High Heat Flow in the Idaho Thrust Belt: A Hot Sedimentary Geothermal Prospect

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ABSTRACT

A synthesis of bottom-hole temperature (BHT) and drill stem test (DST) data compiled for the National Geothermal Data System (NGDS) in the vicinity of southeast Idaho's Blackfoot volcanic field (BVF) was used to calculate heat flow for 31 oil and gas exploration wells drilled in the Idaho thrust belt (ITB). The temperature data and heat flow estimates define a previously unrecognized high-temperature geothermal prospect in Jurassic and Triassic sedimentary rocks adjacent to the BVF at depths of 3–4 km, approximately 25–50 km north of the late Quaternary (58 ka) China Hat rhyolite domes of the BVF. The rhyolite magma, at a depth of 12–14 km, and/or its associated parent mafic magma is believed to be the heat source responsible for driving fluids and heat into the ITB.

Several BHT correction methods were evaluated against DST data and an aggregate average of the best methods was computed and applied to all BHT data. Aggregate thermal conductivities for the formations in each borehole were also evaluated to more accurately estimate heat flow. An area greater than150 km^2 has heat flow greater than 120 mW/m^2 and temperatures in excess of 150°C at 3 km. A separate area defined by a single well also exhibits anomalously high heat flow and subsurface temperatures (116 mW/m^2 and 170°C at 3.5 km, respectively).

The major ion chemistry of hot brines and saline formation fluids indicate they are the product of dissolution of evaporate beds in the Jurassic Preuss Sandstone in response to circulating hydrothermal fluids. Their spatial occurrence relative to salt-bearing strata suggests they may play a role in redistributing and storing heat, which could have implications for how these hot sedimentary reservoirs are developed.

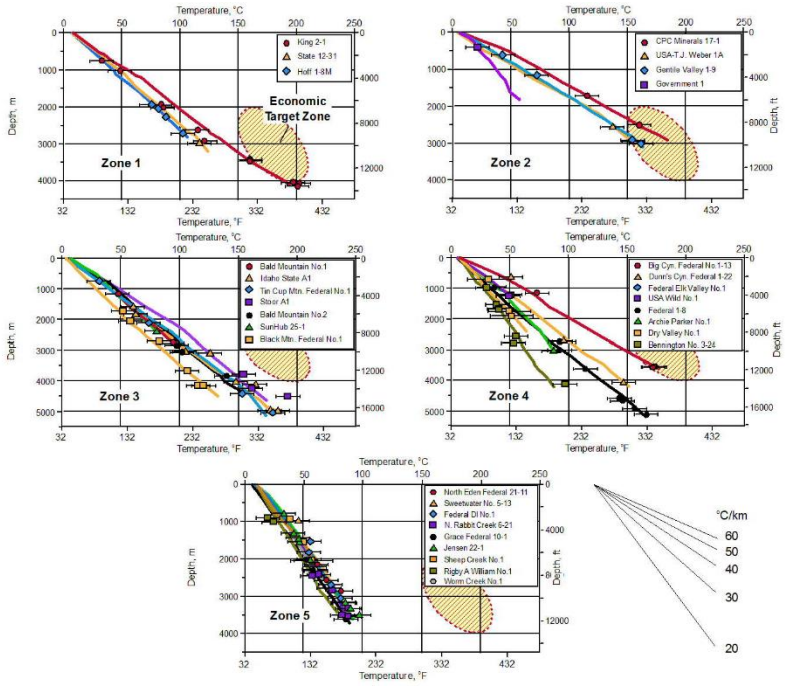

Figure 1: Modeled thermal gradients for 31 deep wells in the ITB, using formation-specific thermal conductivity estimates based on known lithologies. Shaded ellipses indicate economic temperature and depth ranges defined by Allis and Moore (2014) for drilling in hot sedimentary basins.

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