

Using Bottom-Hole-Temperatures from Oil and Gas Wells to Evaluate the Geothermal Potential of Hydrocarbon Basins in Colorado

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As improvements in binary power-plant technology allow electricity generation from lower and lower temperature hydrothermal resources, hydrocarbon basins under normal hydrostatic pressures are becoming potential geothermal resource targets. As with all geothermal resources, the most attractive targets are those where the highest temperatures are found at the shallowest depth, and bottom-hole-temperature (BHT) data from existing oil and gas wells are a low-cost, direct data set for investigating deep subsurface temperatures. For all BHT data, corrections must be made for the disturbance of natural rock temperatures by circulation of drilling fluid, and determination of these corrections is generally poorly constrained. Recent studies of BHT data from the Paradox, Denver (Wattenberg Field), Raton, and San Juan Basins of Colorado have demonstrated the value of BHT data, but the data from each basin have demonstrated a different aspect of basin heat flow and/or the reliability of BHT data. In the Colorado portion of the Paradox Basin geothermal gradients are low, but are increased slightly by thermal refraction over salt structures. In the Wattenberg Field of the Denver Basin, most of the BHT data show no consistent trend with depth and the measurements appear disturbed. Data from two formations which bracket the producing zone, however, yield good and reasonable linear gradients. These gradients suggest that electricity could be produced from water extracted from formations below the gas producing zone. BHT data from the Colorado portion of the Raton Basin indicate above normal heat flow and a general increasing trend in geothermal gradients from west to east, consistent with heat transfer by very slow groundwater movement. Data from the water injection wells on the east side of the basin indicate that conditions may be favorable for producing an enhanced geothermal system with temperatures as high as 150°C (300°F) at 2,500 m (8,200 ft). BHT data around the edge of the northern San Juan Basin indicate very high gradients, but this result is an artifact of thermal refraction and the propagation of small temperature errors at shallow depths. At greater depths in the basin BHT data indicate that water may be hot enough for electricity generation.