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Title: Integrated Crustal Characterization with Full-Lithosphere Basin Modeling as an Aid to Understanding the Cuencas del Sureste, Offshore Gulf of Mexico

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Integrated crustal and basin modeling of the Cuencas del Sureste, or Southeastern Basins of Offshore Mexico, yields a bottoms-up petroleum systems evaluation to aid exploration teams in high-grading areas before lease sales, as well as to improve understanding of existing acreage. Study data included interpreted seismic horizons from the regional 2D Seismic, Gravity & Magnetic Survey (> 185,000 line km of high quality data covering the Mexican Gulf of Mexico). Crustal surfaces were created in a joint study by Bain Geo and TGS, including depth to magnetic basement / top of crystalline crust, mid-crust, and Moho depth. Magnetic data were interpreted to produce Curie Depth (depth to bottom of the magnetic crust), providing an estimate of the magnetic crust thickness, which is an important input to the full-lithosphere thermal model that is calibrated to well temperature data and surface heat flow measurements, and to the prediction of temperature at the bottom of the magnetic crust.

Detailed 2D & 3D potential field models were used to create full-lithosphere basin subsidence and thermal models, calibrated at key wells, and modeled regionally across the Cuencas del Sureste region. This insightful and thorough workflow enhances our understanding of the basin's petroleum system, enabling improved play and prospect generation and analysis.

The study area is a structurally complex salt basin, with many controls on the variation in thermal gradient through time. There is little thermal calibration in the deep basin, so we have carefully selected from several datasets (e.g. well temperatures, subsurface fluid data, seep mapping and seabed heat flow data) the more robust calibration datapoints to integrate into our modeling. The thermal structure of the Salina del Istmo Basin is strongly over-printed by the transient effect of deep young mini-basins as well as thermal anomalies related to conductive salt diapirs. Taking a broader study area and integrating the regional crustal and lithospheric model into our full-lithosphere 1D basin subsidence and thermal modeling approach, we can strip out the salt basin overprint and see how heat flow from basement impacts present-day temperature and thermal stress in overlying sediments. Furthermore, we can use the Curie depth to better guide depth to the asthenosphere, thus enabling building of a more robust thermal model and more confident predictions away from calibration data. This approach allows us to better understand the burial history and petroleum system regionally and highlights more prospective parts of the basin.

This study represents the first of its kind in the Gulf of Mexico available on a regional basis – a truly integrated geophysical and geological case study, covering the regional scale down to the prospect level necessary to assist the high-grading of potential oil-bearing zones in a basin with great variation of hydrocarbon phase.

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