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A RECONNAISSANCE AUDIO-MAGNETOTELLURIC SURVEY AT KILBOURNE HOLE, NEW MEXICO

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The audio-magnetotelluric, AMT, method is an electromagnetic exploration technique which uses energy derived from world-wide lightning storms to measure variations in earth resistivities as a function of depth and position. Because it is an electromagnetic technique it is particularly applicable to locating conductive rather than resistive bodies. A comprehensive review of the method is given by Strangway and others (1973) and details of the U.S.G.S. system is given by Hoover and others (1974).

In AMT surveying, the depth of exploration is proportional to the subsurface resistivity and inversely proportional to the frequency of the received signal. At a frequency of 7.5 Hz, the lowest we use, we estimate the approximate maximum exploration depth in the Kilbourne Hole region is about 700 m. Figure 1 shows data at 7.5 Hz for two orthogonal orientations of the telluric and magnetic sensors at each sounding location. Variations between the two orientations are indicative of nearby lateral variations in resistivities. Large lateral variations in the soundings were seen only at the two sounding locations between Hunts and Kilbourne Holes. Both Kilbourne and Hunts holes are regions of low resistivity, 5 to 10 ohm-m, which could be expected if the holes were filled with breccia. However the absence of a gravity low over the holes, (Cordell, this guidebook) and the extension of the AMT low south beyond Hunts Hole suggests that thermal and/or saline waters are a more probable source of the resistivities.

Between the two holes a prominent resistivity high is seen. This anomaly is associated with a small volcanic vent just north of Hunts Hole and may be due to basaltic feeder dikes which supplied the local flows. The two sets of orthogonal soundings in this high resistivity area indicated large lateral changes in resistivity in the vicinity. The sounding at the southeast edge of Kilbourne Hole corresponds to the sounding VES R-2 of Jackson and Bisdorf (this guidebook) in which no evidence of lateral change is seen. This behavior has been noted before by Strangway and Vozoff (1970). It is due to the better lateral definition obtained with the AMT method by Strangway and others (1973).

Besides these major anomalies, a slight decrease in resistivity trend to lower resistivities toward the east is evident. This is

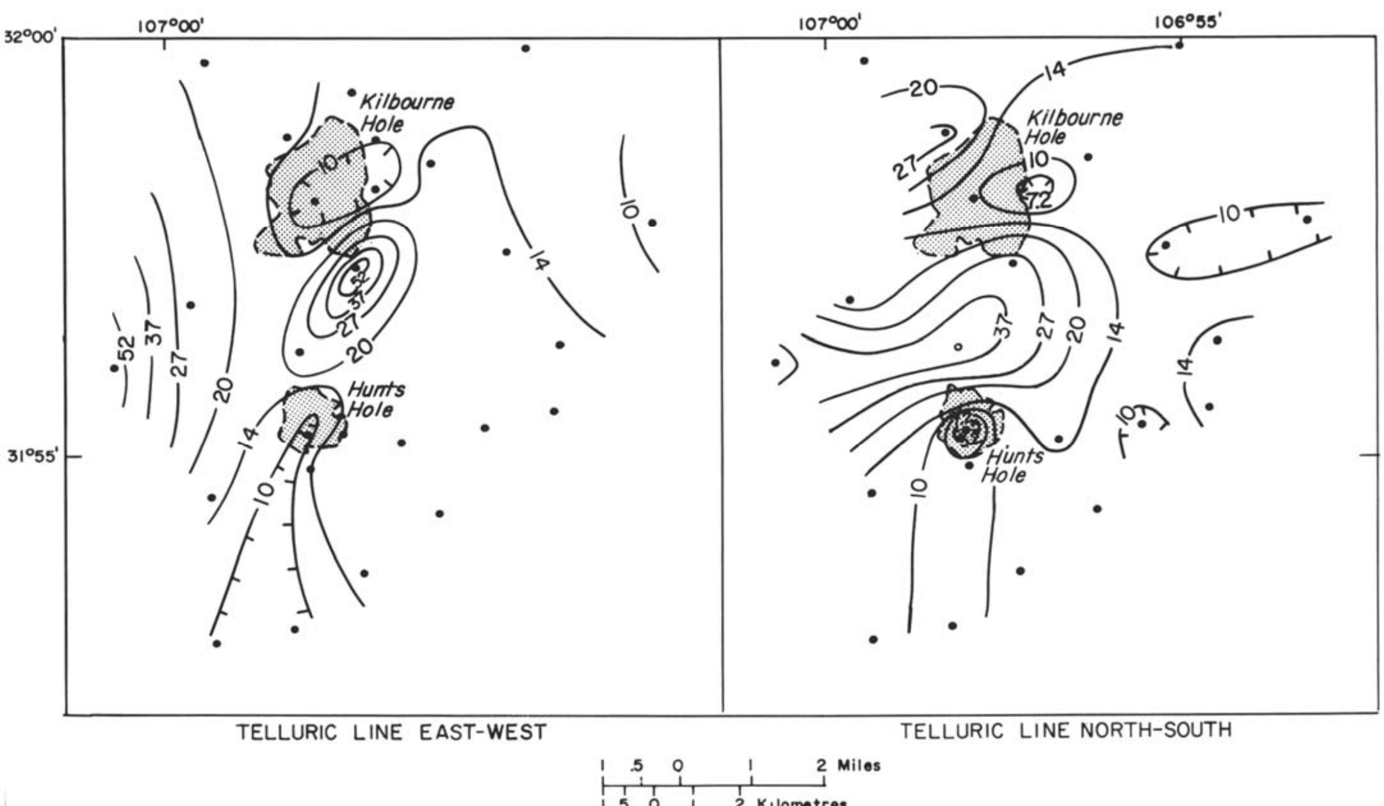

Figure 1. Audio-magnetotelluric apparent resistivity maps at 7.4 Hz, Kilbourne Hole, New Mexico. Resistivity values are in ohm-m with contouring on a logarithmic interval.

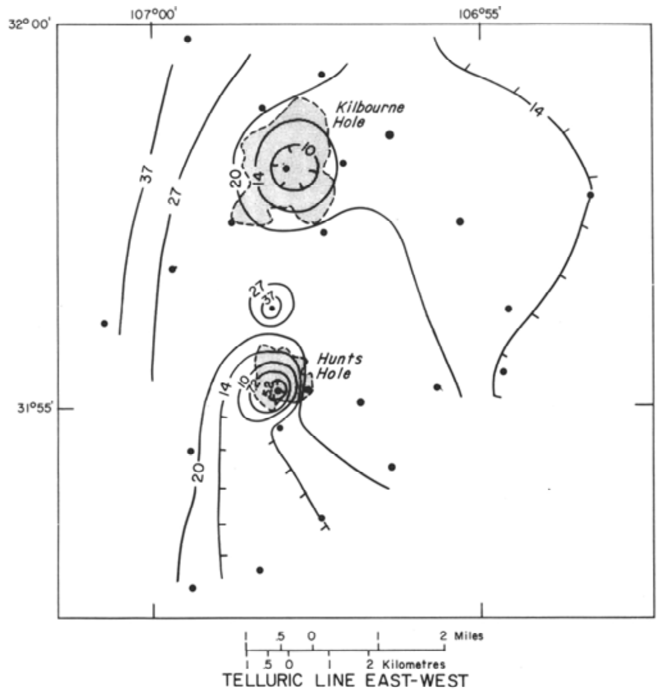

Figure 2. Audio-magnetotelluric apparent resistivity map at 26 Hz, Kilbourne Hole, New Mexico. Resistivity values are in ohm-m with contouring on a logarithmic interval.

consistent with the cross-section of Jackson and Bisdorf (this guidebook) which shows the top of a 2.2 ohm-m layer becoming shallower to the east. In this area the AMT data doesn't penetrate to the high resistivity basement identified by Jackson and Bisdorf.

In Figure 2 an apparent resistivity map is shown at 26 Hz. The same general pattern is seen as in Figure 1, except that the resistivity lows are more pronounced, particularly at Hunts Hole. This suggests that the conductive region covers an area less than one skin depth in radius about the central sounding site, i.e. less than about 400 m. This corresponds approximately with the diameter of the maare as might be expected.

The telluric map of O'Donnell and others (this guidebook) shows a close correlation with the AMT maps showing the maare as the principal conducting regions. This would be expected if the maare were formed by explosive eruptions and the high conductivity is due to rising thermal waters and some consequent rock alteration.

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