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Heat flow and Supervised Learning in the Permian Basin: applying The Magnetic Layer to control thermal property calculations

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Abstract:

Our study makes use of magnetic anomalies produced between the top of crystalline basement and Curie point isotherm depths, which we call The Magnetic Layer (TML). We study the Permian Basin, which formed in a foreland setting as the Early Paleozoic Tobosa Basin but was split in two via Pennsylvanian convergent forces and structural inversion of the Central Basin Platform. We demonstrate that magnetic data analyses, combined with station data (heat flow, thermal conductivity, heat production), support thermal property calculations in the sedimentary basin layer as well as TML. We further demonstrate that these results are improved by Supervised Learning analyses.

Our method integrates thermal properties with basement terranes interpreted, in part, from magnetic susceptibilities derived from 3D modeling, to generate thermal models for Delaware and Midland Basins as well as the Central Basin Platform. These models are refined, employing a suite of Python-based Supervised Learning algorithms, to compare heat flow prediction from thermal properties in the sedimentary basin layer with those in the sedimentary basin layer + The Magnetic Layer. We conclude with examples that connect derived thermal properties with geological elements in the study area.