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# GEOPHYSICAL STUDIES AT LIGHTNING DOCK KGRA, HIDALGO COUNTY, NEW MEXICO

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The Unviersity of New Mexico and New Mexico State University have engaged in integrated geological, geochemical, and geophysical assessment of New Mexico geothermal areas including Lightning Dock KGRA. Reconnaissance gravity, magnetic, and roving dipole resistivity measurements have mapped bounding Basin and Range faults, 1.5-3.0 km of valley fill, and a buried ridge in the vicinity of shallow, hot wells. Detailed telluric and dipole-dipole surveys also detect the ridge; the latter results have been used to construct a preliminary 8-km long geoelectric section to a depth of 2 km. Five magnetotelluric soundings have been used to probe deeper. In particular, a conductive zone is apparent beneath the high resistivity ridge. Geologic mapping suggests that the thermal anomaly occurs at the intersection of a buried mid-Tertiary caldera and a visible Holocene fault. The ridge detected by geophysics may mark a sequence of rhyolite domes along a buried ring-fracture.

An integrated program combining geological, geochemical, and geophysical assessment of geothermal target areas in New Mexico includes Lightning Dock KGRA. The Lightning Dock thermal anomaly is evidenced by several shallow hot wells (101.5°C at 27 m depth) on the east side of the Animas Valley, a portion of the Basin and Range province of southwestern New Mexico. Heat flow values in the area exceed 20 hfu and geothermometry indicates reservoir temperatures near 170°C.

Geophysical investigations by the University of New Mexico and New Mexico State University commenced in 1975 with reconnaissance gravity, magnetic, and roving dipole resistivity measurements. To varying degrees, each of these techniques mapped the bounding Basin and Range faults, a thick (~1.5-3.0 km) sedimentary sequence in the valley, and a prominent, though irregular, ridge trending SSW under the valley fill in the vicinity of the hot wells. Superimposed on the high electrical resistivity (>20 ohm-m) characterizing the ridge is a confined region of low resistivity (~10 ohm-m) in the vicinity of the hot wells. Figure 1 contains an E-W profile of total field apparent resistivity from one of the bipole surveys which illustrates this feature. The figure also shows an approximately 4 mGal residual gravity anomaly associated with the ridge.

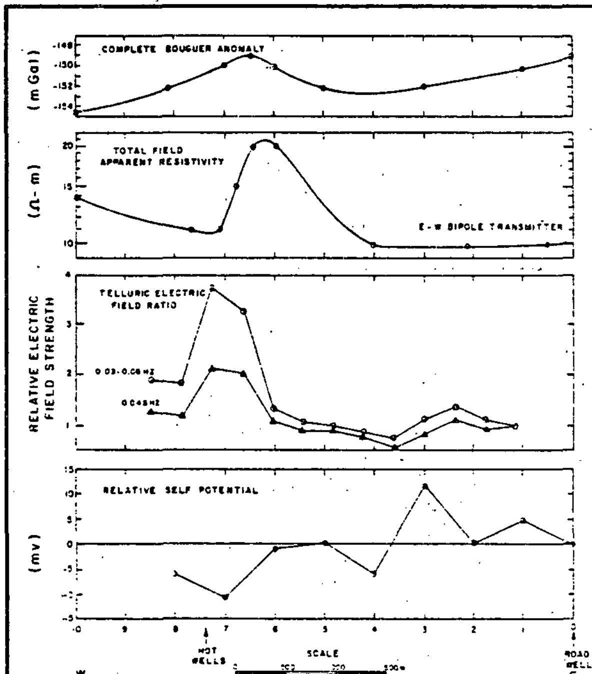


Figure 1

More detailed geophysical surveys have traversed the hot wells to investigate the relative merits of various electrical and electromagnetic exploration techniques. Figure 1 presents results from a telluric survey which clearly detects the buried ridge in the frequency band 0.03-0.06 Hz. A limited self-potential survey (Fig. 1) suggests a negative SP response of approximately 10 mV over the hot wells. A more extensive dipole-dipole resistivity line 8-km long utilizing 500 m dipoles to a maximum N-spacing of 12 has provided sufficient data to yield a two-dimensional geoelectric model of the east side of valley. The preliminary model (Fig. 2) is dominated by a 50 ohm-m ridge less than 100 m below the surface centered slightly to the east of the hot wells. Similar high resistivity is interpreted at 2 km depth below the valley center. Low resistivities (4 ohm-m) modelled may represent thermal waters and/or saline groundwater in the alluvium.

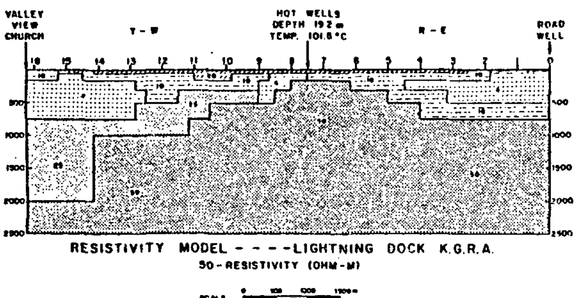

Figure 2

The first definitive probing beneath the high resistivity ridge was accomplished in 1976 by magnetotelluric soundings at periods in excess of 10 sec. Five MT sites using a cryogenic magnetometer were spaced at 1.6 km intervals across the valley. The 0.03 to 200 sec period data have been processed to yield complete tensor impedence information including apparent resistivities in the principal strike directions. Again, the singular most predominate result is the detection of the high resistivity ridge in the vicinity of the hot wells. However, the long period data confirms that a region of lower resistivity underlies the ridge.

Geologic mapping in the Pyramid Mountains, the range to the east of the Animas Valley, has exposed a mid-Tertiary caldera complex marked by two concentric ring-fracture zones along which rhyolite and latite domes have extruded. The Basin and Range faulting which formed the Animas graben apparently transected the caldera and dropped its western margin into the graben. The projection of the mapped ring-fracture zone intersects a visible Holocene fault in the valley at the location of the thermal anomaly. The caldera is not likely the current heat source for the Lightning Dock thermal anomaly but the evidence suggests the KGRA is structurally controlled by intersection of the mid-Tertiary and Holocene features. The ridge detected by geophysical techniques may mark a sequence of rhyolite domes along the buried ring-fracture zone.

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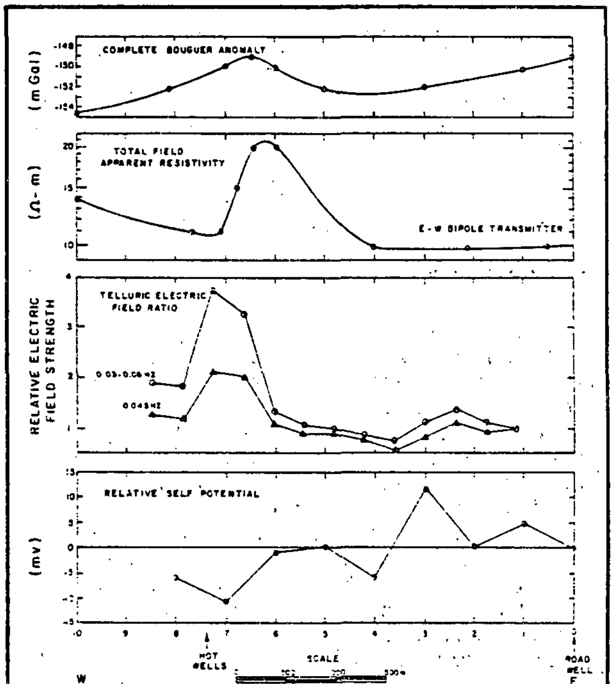


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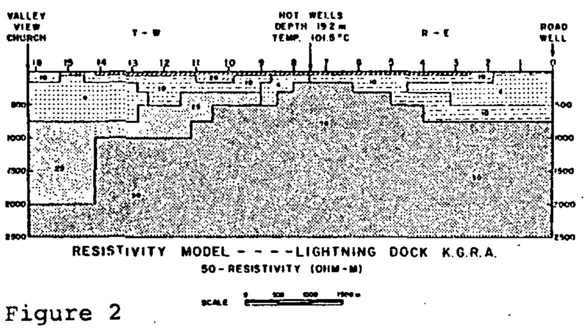


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