Application of HCMM data to regional geologic analysis for mineral and energy resource evaluation

Type II Progress Report
September - November 1981

Prepared for
Goddard Space Flight Center
Greenbelt, Maryland 20771

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TECHNICAL REPORT STANDARD TITLE PAGE

1. Report No.	2. Government Accession No.	3. Recipient's Catalog No.

4. Title and Subtitle	5. Report Date
Application of HCMM data to regional geologic analysis for mineral and energy resource evaluation	6. Performing Organization Code

7. Author(s)	8. Performing Organization Report No.
Kenneth Watson and Susanne H. Miller	

9. Performing Organization Name and Address	10. Work Unit No.
U.S. Geological Survey Petrophysics and Remote Sensing Branch Box 25046, DFC, MS 964 Denver, CO 80225	11. Contract or Grant No.
	13. Type of Report and Period Covered
12. Sponsoring Agency Name and Address Locke M. Stuart HCMM Investigations Greenbelt, MD 20771	Type II Progress Report Sept. through Nov. 1981
	14. Sponsoring Agency Code

15. Supplementary Notes

16. Abstract

A more accurate algorithm was developed to compute thermal inertia from temperature difference and albedo information. The error of this algorithm is about 1/3 of the measurement error in HCMM as opposed to the current algorithm which can have an error 5 times larger.

A northeast trending lineament was discovered in southwestern Arizona on enhanced thermal-inertia images. The geologic significance of this feature is presently being examined using a variety of geophysical and geologic maps.

17. Key Words (Selected by Author(s))	18. Distribution Statement

19. Security Classif. (of this report)	20. Security Classif. (of this page)	21. No. of Pages	22. Price*

*For sale by the Clearinghouse for Federal Scientific and Technical Information, Springfield, Virginia 22151.

Figure 2. Technical Report Standard Title Page

A. Problems

We have encountered a serious registration problem on a day/night data set (AA0150-09410-3; AA0150-20350-1,2) of the Colorado Plateau. An affine transformation, when applied to the entire scene, registers to within a pixel all of the scene except the northeast corner. We had not encountered this problem on any other data sets.

We have ordered but not received scenes for part of the Basin and Range. We have not been able to find cloud-free day/night pairs for the Overthrust Belt and the northwestern part of the Cascades.

B. Accomplishments

Evaluation of thermal-inertia algorithms can be made by computing an exact solution to the one-dimensional heat flow equation subject to the linearized boundary condition and a half-wave heating flux. This solution can be used to compute temperature differences for assumed albedoes and thermal inertias. By performing a regression analysis between the thermal inertia computed by a particular algorithm and the actual thermal inertia an error analysis can be made. We have developed a more accurate algorithm to compute thermal inertia from temperature difference and albedo information. Our new algorithm was found to fit to within better than 1%. A fit using the apparent thermal inertia (HCMM Users' Guide 1980) was accurate to only 15% at 40 degrees latitude and solar declination of 20 degrees. This is larger than the differences we found among igneous rocks in Cabeza Prieta, Ariz., and between the Wasatch and Fort Union Formations in the Powder River Basin. For comparison the noise equivalent thermal-inertia difference of the satellite data is roughly 3%.

A northeast trending lineament was discovered in southwestern Arizona on a specially enhanced, thermal-inertia change detection image. The feature appears to be an extension of a lineament that can be seen on the state aeromagnetic map. The lineament is particularly striking because there appears to be a substantial bilateral symmetry along it and extending through the state of Colorado. The trend passes through the Hope Buttes diatremes and there appears to be two laterally symmetric volcanic field pairs: San Francisco, White Mts., Ariz., and Spanish Peaks, Elk Mts., Colo. Examination of a variety of geophysical and geologic data is currently underway.

The HCMM data of Newberry Caldera, Ore., appear to show a large (45 km diameter) circular feature, roughly centered on the caldera. The boundary does not generally appear to coincide with topographic features or geologic units and circumscribes the cinder cones field and the most highly dissected terrain. There is no obvious counterpart to be found on the Landsat images.

C. Significant Results

Developed a more accurate algorithm to compute thermal inertia from temperature difference and albedo information.

Discovered a northeast trending lineament on thermal-inertia images of southwestern Arizona which appears to be the extension of a major aeromagnetic lineament.

D. Publications and Presentations

E. Recommendations