Characterization of Geothermal Anomalies in the Louisiana Continental Shelf, Gulf of Mexico, Using Corrected Bottom-Hole Temperatures

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ABSTRACT

Some localized, high geothermal-gradient anomalies are observed in the continental shelf, offshore southwestern Louisiana. While typical geothermal gradients in the Louisiana shelf range from 0.013°C/m to 0.035°C/m, those in the anomalous areas are 0.035° C/m to 0.054°C/m. The present study examines possible mechanisms responsible for these anomalies. First, bottom-hole temperature (BHT) data from 44 wells from this area were added to the recently compiled database of the National Geothermal Data System. These BHTs were corrected for the effect of drilling-related disturbances. Second, a detailed geothermal gradient map of the study area was made from the updated database. Third, two-dimensional seismic reflection profiles crossing the anomalous areas were examined for the stratigraphy and sedimentary structures. Fourth, one-dimensional, sedimentary heat conduction models were constructed for areas on and off the geothermal gradient anomalies, using the sediment accumulation history, petrophysical data, and geothermal gradient data as primary constraints. The seismic data do not indicate presence of major salt masses at the locations of the high geothermal gradients. That precludes a possibility that any salt mass significantly affecting the geothermal setting there. In the anomalous areas, we find that the Pleistocene-Pliocene sediment layers are thinner, indicating relatively slower sediment accumulation rates. Our heat transport models show that the difference in accumulation rate and lithology of sediment, their thermal effects can account for the observed variation in geothermal gradients. The study area also coincides with the eastern end of the Corsair growth fault zone. If any of the faults there has active fluid flow along it, as suggested for other parts of the Corsair and Wilcox growth fault systems, it may cause localized high-geothermal gradient anomalies. However, high geothermal gradients are also observed in areas that are not heavily faulted. Therefore, the thermal effects of sediment accumulation are most likely to be the primary cause of the observed variation.

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