Implications of Megasequence Stratigraphy for the Petroleum System of the Ultra Deep Water Gulf of Mexico

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Abstract

Megasequences may be defined as units deposited during one distinct phase of basin evolution, separated by major unconformities that mark a change in fundamental basin-controlling processes.

We have defined and mapped the six megasequences of the ultra-deepwater region of the northeastern Gulf of Mexico. These track the evolution of the basin through two phases of Mesozoic rifting (MS1-2), passive subsidence (MS3), the development of the Cuban collision (T1), and the influx of major northerly-derived clastic wedges in the Miocene and Plio-Pleistocene (T2-3).

This mapping has major implications for the hydrocarbon system of the ultra-deepwater region. Two examples of this are the source system of the western Atwater Fold Belt and the depositional setting of the basal Miocene turbidite systems.

Regional mapping reveals that the oldest megasequence (MS1), which includes the postulated Oxfordian source section, is absent beneath the frontal part of the Western Atwater Fold Belt. The second megasequence (MS2), which contains the Kimmeridgean-Tithonian source interval, is present, and this probably constitutes the major active source kitchen. The frontal part of the western Atwater fold belt rides on an allochthonous salt nappe, and the probable source interval sits beneath this salt. Therefore the major source is probably the Tithonian section beneath the deep salt, not Oxfordian section above it, as has been previously believed.

The Miocene turbidite systems form a northward-thickening wedge (T2), sitting on top of an older, southward-thickening wedge (T1), which may be related to the Cuban orogen. Mapped isochron patterns show a striking gross compensation between T1 and T2. One interpretation of this could be that there was significant constructional topography on top of the T1 wedge, and that the basal Miocene is ponded by the topography at the toe end of the Cuban wedge; in other words the main control on the basal Miocene section may be completely external to the Miocene system.