Basin Modeling of the Guyana Margin: Does the Continent-Ocean Boundary Mark an Outer Limit for Deepwater Exploration?

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Abstract

The 350 km wide Guyana segment of the 8 km thick, sedimentary passive margin of northeastern South America thins from 40–50 km thick crust of the Guiana shield to 6–8 km Jurassic oceanic crust over a 167–74 km tapered necked zone. As exploration continues further offshore, basal heat flow determined by unknown crustal parameters increases uncertainties. This study models the offshore Guyana-Suriname crustal structure using 3D gravity inversion constrained with previous refraction surveys and an interpreted 2D KPSTM seismic grid. Calibrations of downhole temperature measurements were then used to constrain 1D thermal models to find the total radiogenic heat due to the granitic composition of the crust. Three crustal domains are then identified based on basalt flow extent previously indicated by seaward dipping reflectors (SDRs) seen in the literature, crustal structure constrained with seismic, and radiogenic heat production (RHP) from thermal modeling: (1) 10–30 km thinned continental crust with ~28–14 mW/m^2 RHP and partial volcaniclastics; (2) 10–12 km ultra-thin continental crust with ~6.4 mW/m^2 RHP and up to 25 km thick overlying SDRs; and (3) 6–8 km thick oceanic crust with 0 RHP. Thermal stress modeling for each of these domains is then used to indicate maturity trends of Cretaceous source rocks. This study shows a change of ~10°C/km overburden in Lower Cretaceous shales across the three crustal domains.