GROUNDWATER TEMPERATURE RISE DURING AQUIFER RECOVERY AT THE BUCKMAN MUNICIPAL WELL FIELD, SANTA FE, NEW MEXICO

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During the past five years, students attending the Summer of Applied Geophysical Experience (SAGE) field program in Santa Fe have been annually measuring temperature-depth profiles in the Buckman well field. The Buckman field has delivered municipal water to Santa Fe for more than 35 years, and has a history of substantial (> 100 m) drawdown and inelastic subsidence, followed by significant water level recovery and surface rebound after 2003. Repeat measurements of vertical thermal gradients in two monitoring piezometers, SF3 and SF4, showed little to no change between 2013 and 2014. Temperatures at the bottom of these wells rose by 0.33–0.37 °C (±0.05 °C) between 2014 and 2017, with the most dramatic change occurring between 2014 and 2016; artesian flow at two wells began in 2015. The increased temperatures are observed at shallow depths (<100 m) and coincide with surface uplift detected through InSAR analysis of satellite data from 2007 to 2010. Geothermal gradients in SF3 and SF4 are 73 to 80°C/km; the elevated gradients are associated with a small fault near SF4. A deeper piezometer, SF2, located 300 m to the east of SF3, has a geothermal gradient of 45°C/km and a complex warming signal that has shifted to shallower depths through time. The abrupt change in geothermal gradient between SF3 and SF2 coincides with a north-trending stratigraphic discontinuity that is resolved by the InSAR observations and water level and chemistry data. A deep piezometer located outside the zone of water level rise and surface rebound, SF6 (geothermal gradient of 35°C/km), showed no temperature change between 2013 and 2016. Simple, one-dimensional hydrothermal models of pumping, downward flow and convective cooling, followed by water level recovery and conductive heating are qualitatively consistent with the observed increases in groundwater temperature.

Temperature-depth plots for deep (SF3a) and shallow (SF3b) monitoring piezometers in the Buckman well field measured between 2013 and 2016 by Summer of Applied Geophysical Experience (SAGE) students.

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