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Geologic Application of
Thermal-inertia Mapping from Satellite

Type II Progress Report

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16. Abstract Two HCMM nighttime thermal images of the Powder River Basin, WY, distinctly show a major thermal feature. This feature is substantially coincident with a drainage divide and the southward-facing slope appears cooler, suggesting a lower thermal inertia. An initial examination of regional geologic maps provides no clear evidence to suggest what type of geologic feature or structure may be present although it can be noted that its northeastern end passes through the mining district Lead, South Dakota.			
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Figure 2. Technical Report Standard Title Page

A. Problems

B. Accomplishments

The main thrust of the investigation for this past reporting period has been on developing a more accurate geometric registration procedure. Our present routine applies a correction vector to each pixel determined by the four nearest control points and weighted by their inverse square of the distance to the pixel. The resulting registration has not appeared to be accurate to within a pixel, an accuracy which is required to apply our topographic correction. We are in the process of testing a routine which performs a rotation/translation registration to a select set of control points using a very fast algorithm and another routine to adjust for scale changes.

C. Significant Results

For the Powder River Basin in northeastern Wyoming, HCMM nighttime thermal images have been found to show a major thermal feature. The feature can be seen distinctly on two nighttime data sets (AA0132-09050-3 and AA0154-09160-3) and indistinctly on a third (AA0181-09160-3). It is substantially coincident with a drainage divide; however, the southward-facing slope is cooler and no albedo change can be observed across it. Tentatively, we assume that it represents a thermal-inertia difference with the southern side having a lower thermal inertia. This property change could be due to lower soil moisture, lower soil density, lower quartz content, or some appropriate combination of all three effects.

Additional evidence to suggest what type of geologic feature or structure may be present is sparse. No boundary has been found so far on any existing geologic map, including the most recent 250,000-scale map or the 1:24,000-scale surficial geologic maps. The feature crosses units displayed on

regional geology, vegetation, and land use maps of the National Atlas of the U.S. G. Raines, from analysis of lineaments mapped using Landsat data, has proposed that a structural boundary exists in the general vicinity of the feature, but no Landsat lineament is directly associated with it. There is very tenuous evidence in the aeromagnetic data for basement structural control. The regional gravity data does not show any strong evidence for a structure at depth, but there are few stations in this part of the basin. Examination of higher harmonics of the gravity field did not provide any additional information; however, that data is also suspect because of the highly variable station density. There is a suggestion in the ground water temperature data for the Minnelusa Formation and the Madison limestone that cold waters may be moving to the southwest along the general trend and location of this feature. The only significant direction correlation appears to be the drainage divide itself. It is interesting to note, though, that the northern end of the feature passes directly through Lead, South Dakota where the Homestake Gold Mine is located.

D. Publications and Presentations

Ken Watson submitted a paper to Geophysical Research Letters titled "A simple algorithm for computing the sensible heat flux". He also attended the COSPAR meeting in Budapest June 9-13, 1980, at which he gave two invited papers, including one on the NCMM thermal studies and also gave a presentation at BRGM, Orleans, France.

Susanne Miller attended the NCMM Program Science Review held at Goddard June 16 and 17, 1980, and presented the status of this investigation.

E. Recommendations

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F. Funds Expended

Total expenditures to date: \$105,196

G. Data Utility

We have just received the CCTs for 20 August of the Powder River Basin (AA0116-09050-3, AA0116-20010-1,2, AA0116-20020-1,2). We are in the process of registering these scenes.

Also we have received NASA produced thermal-inertia and temperature-difference images for Cabeza Prieta (AA0342-09130-4,5,6,7,8) and for Powder River (AA0410-08430-4,5,6,7,8). These data are being reformatted and will be compared to our products.

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