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Location and Depth Determination of Buried Ferro-Magnetic Bodies in Environmental Site Assessments Using Euler's Homogeneity Equation

Geoscientists apply magnetic and gravity data to determine the depth to the top of the geologic features that produce observed anomalies. For hydrocarbon exploration, this is usually equivalent to determining thickness of the sedimentary section. For minerals exploration, depth estimates help locate geologic structures that produce a magnetic or gravity anomaly.

Since the application of Euler's homogeneity equation by Thomas (1982) and Red et al (1990), it became clear that the location and depth determination of buried ferro-metallic bodies could be achieved if the object's delineation could be based on Euler's relationship. The conventional technique required manual and/or computer-assisted interpretation procedures that were time consuming and, as such, expensive. The results were always dependent on the geophysicist's capabilities.

Euler's homogeneity relationship offers a quasi-automated way to derive plan location and depth estimates of buried objects from a gridded potential data set (magnetic or gravity). The equation relates the potential field and its gradient components to the location of the source, with the degree of homogeneity expressed as structural index, SI (Thompson, 1982). Structural index is a measure of the rate of change of the field versus distance from the source (fall off rate) and is directly related to the source of the observed magnetic anomalies. The technique, called Euler deconvolution, is advantageous over the conventional depth interpretation methods and can be directly applied to large grid data sets. It reduces interpretation time significantly.

The Euler deconvolution method has been applied to data collected over four sites (three magnetic and one gravity). Objects buried at the sites were drums, pipes, and underground storage tanks. Analyses of the data sets have provided characteristic Euler deconvolution signatures and structural indices associated with ferro-metallic features. The solutions obtained indicate the ability to quickly and accurately map the location and depth of buried ferro-metallic objects from gridded potential survey data.

Biographical Sketch

Mustafa Saribudak is a principal of Environmental Geophysics, 9406 Palm Shores Drive, Spring, TX 77379. He received a master's degree in geology and a doctorate in geophysics from Istanbul Technical University, Turkey. He came to the University of Houston in 1989 to work on a project funded by the National Science Foundation. Between 1990 and 1993, he worked for Tierra Environmental and pioneered the application of geophysical methods to environmental problems. Mustafa founded Environmental Geophysics in 1994 to provide near-surface geophysical services for the engineering, environmental, oil and gas industries, and real estate developers. During the last five years he has conducted geophysical surveys at more than 100 sites in the U.S. and Central America. He has published broadly in geophysical and environmental journals. □