GROUNDBASED IMAGING SPECTROSCOPY OF MARS DURING 1988 AND 1990: INSTRUMENTATION AND METHODOLOGIES FOR THE FUTURE OF PLANETARY SPECTROSCOPY; Jim Bell, Paul Lucey, Tom McCord, and Tom Ozoroski, HIG/PGD, Univ. Hawaii, Honolulu 96822; BITNET: jimbo@uhpgvax.pgd.hawaii.edu

Imaging spectrometer datasets are three-dimensional, possessing two axes of spatial information (imaging) and one axis of spectral information (spectroscopy). As such, these data provide a powerful tool for identifying mineralogy and mapping its spatial distribution across a planetary surface. Use of this tool in terrestrial and planetary applications has begun only within the past decade, spurred by the advent of new two-dimensional detector array technologies.

Our goals for the 1988 and upcoming 1990 Mars oppositions are to map the surface of Mars at 150-250 km resolution in the 0.4-2.5 μm range using imaging spectroscopy. One of the great advantages of imaging spectroscopy over traditional narrow-band filter imaging or point spectroscopy is its ability to obtain simultaneous information over wide spatial and spectral ranges. Such measurements produce enormous quantities of data, on the order of 10-100 Mbytes per night of observing. Obviously, this is a concern that must be addressed by the proper choice of image processing hardware and software. Depending on the size of the array used, 10^4-10^6 *individual* spectra can be produced from any single dataset. This huge number prohibits traditional methods of spectrum interpretation, and thus techniques must be derived which can automatically analyze vast numbers of spectra and produce maps of the most important quantities.

For example, we obtained imaging spectrometer data of 70% of the martian surface in the 0.4-1.0 μm range from Mauna Kea Observatory during the 1988 opposition [1]. Using the U.H. 2.24-m Wide Field Grism Spectrograph and IFA/Galileo CCD, 26 raw Mars and standard star image cubes of dimensions 800×200×50 were obtained. Standard spectral and CCD data processing techniques required some 75 hours of continuous processing by a 2 MIPS Sun 3/260 machine just to obtain approximately calibrated reflectance images. After performing this level of reduction we employed the technique of band depth mapping to simplify our analyses. Our 0.4-1.0 μm image cube spectra showed Fe^{3+} absorption bands at 0.65 μm and 0.86 μm which varied spatially on the planet. In a manner similar to lunar spectrum continuum removal, we created an averaged image across the 0.61-0.72 μm region and ratioed that with an image at 0.68 μm. The resulting ratio image shows several classical bright regions on Mars to exhibit up to a 5% deeper 0.65 μm Fe^{3+} band than dark albedo regions, consistent with the idea of bright regions consisting of more weathered (dusty) materials. Possibly of more interest, however, are several regions on the planet where the Fe^{3+} band variations do not correlate well with observed classical albedo boundaries, such as Sinus Sabaeus (Figure 7 in [1]). Such anomalous regions may indicate more heterogeneity than once thought in the martian weathering environment, and are difficult to detect using standard imaging or point spectroscopy techniques.

Observing plans for the upcoming 1990 opposition (the last in the excellent 1986-1988-1990 triad) include further mapping of the entire planet in the 0.4-1.0 μm and 1.0-2.5 μm regions. For the longer wavelength imaging spectrometer data we will concentrate our efforts on the Tharsis/Valles Marineris region in an effort to directly compare our global dataset with the higher resolution though spatially confined Phobos-2 ISM data [2]. Also, an in-depth analysis of the Syrtis Major/Sinus Sabaeus area will be undertaken in an effort to characterize better the compositional nature of the dark regions (can we really see exposed "bedrock?") and provide comparisons to high spatial resolution 1988 groundbased images of the same areas [3].

References: [1] Bell, James F., T.B. McCord, and P.G. Lucey (1990) *Proc. 20th Lunar Planet. Sci. Conf.*, in press. [2] Bibring, J.-P. and 16 others (1989) *Nature, 341,* 591-593. [3] Pinet, P. and S. Chevrel (1989) submitted to *JGR.*