Magnetotelluric Investigation of a Pleistocene Nueces River Valley, Mustang Island, Texas

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ABSTRACT

Magnetotellurics is a geophysical survey technique that can measure the subsurface electrical properties by measuring simultaneously the orthogonal electrical and magnetic variations on the surface. At a particular frequency, the relationship between the surficial electrical fields and magnetic fields provides a measurement of the electrical impedance tensor of a volume of the subsurface. Higher frequencies represent a shallower integrated volume. Thus, by measuring the magnetotelluric response at a range of frequencies, a resistivity sounding can be determined. However, the electromagnetic response of the subsurface is a complex function of the lithology, porosity and porewater salinity, thus such soundings do not provide a unique characterization of the subsurface.

Ideally, a properly interpreted magnetotelluric depends on other data. This study provides such an interpretation. A geoelectromagnetic survey was conducted parallel to two miles of shoreline on Mustang Island, Texas. This barrier island prograded across the mouth of Corpus Christi Bay during the last two to three thousand years. Underlying the fine sands of the barrier island lies a valley-fill sequence consisting of fluvial, bay head delta and estuarine deposits that filled in a Pleistocene erosional surface at a depth of approximately 150 to 200 ft. The survey consisted of eight magnetotelluric soundings with resistivity measurements down to approximately 300 ft below the surface. These soundings were used to construct a resistivity cross section with resistivities in the range of 0.3 to 20 ohm-meters and then correlated with a nearby core and a logged well. Five zones were identified and correlated with the lithostratigraphic facies and water quality expectations derived from a nearby core and logged well.