GLOBAL SPECTRAL AND COMPOSITIONAL DIVERSITY OF MARS: A TEST OF CRISM GLOBAL MAPPING WITH MARS EXPRESS OMEGA DATA. S. M. Pelkey[1], J. F. Mustard[1], J.-P. Bibring[2], R. Milliken[1], Y. Langevin[2], B. Gondet[2], A. Gendrin[1], F. Poulet[2], S. Erard[2], S. Murchie[3], R. Arvidson[4], the OMEGA Science Team, the CRISM Team. [1]Department of Geological Sciences, Brown University, Box 1846, Providence, RI 02912, USA, [2]Institud d'Astrophysique Spatiale, Baitment 121, 91405 Orsay Campus, France, [3] Applied Physics Laboratory, Laurel, MD 20723, USA, [4] Earth and Planetary Sciences, Washington University, St Louis, MI 63130, USA. Email: shannon_pelkey@brown.edu

Introduction: After a year of mapping, the OMEGA instrument onboard the Mars Express has covered >50% of the surface and revealed evidence for a wide diversity of materials, resulting in a new perception of the surface composition of Mars. This data set provides us with an ideal opportunity to evaluate and refine the multispectral mapping strategy set forth for operations of the Compact Reconnaissance Imaging Spectrometer for Mars (CRISM).

Background: CRISM is a visible and near-infrared spectrometer that will launch later this year on the Mars Reconnaissance Orbiter. The instrument will cover the spectral range of 0.4 – 4 µm with over 500 bands and a spatial resolution of 18 m/pixel [1]. Data rate and sensor design limit coverage at this resolution to 5% of the surface so a second operational mode was designed to permit global coverage. This survey mode will cover 100% of the surface of Mars in 60 spectral bands at 200-m/pixel spatial resolution and will have value in both science and operations applications.

One strategy to assist in CRISM targeting is to use spectral parameters from the multispectral bands to quickly sort through the data and identify mineralogically interesting locations to target in the high-resolution mode. The questions we address here are 1) whether the CRISM multispectral mode will sample the surface at sufficient spectral resolution to capture important compositional variations of the martian surface and 2) whether these variations will be sufficiently represented by spectral parameters.

Observations: The OMEGA data set provides an excellent opportunity to address the above questions. OMEGA is a visible and near-infrared imaging spectrometer with 352 contiguous channels that cover the 0.35 – 5.1 µm wavelength range [2]. Spatial resolution of the instrument varies from ~300 m/pix – 5 km/pix depending on the altitude of pericenter of the spacecraft's highly elliptical orbit.

Methodology: Standard processing approaches have been used to convert OMEGA data from instrument units to I/F. A simple but efficient atmospheric correction has also been applied to the data [3].

Avoiding known problem channels in the OMEGA data, we then select OMEGA wavelength channels closest to the CRISM multispectral wavelengths (defined *a priori* but refined from OMEGA results) and derive spectral parameters for every OMEGA observation. Based on the initial results from the OMEGA instrument, we have defined 36 parameters related to surface mineralogy that best match the known diversity of the martian surface. Thirteen atmospheric parameters have also been defined but lie beyond the scope of this presentation.

To faciliate evaluation, gridded global maps of these parameters are produced at a resolution of 32 pixels-per-degree, or about 2 km/pixel at the equator. As a result, parameters derived from the highest resolution OMEGA observations are not incorporated into the global map. CRISM products will be produced with a consistent 200-m/pixel global resolution.

Results: The suite of parameters appears robust under the conditions that have prevailed at Mars during the first 12 months of mapping and highlight mafic minerals, sulfates, hydrated minerals, and ices and frosts.

Basaltic regions are particularly well distinguished by the parameters. Figure 1b shows the global distribution of a parameter formulated to detect low-calcium pyroxene (LCP). The map shows LCP to be focused in the older terrains of the Southern Highlands (Fig. 1b).

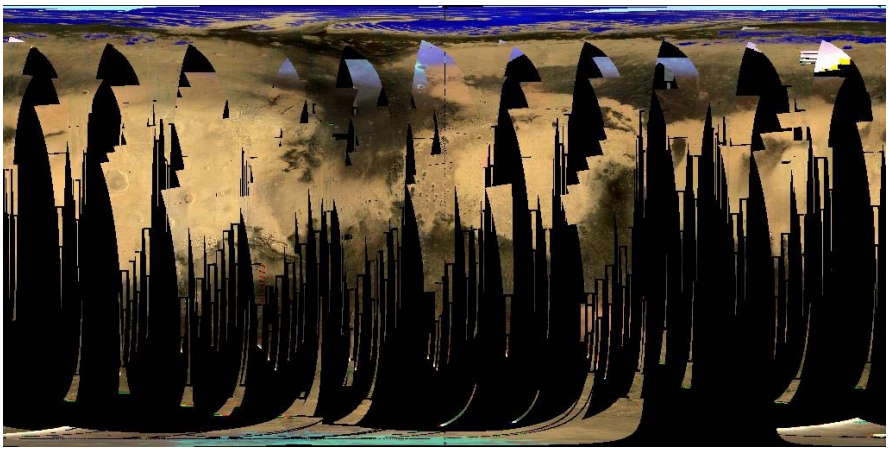
Regional sulfate deposits in Terra Meridiani, Aram Chaos, and northwestern Arabia Terra as well as numerous small sulfate deposits in Valles Marineris are also detected by our parameters (Fig. 1c).

Water and CO_2 ice can also be seen in the OMEGA data (Fig. 1a, c) [4]. Parameters have been designed to focus on these signatures as well.

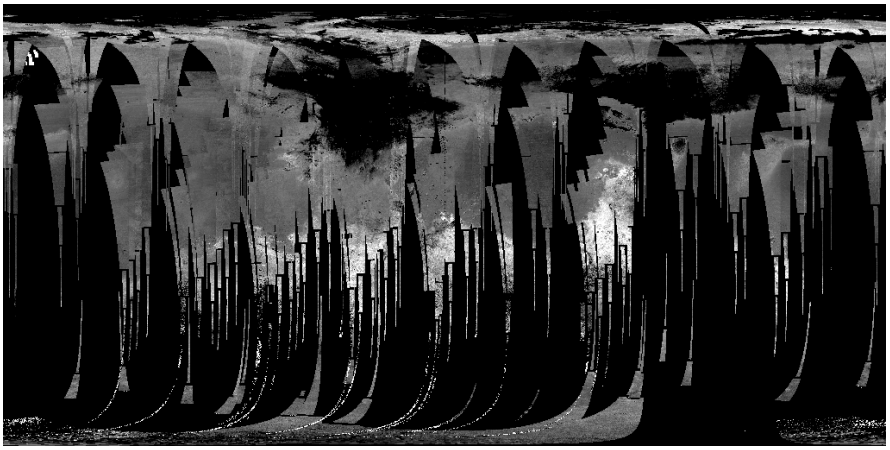
Conclusions: Our results have shown that the CRISM multispectral strategy will succeed in capturing the known diversity of the martian surface. In addition, we have shown that using multispectral parameters to identify mineralogically interesting high-resolution targets is a reliable technique. Production of global 200-m/pix multispectral data will also have outstanding science value and global mineralogic indicator maps such as our own will be useful in the selection of future landing sites.

References: [1] Murchie, S. et al. (2003) *Sixth Int. Conf. on Mars*, #3062. [2] Bibring, J.-P. et al. (2004) ESA-SP, 1204. [3] Gendrin, A. et al. (2004) *Early Mars Conf.*, #8030. [4] Bibring, J.-P. et al. (2004) *Nature*, 428, 627-630.

a)



b)



c)

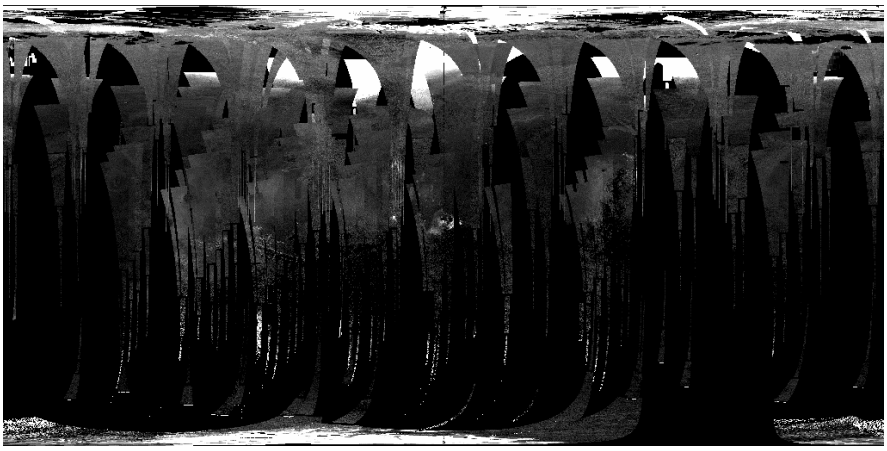


Figure 1: Example global maps of parameters derived from OMEGA data through the end of October 2004 reflecting observations during late Northern winter through early Northern summer. **a)** A RGB composite created to reflect the general cosine-corrected albedo of Mars; red=2.00 μm I/F, green=1.53 μm I/F, blue=1.10 μm I/F. Ice signatures can be seen at both poles reflecting the seasonal behavior. CO2 signatures dominate the southern pole [4], which was observed earlier in the mission, while H2O signatures dominate the northern pole, which was observed later on in the mission. Some of the earlier (underlying) observations detect the retreating H_2O-ice frosts in the mid-high northern latitudes. **b)** Parameter formulated to highlight areas enriched in low-calcium pyroxene using wavelengths in both the 1-μm and 2-μm regions. Brighter values indicate deeper bands. **c)** Parameter formulated to detect hydrated minerals. Brighter values indicate deeper bands. Most obvious is the enhanced hydration in central Meridiani but this parameter is also sensitive to surface frosts in the north and south polar regions.