Paleogeographic Reconstruction and Provenance of Oxfordian Aeolian Sandstone Reservoirs in Mexico Offshore Areas; Comparison to the Norphlet Aeolian System of the Northern Gulf of Mexico

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Abstract

Paleogeographic reconstruction of the Oxfordian (Jurassic) depositional systems in the southern Gulf of Mexico is supported by detailed sedimentological analyses, detrital zircon geothermochronology, and plate tectonic restorations. This integrated approach departs from prior local studies by placing the Bacab Sandstone, a major reservoir in offshore Mexico, in a larger regional to basin-scale context. The sedimentary characteristics derived from detailed core description show how remarkably similar the Bacab Sandstone is to coeval sandstones of the Norphlet Formation of the Northern Gulf of Mexico. Comparison of lithofacies associations suggests similar depositional processes and paleoclimate regimes with aeolian dune forming near base level under arid climatic conditions promoting local evaporation, adequate wind and sediment supply conditions. Construction of prominent ergs (aeolian sand seas) with lateral transitions to updip fluvial-wadis and downdip sabkhas is envisioned for both areas. Reservoir quality over the southern Mexican offshore area is variable as numerous well penetrations over several decades have demonstrated. However, in the core area of the Ek-Balam field complex, the best reservoirs have surprisingly good porosity and permeability for their age (Jurassic) and present-day depth of burial (>4000m). Published information is not definitive on the factors mitigating subsurface reservoir quality destruction, but it is likely that similar processes preserving or enhancing porosity under deep burial conditions for the Norphlet are likely to have

operated in the Ek and Balam field locations. While framework grain content, as determined from available petrographic data, are also similar for Oxfordian sandstones in both the northern and southern GOM, more advanced provenance techniques indicate very different source terranes supplied terrigenous clastics to the Bacab and Norphlet. Detrital zircon geothermochronology age spectra indicate that the Mayan (Yucatan) block was the primary source terrane for the Bacab Sandstone. This is separate and distinct from Norphlet source areas that vary from Appalachian (Laurentian) to Pan-African (Gondwanan and Peri-Gondwanan) terranes. Thus, it is unlikely that the Bacab and Norphlet were connected across the Yucatan margin that lies between the two areas. Dimensional considerations, such as reconstructed source terrane area versus mapped depositional sink, also supports the notion of separated aeolian ergs.