ortance in the analysis of satellite magnetic data. gh transformation of the data to a common mean netic field direction restores the harmonic char- the data, it is essential first to find an optimum er which such an approximation will hold. To do method has been developed to approximate the l spherical observation surface by polygons over he geomagnetic field directions are held constant. dditional concern is the inclination of the magne- vector of the crustal causative body. Given the n of the magnetization vector of the buried body, transform the magnetic data with common incli- obtained above to derive a Newtonian potential corresponding total field over each polygon. method is essentially a modification of the of reduction to the pole described by Baranov. ld generated by the Newtonian potential is free ny distortions due to varying directions of the netic field as well as the dip of the magnetiza- ctor. It may be compared readily with a theoreti- netic field and to some extent the surface gravity estimate the physical dimensions of the buried of the crust.

imal Digital Filter for atitude Magnetic Survey Data — PM-21 §

d D. Brown, Robert D. Regan, and M. Kim son, Phoenix Corp.*

ptimal digital filter has been designed and tested acting the anomalous magnetic field associated crust from magnetic survey data at high lati- Such data are usually contaminated by fields ch external sources as ionospheric and magne c currents. The filter makes use of the difference cter of the autocorrelation functions for external nd crustal fields. The crustal field autocorrela- ction model is derived from a limited set of gnetic survey data in central Canada. The filter autocorrelation of the input signal and extracts raw data, a signal whose autocorrelation func- ees most closely (in a least squares sense) with he crustal autocorrelation model.

ffectiveness of the filter is tested using POGO data. Since the external field is time-varying e crustal field is static in earth-fixed coordi- e crosscorrelation of data from satellite passes same geographic region gives a measure of the of external field contamination. Crosscorrela- re and after filtering show a marked increase in and the sharpness of the crosscorrelation func- r filtering. This indicates a reduction in the of external field contamination in the satellite result that holds not only for quiet-time data disturbed by magnetic storms or the auroral as well. The agreement of the satellite data with upward-continued aeromagnetic data also improves after filtering.

This filtering concept is equally applicable to aeromagnetic, ground, or marine magnetic survey data processing. Since it is not explicitly based on spectral differences, it is useful for separating signals whose spectra overlap. It can be especially useful in processing survey data observed during magnetic storms or external field variations for which no adequate external field model exists.

The Investigation of Anomalous Magnetization in the Raft River Valley, Idaho — PM-22

Lennart A. Anderson and Don R. Mabey, U.S. Geological Survey*

As part of the extensive U.S. Geological Survey investigation of the geothermal potential of the southern Raft River Valley, Idaho, total field magnetic ground surveys were made to define the details of some magnetic anomalies produced by Tertiary volcanic rocks and Precambrian basement rock. Surveying by truck-mounted magnetometer produced a number of anomalies as high as several thousand gammas in amplitude in an area of Quaternary fan gravels. The steep gradients and the small areal extent of these anomalies suggested the sources were localized and very near the surface. To determine the nature of the anomaly-causing rock, a detailed magnetic survey was made in the area of one of these high-amplitude anomalies. Following the survey, a trench was dug at the location of the peak magnetic intensity uncovering rhyolitic boulders similar to the type found strewn over the surface of the region. Oriented samples were obtained from seven boulders cemented in place within the trench and the samples analyzed for their magnetic properties. Magnetic susceptibility values for all samples were found to be so small that the calculated induced magnetization is negligible relative to the remanent component. Demagnetization curves obtained for all samples indicated a predominant isothermal remanent magnetization (IRM) component. Typically, less than 5 percent of the original magnetization remained following a 200 Oe degaussing cycle. It is concluded that the local high-amplitude magnetic anomalies over the fan gravels in the southern Raft River Valley are produced by local cells of IRM in the near-surface rhyolitic boulders induced by a high-current density associated with lightning strokes at the surface of the fan gravels.

Interpretation of Three-Component Drill Hole Magnetic Data — PM-23 §

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We have made a theoretical study of the problem of locating and defining a magnetized body in the

§Paper available

vicinity of a drill hole. The study shows that a three-component borehole magnetometer can be very useful in exploration for deep magnetic targets, which are difficult to intersect by drilling.

Assuming the body is a prism, 9 parameters are to be estimated from the data: the x, y, and z positions of the center of the prism; length, width and depth extent; and the 3 parameters defining the magnetization vector. The parameters are estimated by minimizing the sum of squared differences between the predicted and observed data. Since the problem is nonlinear, it must be solved iteratively. At each iteration, a singular value analysis of the sensitivity matrix is performed, and a particular solution is chosen from a set of minimal length solutions; each solution corresponds to a different rank of the sensitivity matrix.

The main difficulty is an ambiguity involving position parameters and parameters defining the magnetization vector. In order to minimize this obstacle, a parameter scaling matrix is introduced. The effects of noise, wrong model, probe orientation errors, borehole length, and data density are analyzed. We have found that the position and depth extent of the body can be estimated with reasonable accuracy.

Deep Resistivities Under Tucson, Arizona from a Magnetotelluric Sounding — PM-24

Wayne S. Wojniak and John S. Sumner, University of Arizona*

A magnetotelluric (MT) sounding was made over periods of 20 to 10,240 sec at Tucson, Arizona during November 1978. The resulting anisotropic orthogonal apparent resistivities and their principle strike direction were interpreted as being due to the contact of low-resistivity Tucson basin Tertiary sediments with surrounding high-resistivity mountain ranges. The anisotropic apparent resistivities were then geometrically averaged, and the resulting apparent resistivity curve was modeled as a 1-D layered case. The resistivity model consists of four layers: (1) water-saturated rocks of 20 Ω-m resistivity above 4 + 2 km depth; (2) low-porosity crust of greater than 1000 Ω-m resistivity between 4 ± 2 and 30 + 10 km; (3) a low-resistivity zone of 10-30 Ω-m in the upper mantle between 30 ± 10 and 75 ± 30 km; and (4) upper mantle resistivities of 100-1000 Ω-m below 75 + 30 km.

The low-resistivity zone is probably the seismic low-velocity zone, and may be due to partial melting in the upper mantle associated with the extensional tectonics of the Basin and Range. The top of the low-resistivity zone, at 30 + 10 km depth, is probably the lithosphere-athenosphere boundary. Other available geophysical evidence for southern Arizona indicates the lithosphere-athenosphere boundary becomes shallower to the southwest, and deeper to the northeast from Tucson.

The MT data were analyzed by the impedance tensor method. Two 3-hour data sets, taken during magnetic substorms, were fast Fourier transformed, and the autospectra and crosspectra of their horizontal orthogonal magnetic and electric fields were computed in the frequency domain.

Further magnetotelluric soundings in southern Arizona could determine whether the upper crustal temperatures are favorable for hydrocarbon accumulation in the speculative "deep overthrust belt" of southwestern Arizona, or define the shallow low resistivities associated with geothermal systems.

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Calculation of the Distribution of the Intensity of Magnetization and Delineation of the Horizontal Extent of Highly Magnetic Bodies in the Underground

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Poster Paper

Display of Features on the U.S. Geological Survey's Logging Truck Built Especially for Borehole Gravity Surveys — PM-34 §

Stephen L. Robbins, U.S. Geological Survey

The U.S. Geological Survey has developed a logging truck designed specifically for the operation of borehole gravity meters. The truck is self-contained for most logging operations and can accommodate most conventional wireline tools. The diesel truck is capable of sustained highway speeds while hauling an equipment trailer containing a support vehicle. The truck contains the following features: (1) a large work area inside the control van which also serves as a mobile electronics laboratory; (2) a hydraulically operated tower that extends to a height of 25 ft; (3) a hydraulically operated draw-works with about 12,000 feet of 15/32 inch 7-conductor cable; (4) 4 hydraulic-outrigger cylinders for stabilization; (5) two 6 KW 110-volt ac generators — one driven directly by a diesel engine, the other driven hydraulically; (6) 2 independent cable-depth measuring systems; (7) a magnetic cable-marker system; (8) a built-in cable-clamp/line-wiper control system operated from inside the control van; (9) built-in air-compressor and high-pressure liquid cleaning systems; and (10) a special "damped" carrying system for transporting a borehole gravity meter vertically in its pressure sonde while on "heat."

Detailed descriptions of these features are given in U.S.G.S. Open-file report 79-1511 (Robbins, S.L., 1979).