Thermal Gradient Trends in the Tuscaloosa Marine Shale Play Area: Preliminary Results from Studies to Support Oil and Natural GasResource Assessments

Celeste D. Lohr[1], Paul C. Hackley[1], Brett J. Valentine[1], and Catherine B. Enomoto[1]

[1]U.S. Geological Survey, Reston, Virgina

ABSTRACT

The U.S. Geological Survey (USGS) is conducting an oil and natural gas resource assessment of undiscovered, technically recoverable continuous hydrocarbon resources in the Tuscaloosa Marine Shale (TMS), which is a shale oil play located in southwestern Mississippi and southern Louisiana. In support of the assessment, this study focuses on systematic thermal gradient trends in the TMS play area to provide constraints on burial history and hydrocarbon generation. Expanding on previous work by the authors, bottom hole temperatures (BHT) were obtained from the IHS Inc. Energy database for 787 wells over 61,401 km^2 for 23 parishes in Louisiana and 17 counties in Mississippi. Wells with BHT, log total depth, and time since circulation data were used to calculate a corrected BHT using Waples et al.'s method for correcting log-derived temperatures in deep wells. Thermal gradients, calculated from the corrected BHT values, were interpolated using geographic information system software to create a thermal gradient map for the TMS play area. The thermal gradient map reveals a southeast to northwest trending thermal high from Adams, Wilkinson, and Amite counties in southwestern Mississippi to parishes in northern Louisiana. Lower gradients are present in the southwest corner of Wilkinson County and east of Amite County. The southeast to northwest trending thermal maximum crosses the Adams County High (ACH), La Salle Arch, Monroe Uplift, and North Louisiana Salt Basin. Previous research by our team attributed anomalous higher thermal maturity on the ACH (determined by solid bitumen reflectance [BRo] in the lower Cretaceous section) to paleoheat flux, which is consistent with higher present-day thermal gradients. Higher thermal gradients in the northwest part of our study area may be associated with: higher radiogenic heat production beneath the thicker crust of the Monroe Uplift and La Salle Arch, heat-producing elements within igneous intrusives, or high conductivity of buried salt deposits, consistent with the findings of other authors; or due to an increased number of shallow wells with corrected BHT data in La Salle Parish, Louisiana, using a BHT correction method that favors deeper wells. Thermal gradient spatial trends remain less defined in the portions of our study area with limited corrected BHT data. To understand better the geology and burial history of the ACH and thermal maturity in the TMS play area, comparison of calculated thermal gradients to vitrinite reflectance or BR0 values from TMS samples is recommended. Additionally, to ensure the BHT corrections are accurately incorporating well depth data, an alternative method of correcting BHTs in shallower wells is suggested.