VIKING ORBITER MULTISPECTRAL IMAGES LINKED TO LANDER IMAGES AND LABORATORY ANALOGS

[1]M. O. Smith, [1]J. B. Adams, [2]E. A. Guinness, [2]R. E. Arvidson
[1]University of Washington, Seattle, WA 98195
[2]Washington University, St. Louis, MO 63130

A previous study (1) presented evidence that the spectral variance in Viking Lander six-band images could be explained by mixtures of the spectral endmembers soil, rock and shade. Analysis of additional lander images at both the Lander 1 and 2 sites supports the earlier conclusions, but also includes very bright soil/duricrust and a dark "blue" rock as two additional endmembers. Differences in the spectral mixing volumes between Lander images are mainly associated with temporal changes in the relative proportions of endmembers. For example, the percent cover of dust increased following storms. The Lander-derived spectral endmembers were interpreted in terms of laboratory spectra of known materials by calibration procedures described in (1). The best analog for the soil is a tan Hawaiian palagonitic tephra (h34). Analogs for the Lander rocks are a gray rock of the general class of andesite-basalt (t2bb) and a blue-black glassy basalt (h190).

We have now compared the spectral mixing volume defined by the Lander endmembers with that in a 3-band Viking Orbiter image that includes the Viking Lander 1 site. Spectral endmembers derived from the Orbiter image (bright cliffs, red plain, blue crater, and shade) lie within the mixing volume defined by the Lander endmembers (Fig. 1), suggesting that the Lander materials are sufficient to explain the spectral differences at the Orbiter scale.

To assess calibration differences between the Lander and Orbiter images, we linearly regressed the four endmembers of the Orbiter image against the same four endmembers of the Lander images separately for each band. For each of the three visible bands the resulting correlation was greater than 0.96 and the offsets less than 3 DN's. These results imply that Orbiter endmembers are similar to Lander spectral endmembers, and the results are consistent with a simple gain correction. To correct for the differences in the wavelength positions and shapes of the bandpass filters between Lander and Orbiter we used the laboratory soil and rock analog spectra from (1) to calculate gains for each endmember associated with filter differences.

The calibrated image endmembers in the Lander and Orbiter images are identical within the limits of the given assumptions and system errors (Fig. 1). Although the three broad bandpasses of the Orbiter impose severe restrictions on the ability to identify materials, the similarity of the mixing volume for the Orbiter scene to that in the Lander scene in the same area suggests that the Orbiter data can be interpreted in terms of the Lander materials and its laboratory analogs.

We thus propose that the bright cliffs and "red" areas in the Orbiter image are dominated by soil/dust at the surface, reminiscent of the Lander 1 site that lies within this unit. The "blue" areas are interpreted as unoxidized rock of likely basaltic affinity. The blue areas, however, show streak patterns suggestive of wind transport, and may be equivalent to the rock-derived coarse sand described in (1). These interpretations are consistent with thermal inertia models (2). The "brown" areas are interpreted as mixtures of soil, blue rock and shade, suggesting possible boulder fields or partially dust-mantled outcrops. The Lander 1 rock endmember (t2bb) mixed with shade is spectrally analogous to the brown unit. These interpretations may be applicable to large areas of Mars, as similar units have been described in the Orbiter apoapsis mosaic of the central equatorial region (3).

References

1. Adams, J. B., M. O. Smith, and P. E. Johnson (1986), *J. Geophys. Res.*, 91, 8098-9112.
2. Kieffer, H. H., Martin, T. Z., Peterfreund, A. R., Jakowsky, B. M., Miner, E. D. and Palluconi, F. D. (1977), *J. Geophys. Res.*, 82, 4249-4291.
3. Presley, M. A. (1986), Masters Thesis, Depart. of Earth and Planet. Sci., Washington University, St. Louis, MO.

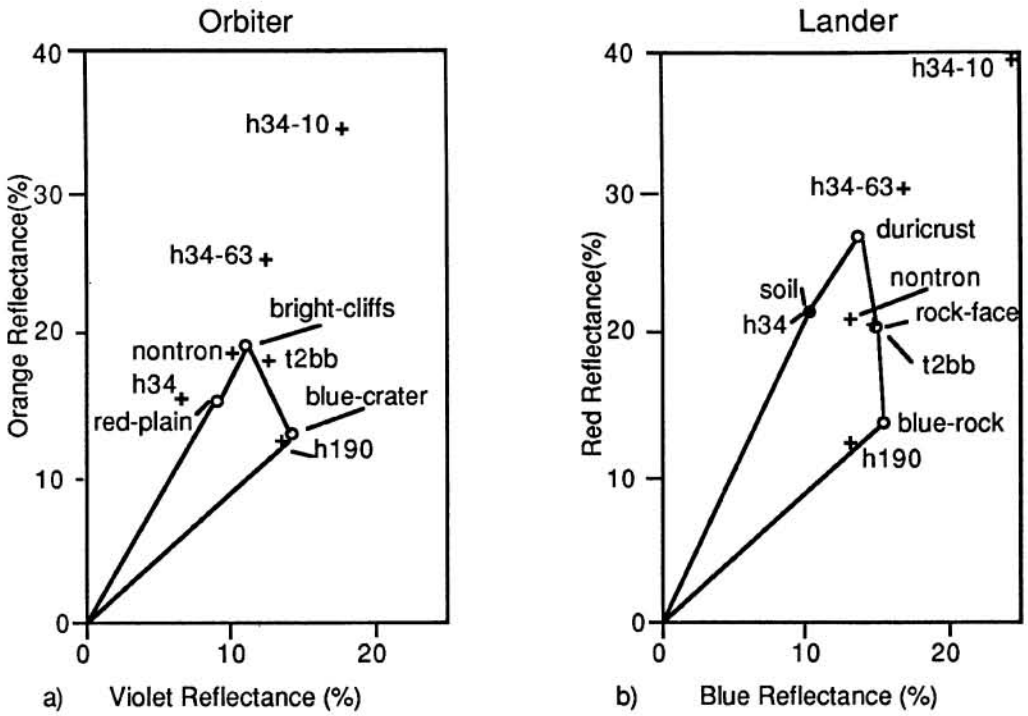

Figure 1. The calibrated spectral mixture volumes for Viking Orbiter endmembers (a) and Viking Lander endmembers (b) are delineated by solid lines. Laboratory spectra are denoted by "+" and image endmember spectra are denoted by "o". Mixing trends in the soil and duricrust are similar to those created by a tan Hawaiian palagonite of varying particle size, e.g., h34, h34 (<63µm), h34 (<10µm). Other laboratory samples displayed include nontronite (nontron), a dark blue Hawaiian basalt (h190), and a gray andesite (t2bb). When the two mixing volumes are compared by calibrating the Orbiter bandpasses to the Lander bandpasses using gains derived from the laboratory analog spectra, then the Orbiter data fall within the Lander mixing volume. The mixing volumes shown are two dimensional projections of three and six dimensional mixing volumes for Orbiter and Lander respectively.