km in ~251 ka of the location of the shelf edge from an earlier ~270 ka MIS–8 shelf-edge delta. Due to a combination of growth fault activity and sediment loading the upper surface of the MIS–8 delta is now situated at about -230 m below present sea level.

These high-resolution seismic views of late Quaternary shelf edges and associated shelf-edge deltas are correlated with detailed bio-, litho-, oxygen isotope, and ^{14}C stratigraphy established in four shelf and upper slope core holes acquired as part of the Gulf of Mexico Shelf Slope Research Consortium (Roberts et al., 2004).

In the northern Gulf of Mexico, we learned is that it is relatively simple to identify shelf edge positions in high-resolution seismic records, but also that shelf edge deltaic clinoform sets are typically less than 100 m thick (~75 ms two-way travel time) and therefore much more difficult to recognize on conventional industry seismic data. Moreover, while ~100 m thick sandy deltaic section is readily apparent in conventional well logs, sandy deltaic systems cannot always be distinguished from other sand-rich depositional systems like submarine fans based on well logs alone. A multidisciplinary approach that includes biostratigraphy is critical in distinguishing ancient shelf edge systems.

… (Note: The full version of this extended abstract, including complete text, illustrations, and references, will be made available at a later date on both the 2014 GCAGS convention website [www.gcags2014.com] and AAPG Search and Discovery website [www.searchanddiscovery.com]).