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Integrated Overburden Fluid and Geothermal Characterization Offshore Uruguay

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ABSTRACT

Author: Owain Lavis (Merlin Energy Resources) Email: Owain_Lavis@merlinenergy.co.uk Co-Authors: Dr Mads Huuse (University of Manchester), Dr Philip Thompson (Shell). Richard Walker. BG Group & ANCAP sponsored MSc project. Frontier deepwater margins have seen a surge in petroleum exploration interest over the past decades with most areas experiencing a step change in seismic data quality and extensive coverage by 3D seismic data. As water depths increase, the abundance of borehole data, both locally and from analogous settings globally, decreases rapidly and there is a need to gain maximum insight from remote sensing data including 3D seismic datasets. This study reports the application of a robust workflow to assess heat flow and geothermal regime from bottom-simulating reflectors (BSRs) and stacking velocities derived from a 3D seismic dataset offshore Uruguay. The BSR is sensitive to pressure and temperature conditions and this enables the quantification of thermal gradients and heat flow based purely on reflection seismic analysis. A gas hydrate-related BSR is recognised within the shallow subsurface offshore Uruguay (< 500 m) covering a total expanse of 3750 km2 and extending over an rifted and attenuated proto-oceanic crust out onto bona fide oceanic crust. Thickness of the gas hydrate stability zone (GHSZ) between BSR and seabed increases gently with sea floor depth. The spatial distribution and character of the BSR are linked with seismic- and litho-facies, presence of free gas, and bathymetric relief. Geothermal gradient and heat flow are derived utilising the seismic observations and knowledge of the gas hydrate phase boundary whilst thermal conductivity of sediments within the GHSZ are calculated using experimental seismic velocity transforms. Estimated heat flow increases from the basin floor to the upper slope, ranging between 40.4–68.0 mW/m2, with an average geothermal gradient of the GHSZ of 5°C/100m. The results from this BSR-based study are comparable to data points derived from a global heat flow database. Extrapolation of BSR-derived heat flow within integrated basin models helps constrain the petroleum system offshore Uruguay. Extrapolating the geotherm downward using a velocity-conductivity transform yields and an oil window at c. 2250 mbsf. This study demonstrates the utility of an integrated fluid and heat-flow analysis workflow to estimate geothermal parameters in any frontier basin hosting gas-hydrate BSRs.