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"Use of MAGSAT anomaly data for crustal structure and mineral resources in the U.S. Midcontinent"

from

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This project began in December 1980, and we received our first significant amount of investigator MAGSAT data from NASA in late March 1981.

We have been processing the available data for the study area (U.S. Midcontinent). This has involved removing some individual tracks of apparently erroneous data, and then averaging data (e.g. on one-degree or smaller blocks), continuing to a uniform altitude, doing spatial filtering, and plotting anomaly maps. We are interested in the best possible anomaly data which will have characteristic wavelengths (and hence geological resolution) between those of the highly-averaged long-wavelength data of the global MAGSAT maps, and those of the highly-detailed low-altitude aeromagnetic maps. One hope is, for a region with major geologic provinces and crustal structures, to be able to estimate what one can resolve using data at a given altitude. The latter might be that of MAGSAT, or of downward-continued MAGSAT data, or of the Shuttle, etc.

The preliminary data indicate more detail than is witnessed on previous global-scale satellite magnetic maps. We are trying to identify as much true "geologically-based" short-wavelength detail as possible from the data set in hand and yet to come. The objective is to then try to correlate this detail with major geologic and crustal features: geologic provinces differing in composition/petrology and age, deep-seated structures, crustal thickness (as measured down to the Moho boundary), "magnetic lithosphere" thickness (as measured down to the Curie isotherm), or crustal expression as "seen" by LANDSAT remote sensing imagery.

We have had a MAGSAT data set for only a couple of months, and are still evaluating optimum ways to process and analyse it considering our interpretation objectives.

In doing detailed work for a relatively localized area, such as the U.S. Midcontinent, it appears from the data set to date that one must consider the correspondence of spatially-related (i.e. overlapping, or near-neighbor) satellite data tracks. This is to remove, or at least take into account, both temporal changes in the geomagnetic field, and possibly problems with the initial processing that generated the investigator data tapes. Some of our current analysis is directed at examining whether a map data feature such as an elongated anomaly or trend, which seems to parallel the satellit data tracks, is likely of crustal origin or is an artifact of the data set.

Problems

None which are unexpected.

Accomplishments and Significant results

Our preliminary magnetic anomaly map processing not yet complete, and in only a hand-drawn stage) for the U.S. central midcontinent agrees in broad aspects with the preliminary global MAGSAT map provided by NASA recently. There are, however, because of our data evaluation and finer-scale averaging, more detailed features which hold promise for eventual geological/crustal interpretation.

Publications

Attached is an abstract accepted for the International Conference on Basement Tectonics, to be held in Oslo in August 1981, the week after the IAGA/Magsat conference in Edinburgh. The timing is convenient, the conference sites are in close proximity, and the Tectonics conference affords the opportunity to speak of NASA's MAGSAT project to a geological audience interested in crustal structure, composition, evolution, and geotectonics.

Recommendations

None to date.

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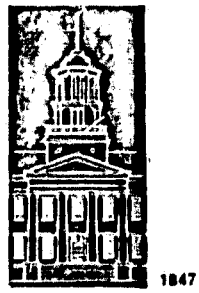

REVISED Abstract for: 4th Intern. Conf. on Basement Tectonics
August 10-14, Oslo Norway
(original Abstract submitted January 25, 1981)

To: Roy Gabrielson, Dept. of Geology, University of Oslo
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For: Oral (and poster?) presentation

From: Robert S. Carmichael, Dept. of Geology, University of Iowa
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Session: S2 (Sensing Technology), Aug. 10th
Floyd Sabins, Chevron Oil Field Research Co., Box 446
LaHabra, Calif. 90631

USE OF "MAGSAT" SATELLITE DATA TO INTERPRET CRUSTAL GEOLOGY, STRUCTURE, AND GEOPHYSICAL PROPERTIES OF THE U.S. CENTRAL MIDCONTINENT

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NASA's MAGSAT satellite measured magnetic fields from Oct. 1979 until June 1980. The processed magnetic data yield long-wavelength anomalies, arising from crustal sources, which have a resolution not previously achieved by satellite sensing. This recent advance in remote-sensing geophysics technology, when combined with correlative data sets such as gravity and aeromagnetics, electromagnetic remote sensing imagery, heat flow and geothermal gradients, and known subsurface geology, should lead to better understanding of major deep-seated geologic structures and crustal composition. Such work has application to resource application, and geotectonics. As part of the NASA project to use the MAGSAT data, we are developing analysis and interpretational techniques to help understand the structure and character of the lithosphere in central North America. The techniques include surface-fitting, trend-surface analysis, upward and downward continuation, spatial filtering, and correlation of different data sets. The study region includes the "Midcontinent Gravity Anomaly", a paleorift zone 1200 km long and 80 km wide which intruded 1.1 billion years ago, and the New Madrid rift/seismic zone. Our preliminary analysis of the initial MAGSAT anomaly data, released in 1981, in combination with correlative geological and geophysical data, shows the utility of satellite data for regional crustal and basement study.