HIGH SPECTRAL RESOLUTION 0.4-0.8 μm OBSERVATIONS OF MARS DURING 1988 AND 1990; James F. Bell III, Thomas B. McCord, Paul G. Lucey, and Thomas A. Ozoroski (Planetary Geosciences Division, University of Hawaii, Honolulu 96822).

Study of the composition, distribution, and crystalline state of iron oxides on Mars has important implications for the past and current martian weathering and thermal regimes. Telescopic observations of Mars in the visible and near-IR (the most diagnostic spectral region for iron oxides) have been made for decades. However, the favorable 1988 and 1990 Mars oppositions have provided the first opportunities to test a new generation of astronomical imaging spectrometer instrumentation, designed to acquire contiguous spatial and spectral information on extended objects [1,2]. Imaging spectrometer data sets are three-dimensional (two spatial axes and a spectral axis; thus the name "image cubes"), and have emerged as a powerful multispectral mapping tool due to advances in two-dimensional array detector technology over the past decade [3,4]. The first image cubes of Mars were acquired in 1988 by several groups working independently from Mauna Kea and Mount Bigelow Observatories [1,5,6]. Preliminary results from our 1988 data set have been reported previously [1]; in this abstract we present more detailed high resolution spectra of Mars in the 0.4-0.8 μm range and discuss the mineralogic implications of these new data.

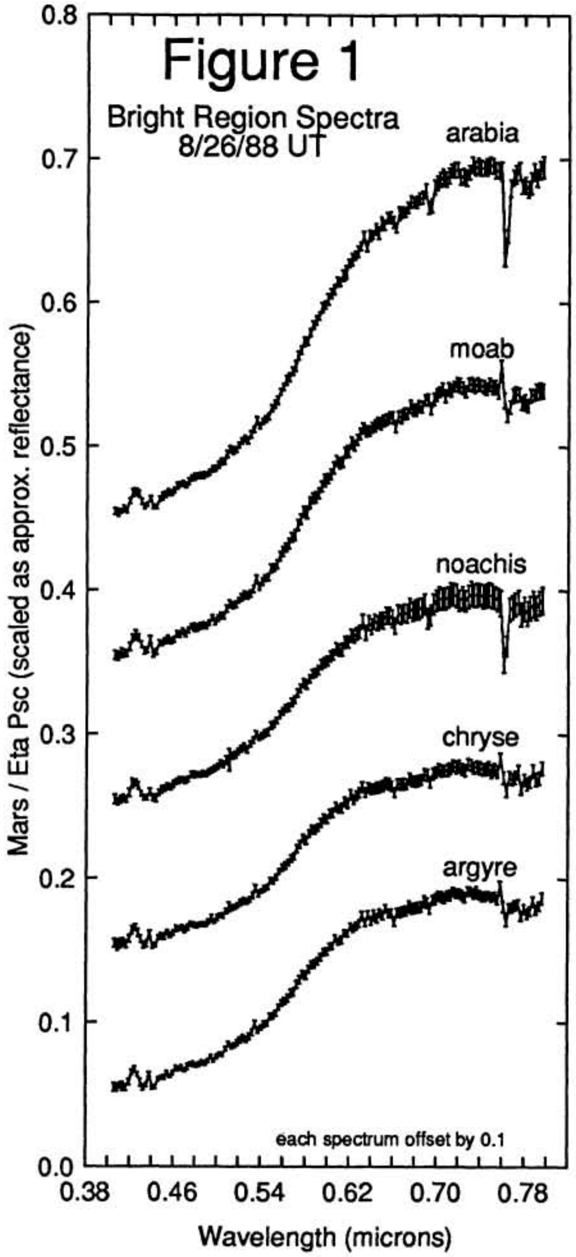
Our data sets were obtained with the Wide Field Grism Spectrograph (WFGS) on the University of Hawaii 2.24 m telescope at Mauna Kea Observatory (MKO) in August and September 1988 and November 1990 (Table 1). WFGS was mounted at the f/35 Cassegrain focus of the telescope. The spectrograph uses a TI 800 X 800 pixel CCD, with a readout noise of ± 6 electrons rms. The grism (a transmission grating ruled on a prism) is blazed at 4800 Å, has a dispersion of 400 Å/mm, and was used in first order, yielding an effective spectral resolution of $R = \lambda/\Delta\lambda \approx 350$ in this wavelength range.

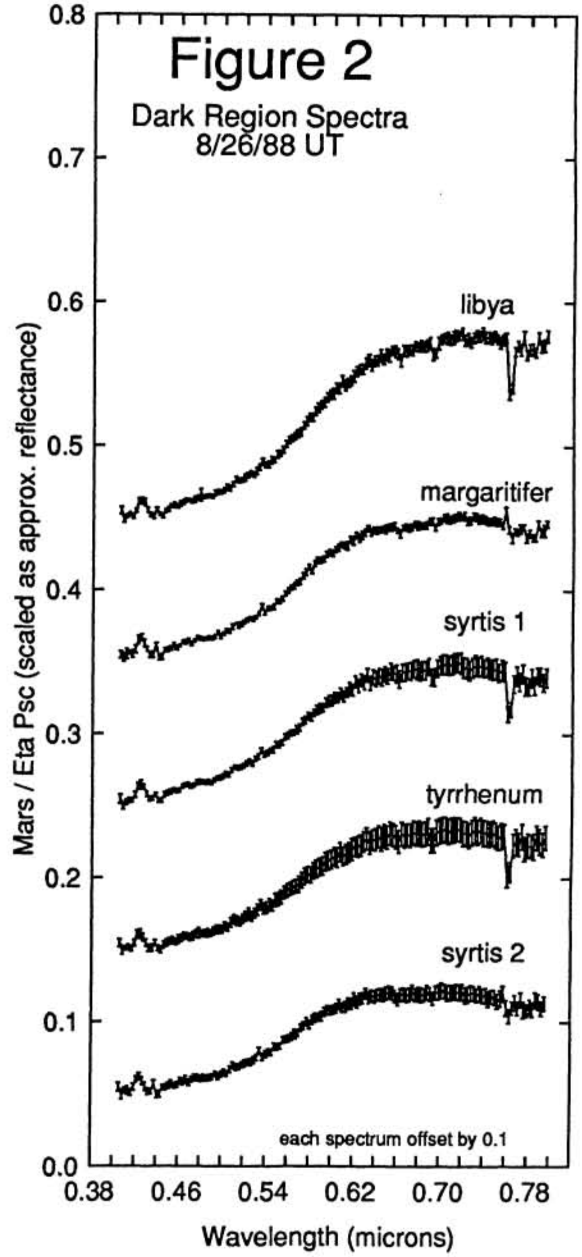
TABLE 1. 1988-1990 Mars Opposition MKO WFGS Observing Runs

Date (UT)	L_s	Phase	# Images	# Spectra	λ Coverage
8/26/88	259°	27°	750	3500	0.4-0.8 μm
9/28/88	280°	3°	300	1000	0.4-0.8 μm
11/9/90	330°	17°	800	4000	0.5-0.95 μm
11/10/90	330°	16°	1200	6000	0.5-0.95 μm

Bright and Dark region reflectance spectra (relative to G8III star η Psc) from the 1988 data set are presented in Figures 1 and 2. Error bars represent one standard deviation of the spectra, which are averages of 5 X 5 pixel boxes (each spectrum has an effective spatial resolution of 300-500 km). The data were scaled as "approximate" reflectance to facilitate intercomparisons by setting the Mars/η Psc value to 0.055 at 0.4 μm [7,8].

Many interesting features can be seen in the spectra of Figures 1 and 2 (sharp features near 0.42 μm, 0.69 μm, and 0.76 μm are artifacts from the standard star and terrestrial atmospheric correction). In Figure 1, the brightest regions observed, Arabia and Moab, have steep, well-defined near-UV O^{2-}->Fe^{3+} charge transfer absorptions with distinct slope changes near 0.49 μm and 0.54 μm. In addition, a weak "cusp" absorption band is seen at 0.62-0.70 μm in all of the bright region spectra. This band has been interpreted as the $^6A_1 \rightarrow {}^4T_2(^4G)$ electronic transition of Fe^{3+} [9]. This feature provides evidence of crystalline iron oxides in the martian bright regions, and combined with previous data sets provide further support for the presence of hematite on Mars [9,10]. Analysis has shown that dark region spectra in general show less evidence of crystalline absorption features than bright regions. The near-IR (0.7-0.8 μm) slopes of the dark region spectra appear to be steeper than those in the bright regions, possibly indicating deeper absorption at 0.9-1.1 μm. Data reduction and subsequent analysis of similar 1990 data covering the 0.5-0.95 μm region will be useful in determining the relationship between absorption near 1.0 μm (indicative of Fe^{2+} mineralogy) and albedo.





References: [1] Bell J.F. III, P.G. Lucey, T.B. McCord (1990) *Proc. Lunar Planet. Sci. Conf. XX,* 479-486. [2] Lucey P.G. *et al.* (1991) *Proc. Lunar Planet. Sci. Conf XXI,* in press. [3] Goetz A.F.H. *et al.* (1985) *Science, 228,* 1147-1153. [4] Adams J.B. *et al.* (1991) in *Remote Geochemical Analysis* (Pieters and Englert, Eds.), in press. [5] Bell J.F. III, T.B. McCord, P.G. Lucey (1989) *Lunar and Planet. Sci. XX (abstract),* 56. [6] Singer R.B. *et al.* (1990) *Lunar and Planet. Sci. XXI (abstract),* 1164-1165. [7] McCord T.B. and J.A. Westphal (1971) *Astrophys. J., 168,* 141-153. [8] McCord T.B., J.H. Elias, and J.A. Westphal (1971) *Icarus, 14,* 245-251. [9] Bell J.F. III, T.B. McCord, P.D. Owensby (1990) *J. Geophys. Res., 95,* 14447-14461. [10] Morris R.V. *et al.* (1989) *J. Geophys. Res., 94,* 2760-2778.

Acknowledgments: We thank the UH MKO 88" day crew, operators, and TAC for their support. This research supported by NASA Planetary Astronomy Grant NSG-7323.