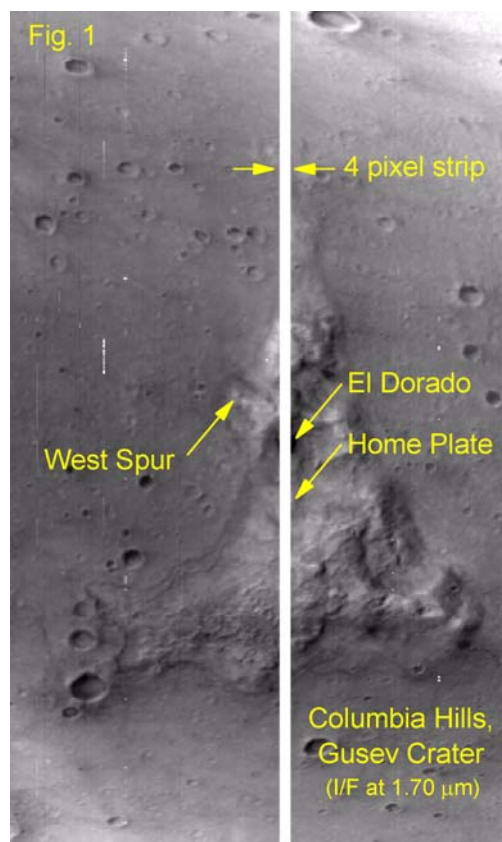**INITIAL RESULTS FROM THE MRO CRISM HYPERSPECTRAL IMAGING SPECTROMETER FOR THE COLUMBIA HILLS IN GUSEV CRATER ON MARS.**

R. V. Morris[1], R. E. Arvidson[2], S. Murchie[3], J. F. Bell III[4], D. Humm[3], K. Lichtenberg[2], F. Seelos IV[3], M. Wolff[5], and the CRISM Science Team. [1]KR/ARES NASA Johnson Space Center, Houston, TX 77058 (richard.v.morrris@nasa.gov). [2]Dept. of Earth Planet. Sci., Washington Univ., St. Louis, MO 63130. [3]Applied Physics Laboratory, Laurel, MD 20723. [4]Dept. of Astronomy, Cornell Univ., Ithaca, NY 14853. [5]Space Sciences Institute, Brookfield, WI 53045.

Introduction. Initial results from the Mars Reconnaissance Orbiter (MRO) Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) instrument [1] are reported for the Columbia Hills region in Gusev Crater, Mars (Fig. 1). The imaged region (data product FRT00003192_07) includes the surface traversed by the Mars Exploration Rover (MER) Spirit. CRISM hyperspectral data (~0.4 to 2.6 μm) are compared with multispectral data (~0.4 to 1.0 μm) obtained by Spirit's Panoramic Camera (Pancam) instrument.

Spectral Data. CRISM is a line scanning imaging spectrometer with a spectral smile, so that the center wavelength for each spectral band is not quite constant across the field of view of the spectrometer. Therefore, we selected for detailed analysis a transect 10 pixels wide (spatial resolution ~20 m/pixel [1]) that intersects locations in the Columbia Hills called El Dorado and Home Plate that were studied by Spirit. The radiative transfer program DISORT was used to validate the wavelength calibration and also to retrieve Lambert Albedos for the transect. We used lighting and viewing conditions that pertained to the observations, dust optical depths determined from Pancam observations during the overflight (0.37 at a wavelength of 0.88 μm), and an ice aerosol optical depth of 0.04. Gases modeled included carbon dioxide, carbon monoxide, and water vapor, using historical data generated by TES over the past several Mars years. We found that the nominal values for DISORT modeled the data well and allowed retrieval of Lambert albedos from 0.4 to 2.6 micrometers, although some residual gas band features are evident near 2 μm. The transect was reduced to 4 pixels in width after correcting for the slightly different fields of view of the visible (S) and near-infrared (L) detectors. The location of the strip is shown on the image in Fig. 1 (I/F = 1.70 μm).

The Lambert albedo at 1.70 μm for the transect is show in Fig 2. Hyperspectral data (Figs. 3a and 4a) were obtained as averages of selected locations that contain 4 to 20 pixels. Locations and derived spectra are correlated in Figs. 2 and 4a. At this preliminary stage, CRISM spectra have not been fully calibrated and not all instrumental artifacts have been removed. The gaps in the spectra (Fig. 3) correspond to intervals where data are not currently reliable. The join between the S and L detectors is near 1.0 μm [1], so an offset could occur there if the fields of view of the two

detectors were not aligned perfectly. For reference, calculated CRISM I/F spectra for surfaces having uniform Lambert albedos (0.05, 0.20 and 0.35) in the presence of atmospheric gasses and aerosols are shown in Figs. 3b and 4b.
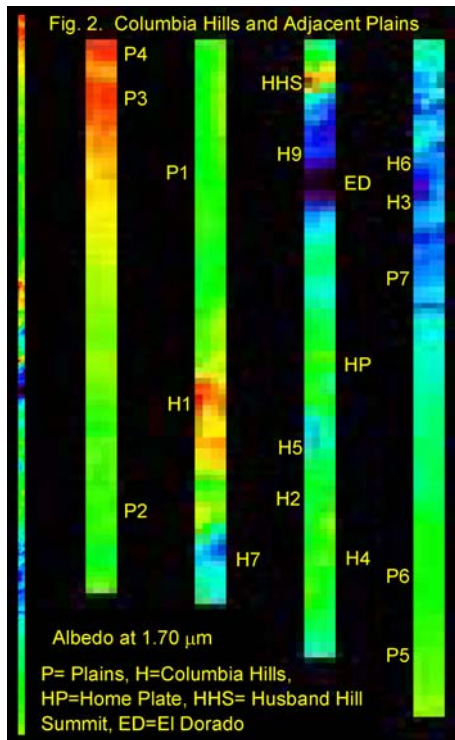

Fig. 1

4 pixel strip

El Dorado
Home Plate
West Spur
Columbia Hills, Gusev Crater (I/F at 1.70 μm)

Relative reflectance (R* [2]) spectra for multispectral Pancam data were obtained from images of undisturbed surface soils acquired on Spirit sols 72 (Bright Bear Paw), 589 (Whymper), and 711 (El Dorado). These values are effectively Lambert albedos and can be directly comparable to the CRISM-based retrievals.

Discussion. The general shape of Gusev CRISM (and OMEGA [3]) spectra (Figs. 3a) is a ferric absorption edge from ~0.4 to 0.6-0.8 μm and a negative spectral slope for low albedo regions (e.g., ED and H3) and a flat to positive spectral slope for high albedo regions (HHS, H1, P3, and P4). As shown by the vertical line at 0.8 μm, the relative reflectivity maximum occurs at shorter wavelenghts for dark

regions than for bright regions. The same general trends are shown in Pancam spectra (Fig. 5).

The degree of negative slope appears to correlate with the thickness of the dust coating [4], with low albedo areas like El Dorado having the least dust. This result is confirmed by MER data. Mössbauer spectra of undisturbed surface soil at El Dorado show very little nanophase ferric oxide (npOx), which is the ferric-bearing component of Gusev dust, compared to bright undisturbed soils like Whymper [5,6].

The high olivine content of El Dorado soil [6] and the continuation of the negative slope at wavelenghts longer than ~1.0 μm for CRISM spectra (i.e., no distinct olivine band minimum near 1.0 μm) suggest that the negative slope in the Pancam (and CRISM) spectrum of El Dorado results primarily from the presence of dust and not primarily from the presence of olivine.

Fig. 2. Columbia Hills and Adjacent Plains

Albedo at 1.70 μm

P= Plains, H=Columbia Hills, HP=Home Plate, HHS= Husband Hill Summit, ED=El Dorado

Even though we have not yet been able to completely remove the effects of atmospheric gasses from CRISM spectra (compare Figs 4a and 4b), there is clear indication of a H_2O feature near 1.9-2.0 μm. It is most evident in high-albedo spectra and may result from adsorbed or trapped H_2O. There is currently no compelling evidence of the presence of a M-OH band (M=Al, Si, Mg, and Fe) between 2.1 and 2.6 μm (Fig 4a) and no compelling evidence for the presence of Fe^{2+} bands near 1.0 and 2.0 μm that would indicate the presence of olivine and/or pyroxene, despite clear evidence for their presence in rock, soil, and dust from Mössbauer analyses made by Spirit [5].

In summary, CRISM hyperspectral data for a transect through the Gusev Columbia Hills are dominated by variable proportions of a bright Fe^{3+}- and probably H_2O-bearing component and a dark, spectrally-neutral component. From Mössbauer analyses by Spirit, the two components are npOx in rock, soil, and dust and weakly altered basalt, respectively. At the current state of refinement of CRISM Gusev spectra, we find no clear evidence for spectral features associated with either M-OH (e.g., in phyllosilicates) or Fe^{2+} in silicate minerals.
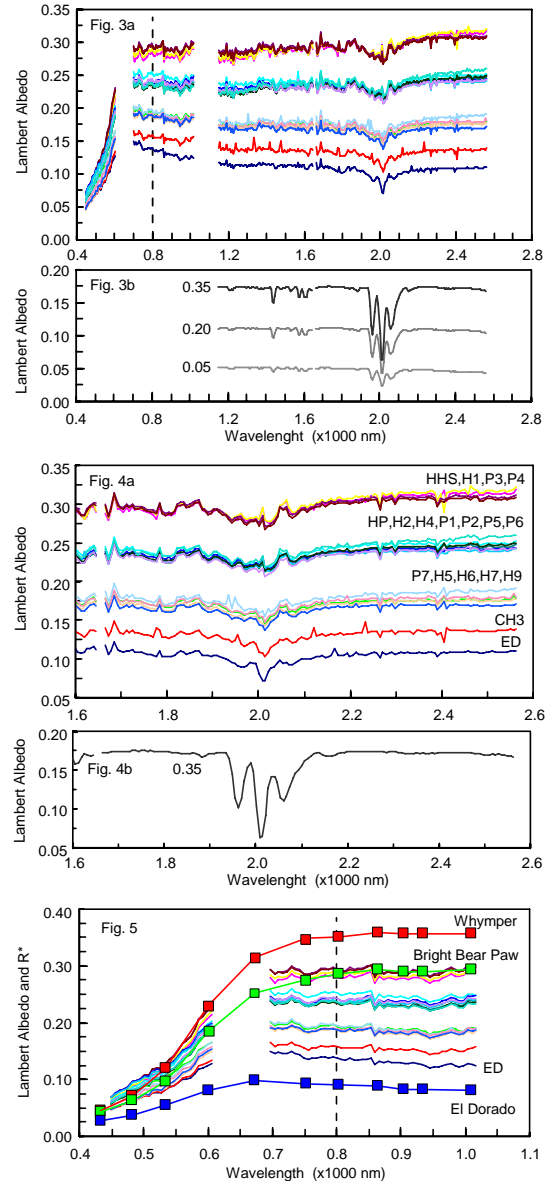
References. [1] Murchie et al. (2007) *JGR*, in press. [2] Bell et al. (2006) *JGR*, 111, E02S03, doi:10.1029/2005JE002444. [3] Lichtenberg et al. *JGR*, submitted. [4] Johnson and Grundy (2001), *GRL*, 28, 2101. [5] Morris et al. (2006), *JGR*, 111, E02S13, doi:10.1029/2005JE002584. [6] Morris and Klingelhöfer, unpublished.