Linear Relationships between Geothermal and Geopressure Gradients in the Northern Central Deepwater Gulf of Mexico

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ABSTRACT

Geothermal gradients for 147 wells and geopressure gradients for 150 wells were calculated for the four deepwater Gulf of Mexico protraction areas of Garden Banks, Green Canyon, Keathley Canyon, and Walker Ridge. These gradients were then converted to the depth at which 300°F is reached and depth to the top of overpressure at 0.70 psi/ft, respectively, per standard procedure. Contour maps were then created for both parameters and each exhibited a unique pattern. The contour map for the depth to 300°F shows a strong correlation to the sediment thickness contour map between the seafloor and depth to magnetic basement, implying that the heat flux reaching the seafloor is strongly correlated to sediment thickness. The presence of vertical salt underneath the Sigsbee Escarpment also contributes to the relative heat flow. The contour map for depth to the top of overpressure shows an unexpected diagonal trend from the northwest to the southeast, following seafloor dip going from Garden Banks to Walker Ridge. Water depth is the only factor related to overpressure showing a linear correlation with all wells inside the study area. Direct comparison between temperatures and pressures calculated (or measured) along the boreholes of 130 wells shows a linear regression R^2 factor of 0.7807. Low temperatures and pressures in zone 1 overpressures are due to mechanical disequilibrium compaction. The next level of overpressure (zone 2) is caused by hydrocarbon generation. Zone 3 wells exhibit overpressure caused by illitization. Zone 4 wells are rare in that they evidence the hard overpressure due to sandstone diagenesis. The primary factor in determining which types of overpressure dominate is the geothermal gradient.

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