Geothermal Evaluations in the Rio Grande Rift, New Mexico Using SAGE Magnetotelluric Soundings

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ABSTRACT
Magnetotelluric (MT) data were collected as part of the SAGE (Summer of Applied Geophysical Experience) 2010 program south of Santa Fe, New Mexico on the Santa Domingo Pueblo to evaluate subsurface resistivity variations from roughly 10 m to 25 km depth. The field site contains four linearly aligned stations trending northeast-southwest positioned between the northern ends of the San Francisco Fault and the La Bajada Fault. Raw Long-period MT data collected using the remote reference technique measured MT impedances in order to detect geologic and hydrologic stratigraphy, which were reviewed using ACQMT software, and then converted using MATLAB software into file formats suitable for interpretation with WinGLink software; One-dimensional (1-D) models clearly showed a 300 m-thick resistive layer at the stratigraphic top with a resistivity of 40 Ωm corresponding to observed Cenozoic sandy alluvium basin fill; an underlying conductive layer 1.7 km thick with an average of 5 Ωm resistivity, interpreted to be saturated sedimentary rocks of with decreasing resistivity with depth; and a large resistive section beginning at a depth of about 2 km which was interpreted as thick Paleozoic sandstone overlying Precambrian basement with a total of about 18 km thick and 100 Ωm resistivity. A split in the TE and TM mode resistivity values indicate a lateral discontinuity possibly caused by a fault or unconformity within the conductive saturated sedimentary rock layer. The models revealed a deeper conductive layer possibly indicative of partial melt and/or aqueous fluid, which we label as a mid-crustal conductor. This layer is detected at 20km depth with an underlying resistive layer of unknown thickness not shown in previous data. The conductor is constrained by a conductance range of 1000-1700 S, with an assumed thickness of 600 m-1.5 km. Mid-crustal conductor resistivity values range from 0.5-2Ωm, which supports a fractional porosity of 0.01 and a fluid resistivity of 0.01 Ωm. Whether this layer is cause by partial melt or ion-rich fluid depends largely on geologic composition; a geothermal gradient of 30°C/km yields a temperature of ~618°C, sufficient to melt felsic material.