Temperature Mapping within the Onshore Oil and Gas Production Region of the U.S. Gulf Coast Basin

Justin E. Birdwell[1], Scott A. Kinney[1], Rand D. Gardner[1], Lauri A. Burke[1], Marc L. Buursink[1], and Nicholas J. Gianoutsos[1]

[1]U.S. Geological Survey

Abstract

The extensive petroleum exploration and development activity that has occurred in the onshore Gulf Coast Basin of the southern United States (U.S.) over the last 100 years provides an invaluable source of information for evaluating geothermal resources. In petroliferous basins, most reported temperature data are bottom-hole temperatures (BHT) recorded during borehole logging. BHT values combined with their corresponding depths can be used to help evaluate source rock thermal maturity in petroleum system analysis and to investigate subsurface thermal regimes to identify potential geothermal resources. Using BHT and depth data for wells in the Gulf Coast region, 3-D temperature and thermal gradient maps were constructed. Data queries from oil and gas wells in the onshore U.S. Gulf Coast Basin were compiled from the IHS Markit^{TM} database. Approximately 50,000 BHTs and corresponding depths were binned into 3,448 square-cells, each with an area of 93 km^2 (36 mi^2), from the Texas- Mexico border to the Florida Panhandle and from the coastline into central Arkansas. Data density was generally good, with only 664 cells being limited to a single BHT-depth data pair. Relatively high-density data, defined as containing 10 or more data pairs, were available for over 20% of the cells (770).

Although issues regarding the veracity of and uncertainty in reported BHTs are a concern due to temperature differences between the reservoir and the drilling fluid, differences in well characteristics and drilling technology used, and the thermal diffusivity of the reservoir, the very large number of measurements available provides some reassurance that the observed trends are valid. BHTs were corrected for a subset of wells using the Waples correction developed for the Gulf of Mexico, which requires time-since circulation (TSC) values. By plotting the measured and corrected BHTs for this subset of wells, we developed a generalized correction factor that was then applied to the remaining datapoints for which TSC was not available. Using basin modeling software, isothermal surfaces were constructed for 90°C (194°F) and 150°C (302°F), which represent the transitions from low to moderate and moderate to high temperature geothermal resources, respectively, as defined in recent geothermal assessments by the U.S. Geological Survey. These maps provide a starting point for evaluating geothermal resource potential in the onshore U.S. Gulf Coast Basin. Initial evaluation of the mapped area shows that approximately 36,000 km^2 (14,000 mi^2)are estimated to have temperatures ≥ 150°C at a depth range between 1,500 and 3,000 m (~5,000 to 10,000 ft). These results are comparable to previous efforts to evaluate thermal gradients and subsurface temperatures in the U.S. Gulf Coast region.

Professional Posters Monday, July 25