Locating the Source of Heat for Waunita Hot Springs, Colorado

Morgan, Paul [*1]; Willingham, Jake [2] (1) Colorado Geological Survey, Denver, CO. (2) Department of Geosciences, Depauw University, Greencastle, IN.

Waunita and Mt. Princeton (Hortense) Hot Springs are the two hottest spring systems in Colorado. Both have surface temperatures above 75°C (167°F). Their reservoir temperatures are estimated to be in the range of 130-150°C (266-300°F). Mt. Princeton is located in an accommodation zone in an offset of the Sawatch Fault, a major bounding fault of the Upper Arkansas Valley in the Neogene northern Rio Grande rift. Waunita Hot Springs are in two groups, Upper and Lower Waunita Hot Springs. They have no obvious structural association with a major extensional basin. They lie at the east end of the Gunnison Basin, an east-west basin with no strong structural definition or age.

Eight temperature gradient holes were drilled around Waunita Hot Springs and data from these holes were reported and contoured in 1981 as temperature gradients. Plotted in this form they did not allow the direct inclusion of the hot spring surface manifestations. We have reanalyzed the data to determine the depth to the 9°C and 15°C isotherms at each well site. 9°C was within the actual range of measurements of six of the eight gradient wells. 15°C was above the minimum temperature measured in all of the wells. We also added temperature data from a 76 m water well to the immediate north of Lower Waunita Hot Springs. By plotting the depth to isotherms rather than geothermal gradients we were able to include the hot springs as data points for plotting. The new isotherm contour maps define a significantly different shape for the thermal anomaly than previously mapped by thermal gradient data. The isotherm contours indicate that the hot spring water is controlled in the shallow subsurface by structure and faults in the Dakota Sandstone. Locally, between 600 and 800 m of sedimentary rocks cover the Precambrian. Regional heat flow data suggest that the background thermal gradient is likely to be in the range of 25 to 60°C/km depending on thermal conductivity. Even at the high end of this range, circulation of ground water within the sedimentary column is insufficient to explain the temperature of surface temperatures of Waunita Hot Springs. Tomichi Dome, an eroded flow immediately south-southwest of Waunita Hot Springs, has commonly been cited as the heat source for the springs. Simple analog thermal modeling indicates that its Tertiary age (14 - 34 Ma?) is too old to have significant residual heat. The possibility of young fault activity is suggested by a lineament connecting Tomichi Dome to seismicity to the north-northwest, the most recent of which was a swarm of activity in 1986 at Crested Butte. We therefore interpret the heat source for Waunita Hot Springs to be deep circulation of water into the crystalline basement and/or a component of magmatic heating significantly younger than the igneous activity that formed Tomichi Dome.