

A New Heat Flow Map of the Williston Basin

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Abstract

Different heat flow contour maps that include the Williston Basin show differences of 10 to 50 mW m⁻² for the same regions raising questions about the accuracy of the data and the methods used to determine the heat flow values. Our analysis of the data found three possible sources of error. Over half of the heat flow values were determined using bottom-hole temperature data, and the BHT-determined heat flow values used thermal conductivity estimates based on rock type. Our thermal conductivity measurements with a divided bar on core samples from the Basin show high variability within rock types rather than a “standard” value. The transition from predominantly clastic Cenozoic and Mesozoic age rocks with low thermal conductivities to predominantly carbonate Paleozoic age rocks with high thermal conductivities creates a 2-fold change in the geothermal gradient, making the two-point estimate of the temperature gradient invalid. Finally, corrections applied to the data, i.e., Harrison or Kehle, are appropriate for the litho-stratigraphic sections where they were developed but not for the Williston Basin. We have developed an analysis for heat flow using lithostratigraphy and the harmonic mean thermal conductivities to produce a well-constrained heat flow map of the Williston Basin. The result will better inform geothermal development and understanding thermal maturity of source rocks in the Basin.