

Unravelling the Complex Tectonic and Magmatic Evolution of the Eastern Gulf of Mexico

Athanasia Vasileiou¹, Douglas Paton¹, Aleece Nanfity², David Lewis², Mohamed Gouiza¹, Paul Markwick³, Jean-Sébastien Hall²

¹University of Leeds; ²BHP; ³Knowing Earth Ltd.

9.29.2020 - 10.1.2020 – AAPG Annual Convention and Exhibition 2020, Online/Virtual

Abstract

The tectonics of the Eastern Gulf of Mexico plays a pivot role in the evolution of the entire Gulf of Mexico area, offshore Mexico and indeed the pre-breakup configuration of the wider Central Atlantic system. Despite this our understanding of the basin remains poorly constrained, which is a function of the multi-rift nature of crustal stretching, the presence of magmatic and non-magmatic crust, the emplacement of the CAMP system, the potential dissection of crustal domains by strike slip re-organisation, and the influence of rotational tectonics as Yucatan undocks. The aim of the project is to develop a coherent structural model for the Eastern Gulf of Mexico that attempts to explain this complex and multi-faceted evolution. Given its evolution there are a number of existing models to explain its evolution, therefore, to reduce the potential of bias on the interpretation, this contribution will initially re-evaluate the crustal domains from first principles and document the seismic reflection characteristics of the oceanic crust, magma-rich crust including seaward-dipping reflectors, zones of hyper-extension, the rifted continental crust, and location of salt basins. A key component of this is to recognise areas of uncertainty within the interpretation and to consider the implications of this on the definition of structural domains. The resulting crustal map demonstrates a complex juxtaposition of structural domains that in part reflect abrupt changes from magmatic to non-magmatic crustal stretching process along the margin but also the influence of strike-slip deformation that dissect the 'typical' margin architecture that might be anticipated. Restorations of the structural maps result in two distinct phases of crustal stretching from the Late Triassic to Late Jurassic. This is in part a function of two different extension orientations but is also a

consequence of the rotation of the various crustal domains in the region. In addition to this extension, both sinistral and dextral transfer faults were active during the first rifting. However, there is also evidence of later activity of the transfer faults. Salt was deposited in a basin close to the study area and migrated to the south-east at the end of the second rifting reflecting rapid changes in basin subsidence. This new interpretation and model provides a robust understanding of the Eastern GOM margin and in doing so provides insights into the evolution of the Yucatan system and the wider GOM, in particular the interplay of magmatic and non-magmatic margin and crustal reactivation. These new insights have important implications for understanding and predicting the petroleum systems as exploration interest increases both in Eastern GOM and Yucatan.