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ATTN: a) Technical Officer, Code 902
b) Contracting Officer, Code 269
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d) Patent Counsel, Code 204

From: L.W. Braile, W.J. Hinze and R.R.B. von Frese, Dept. of Geosciences
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Subject: Quarterly Progress Report - October, November, December, 1981

Date: December 30, 1981

Progress has continued on all phases of the research program during the period October, November and December, 1981. A number of our spherical earth processing programs were cleaned and forwarded to NASA-GSFC on magnetic tape. These programs include:

1) NVERTSM which inverts total or vector magnetic anomaly data on a distribution of point dipoles in spherical coordinates. Output includes magnetic susceptibility values such that the magnetic anomaly field of the point dipole distribution fits the input data in a least squares sense.

2) SMFLD which utilizes output from NVERTSM to compute total or vector magnetic anomaly fields for a distribution of point dipoles in spherical coordinates. This program is useful for vector component computations, continuation, and magnetic pole reductions of anomaly fields inverted by NVERTSM.

3) NVERTG which inverts gravity anomaly data on a distribution of point poles in spherical coordinates. Output includes density values such that the gravity anomaly field of the point pole distribution fits the input data in a least squares sense.

4) GFLD which uses output from NVERTG to compute gravity anomaly fields for a distribution of point poles in spherical coordinates. This program is useful for vector component calculations, continuation, and radial derivative and Laplacian computations of anomaly fields inverted by NVERTG.

The documentation of a user's manual for these programs currently is being initiated.

Considerable attention also has been given during this period to the preparation of papers related to the MAGSAT program. On 4 Nov. 81, a paper was presented by W.J. Hinze, J.L. Sexton, R.R.B. von Frese and L.W. Braile entitled CORRELATION OF REGIONAL GEOLOGIC FEATURES WITH LONG-WAVELENGTH MAGNETIC ANOMALIES IN THE U.S. at the 94th Annual Meeting of the Geological Society of America in Cincinnati, Ohio. This paper confirmed a number of regional correlations between NOO aeromagnetic anomalies

and geologic features that have also been observed using POGO and MAGSAT data.

A number of papers have been prepared and submitted for the forthcoming MAGSAT issue of Geophysical Research Letters. These include the paper entitled VERIFICATION OF CRUSTAL COMPONENT IN SATELLITE MAGNETIC DATA by R.R.B. von Frese, W.J. Hinze, J.L. Sexton and L.W. Braile, wherein good correspondences are shown to occur at satellite elevations over North America between MAGSAT, POGO and NOO aeromagnetic anomaly data for wavelengths smaller than about 7.5°. Another paper entitled REGIONAL MAGNETIC AND GRAVITY ANOMALIES OF SOUTH AMERICA by W.J. Hinze, R.R.B. von Frese, M.B. Longacre, L.W. Braile, E.G. Lidiak and G.R. Keller, outlines a number of interesting associations between MAGSAT magnetic and free-air gravity anomaly data which are useful for identifying and analyzing the megatectonic regime of South America and adjacent marine areas. The third paper entitled SATELLITE MAGNETIC MODELS OF THE ANDEAN SUBDUCTION ZONE AND AMAZON RIVER AULACOGEN by M.B. Longacre, W.J. Hinze and R.R.B. von Frese, presents geophysical models based on radially polarized 2°-averaged MAGSAT data for some of the major tectonic features of South America. Abstracts for these papers, as well as the GSA-paper are enclosed.

CORRELATION OF REGIONAL GEOLOGIC FEATURES WITH LONG-WAVELENGTH MAGNETIC ANOMALIES IN THE U.S.

by

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Abstract

Magnetic anomalies which have significant energy in wavelengths of several hundred kilometers may be used to investigate regional structures within the magnetic crust. Total intensity aeromagnetic observations obtained during the U.S. Naval Oceanographic Office - Vector Magnetic Survey are useful in mapping the long-wavelength magnetic anomalies of the conterminous U.S. These data which were obtained at 0.1 km intervals and an elevation of roughly 500 meters above ground level along 1° meridians have been screened for periods of intense diurnal magnetic activity and reduced to anomaly form using the updated IGS-75 geomagnetic field model. These data have been high-cut filtered with a 50% cutoff at 200 km wavelength. Filtered and unfiltered profile maps and a contour map of the filtered data have many interesting correlations with regional geologic features and other geophysical data including gravity, heat flow, and mean crustal velocity. Wavelength and strike-filtering of the data are useful in improving interpretations. Prominent positive magnetic anomalies occur over mafic basement rocks in eastern Kentucky and Tennessee, the Colorado Plateau, and a zone of 1500 MY old anorogenic felsic plutons in the midcontinent. Examples of prominent negative magnetic anomalies occur over the Mississippi Embayment and southern Rocky Mountains.

VERIFICATION OF THE CRUSTAL COMPONENT IN SATELLITE MAGNETIC DATA

by

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Abstract

To investigate the utility of satellites for mapping crustal magnetic anomalies, POGO and preliminary MAGSAT magnetometer data are compared with scalar aeromagnetic data obtained by the U.S. Naval Oceanographic Office - Vector Magnetic Survey of the conterminous U.S. POGO and available MAGSAT data demonstrate remarkable consistency over the study region. The NOO aeromagnetic data are low-pass filtered for wavelengths larger than about 4° and spherically upward continued to 450 km elevation by equivalent point source inversion for direct comparison with POGO satellite magnetometer observations. The upward continued NOO data show that most of the energy is in the long wavelength (≥ 1000-3000 km) anomalies. Removal of these wavelengths by suitable filtering reveals a residual anomaly field that corresponds well with the satellite measured anomalies, thus, demonstrating that the satellite data are useful for mapping crustal magnetic anomalies. A number of correlations between the NOO, POGO and preliminary MAGSAT data are evident at satellite elevations, including a prominent transcontinental magnetic high which extends from the Anadarko Basin to the Cincinnati Arch. The transcontinental magnetic high is breached by negative anomalies located over the Rio Grande Rift and Mississippi River Aulacogen.

REGIONAL MAGNETIC AND GRAVITY ANOMALIES OF SOUTH AMERICA

by

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Abstract

Preliminary satellite scalar magnetic anomaly data (MAGSAT) reduced to vertical polarization and low-pass filtered free-air gravity anomaly data of South and Central America are compared to major tectonic features. Statistical analysis of the magnetic data reveals that South and Central American continental magnetic anomalies have greater amplitude and are more variable than the adjacent marine magnetic anomalies. The continental shields generally are more magnetic than adjacent basins, oceans and orogenic belts. In contrast, the major aulacogens are characterized by negative magnetic anomalies. The Andean Cordillera are apparent in both the magnetic and gravity data, where south of the equator gravity maxima are related to negative magnetic anomaly patterns, and north of the equator anomaly correlations are between maxima.

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SATELLITE MAGNETIC MODELS OF THE ANDEAN SUBDUCTION ZONE AND AMAZON RIVER AULACOGEN

by

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Abstract

Magnetic modeling of the Andean Subduction Zone and the Amazon River Aulacogen illustrate the utility of satellite magnetic data in characterizing the properties and structure of the lithosphere. The model of the Andean Subduction Zone in southern Peru suggests that the radially polarized positive magnetic anomaly is associated with a low subduction angle and perhaps lower crustal temperatures than adjacent portions of the subduction zone. The inverse relationship of radially polarized negative magnetic anomalies and positive gravity anomalies over the Amazon and Takatu Aulacogens is similar to the relationships observed over the Mississippi River Aulacogen. Modeling suggests a thinner and less magnetic crust associated with the aulacogens.

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