REFLECTANCE RADIOMETRY OF THE EARTH: PRELIMINARY RESULTS FROM THE SHUTTLE MULTISPECTRAL INFRARED RADIOMETER. Alexander F.H. Goetz, Jet Propulsion laboratory, Pasadena, CA 91109

The Shuttle Multispectral Infrared radiometer (SMIRR) was carried as part of the OSTA-1 payload aboard the second flight of Columbia on November 12-14, 1981 It obtained approximately 400,000 10 channel spectra, in clear weather conditions, over four continents. SMIRR, proposed in 1976, was designed to obtain radiometric measurements of the Earth's surface in ten spectral channels between 0.5 and 2.35 μm (fig. 1)

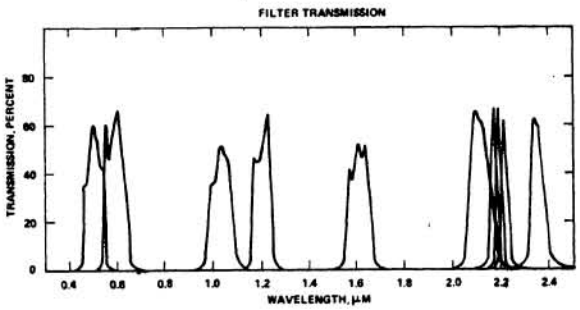

Figure 1: Bandpasses for the 10 SMIRR spectral filters.

Although many more channels were desired, constraints of resources and data storage aboard Shuttle limited the scope of the experiment.

The experiment was proposed as a logical step in the development of remote sensing capabilities for geologic mapping. Previous work with Landsat (1,2) had identified the limitations of radiometric imaging in four relatively broad spectral bands short of one micrometer in wavelength. While computer processed Landsat images are useful in discriminating among geologic units, no unique identification of mineralogy is possible, except for limonite in nearly vegetation-free areas. Field spectral measurements (3) as well as laboratory studies (4) of rocks and minerals reveal a wealth of diagnostic information in the region 1-2.5 μm that has not been exploited for geologic mapping. In particular, the region 2-2.5 μm contains diagnostic spectral absorption features for layered silicates and carbonates. Since clays make up an important part of the weathered layer measured by remote sensing techniques, special emphasis was placed on this region.

The objectives of the SMIRR experiment were to: (1) obtain spectroradiometric measurements from orbit of land surfaces in 10 wavelength channels known to be useful for rock and mineral identification; (2) determine the spectral response of known rock types under different climatic conditions worldwide; (3) establish the utility of orbital narrow-band radiometry in the 2-2.5 μm region for direct identification of rocks and minerals and establish the requirements for future narrow-band imaging systems (5).

SMIRR consists of a 19 cm diameter telescope (MVM'73) followed by a 100 rps spinning filter wheel and two thermoelectrically cooled HgCdTe

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SMIRR - Reflectance Radiometry

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detectors. The instantaneous field-of-view (IFOV) is a 100 m diameter spot directly beneath the spacecraft. The position of the spot is determined by bore-sighted 16 mm framing cameras with glass platens containing fiducial marks. Timing information accurate to .01 seconds is recorded on the film edge. The alignment was made with a laboratory collimator and the true position checked post-flight by inspection of the radiometer output at shoreline crossings. The post-flight analysis shows that the alignment has remained constant within one IFOV since it was established two years ago. The detector output, after suitable signal handling, was recorded on the shuttle payload tape recorder.

The shortened mission yielded 186 minutes of SMIRR data out of an originally planned 305 minutes. Cloud-free coverage was obtained in the eastern U.S., Mexico, southern Europe, North Africa, Middle East and China. Planned coverage of Australia and South America was not possible because of the unfavorable lighting resulting from the two hour launch delay. Approximately 70 minutes of data, equivalent to 400,000 spectra, were obtained under totally cloud-free conditions. Another 50 minutes of data were acquired in apparently cloud-free conditions but the presence of high thin clouds cannot be ruled out. The radiometer data occupy a total of 4 computer compatible tapes. These and two 400′ rolls of 16 mm film along with a calibration report will be placed in NSSDC by June 1982.

As of this writing, only data from Orbit 18, extending from lower Baja California to southern Virginia, have been analyzed. Atmospheric corrections were made using the Lowtran-V atmospheric model. Several ground control points such as a sand beach and a coniferous forest were used to establish preliminary normalization factors, to allow absolute spectral reflectances to be plotted. The preliminary results show the expected major influence of vegetation on the spectra as well as areas in which clay bands can be observed. The variation in reflectance values in the 2-2.5 μm band is greater than anticipated but verification of the results must await ground spectral measurement.

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