ELEMENTAL COMPOSITION VARIATIONS FOR LARGE DUSTY AND ROCKY REGIONS ON MARS USING GAMMA-RAY DATA FROM THE MARS ODYSSEY GAMMA-RAY SPECTROMETER*. L. G. Evans[1], R. D. Starr[2], R. C. Reedy[3], and W. V. Boynton[4], [1]Science Programs, Computer Sciences Corp., Lanham, MD 20706 USA (larry.evans@gsfc.nasa.gov), [2]The Catholic University of America, Washington, D. C. 20064 (richard.starr@gsfc.nasa.gov. [3]Inst. of Meteoritics, MSC03-2050, Univ. New Mexico, Albuquerque, NM 87131 USA (reedy@unm.edu), [4]Lunar & Planetary Laboratory, Univ. Arizona, Tucson, AZ 85721 USA (wboynton@gamma1.lpl.Arizona.edu).

Introduction: The Gamma-Ray Spectrometer (GRS) on the Mars Odyssey spacecraft has been mapping the elemental composition of the surface materials since June 2002. To study elemental composition variations on the martian surface, seven large regions of Mars were selected: 3 very dusty ones and 4 mainly rocky ones. Large regions were used to get good counting statistics on as many gamma-ray peaks as possible from spectrum accumulated by the GRS experiment on Mars Odyssey, including elements with poor counting statistics. Data from TES were used to help select these regions. Gamma-ray peaks for several elements were analyzed. Some results and trends are reported.

Regions on Mars: A global map of thermal inertia [1] was used to select three regions with thick dust covers (low thermal inertia). According to many MOC and THEMIS visible images, there is a thick dust covering in these regions [H. Newsom, priv. comm.]. Four regions were selected with high values of thermal inertia [1] and high concentrations of TES surface types 1 or 2 [2], (two for each type). The regions used are summarized in Table 1. The area of the regions was selected as large as possible to maximize the gamma ray signal (which minimized statistical uncertainties) while keeping the distinct geochemical nature of the region relatively intact. A large region of the planet consisting of the mid-latitude region plus the polar regions free of any seasonal CO_2 frost was also analyzed to compare with the dusty-rocky regions.

Spectral Analysis: Gamma ray spectra summed for these regions using spectra from June 2002 to October 2003 were analyzed with standard peak fitting methods. Concentrations of major, minor, and trace elements were determined using the conversions calculated by MCNPX code at the University of Arizona. Results were obtained for H, Si, Fe, Cl, S, Al, K, Th, and U. The Si and Al values were determined using the strongest neutron inelastic gamma ray lines. Fe, Cl, H and S were determined from the stronger neutron capture gamma ray lines. K, Th, and U were determined from the strongest natural radioactive gamma rays. Calculated uncertainties are based on the statistics of the spectral fitting, including the background continuum and any spacecraft signal inferred above the thick winter southern seasonal CO_2 polar cap.

Table 1. Martian spatial regions analyzed, the main surface covering, location, its thermal inertia (TI) [1], and its TES spectral type [2].

Region	Cover	Lat.	Long.	TI	Type
Amazonis Planitia	Dust	10S-30N	175-210	Low	---
Olympus Mons	Dust	10S-40N	210-260	Low	---
Arabia Terra	Dust	10S-45N	0-30	Low	---
Northern Argyre	Rock	40S-15S	300-330	High	1
Syrtis Major	Rock	20S-20N	55-75	High	1
Acadalia Planitia	Rock	20N-50N	300-340	High	2
Utopia Planitia	Rock	35N-50N	80-140	High	2
Frost Free	All	45S-45N	0-360	---	---

Results: Within the sub-regions that make up the regions, there were some variations in composition, though the statistical uncertainties make these somewhat difficult to compare.

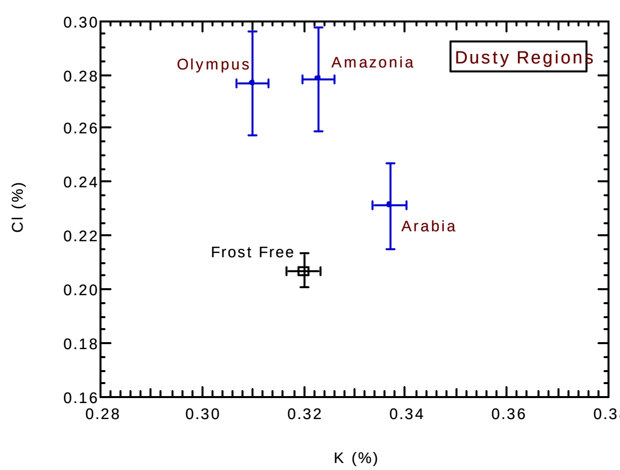

Fig. 1. Cl and K abundances for the 3 large dusty regions.

Fig. 1 shows a plot of Cl versus K is shown for the three dusty sub-regions, which each have distinct K values. Arabia Terra appears to have less Cl than the other two.

In comparison, Fig. 2 shows that the Dusty region has more Cl than either Rocky region, but the Rocky2 region has more K than either the Dusty or Rocky1 region.

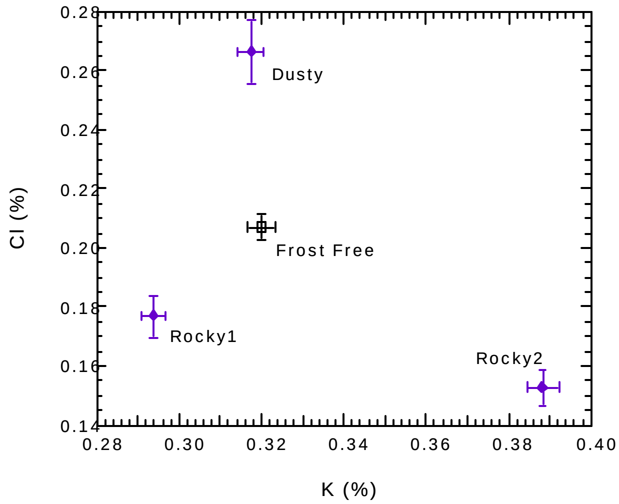

Fig. 2. K and Cl abundances for regional types.

Results for the two Rocky regions show significant difference in composition for K and Th. However, the K/Th ratios for the two Rocky regions are similar. Preliminary results for U show much scatter and a poor correlation with Th. Preliminary Al abundances roughly correlate with Si abundances. Elements that do not show much variation in composition (within the uncertainties) that were analyzed with the gamma-ray data are Fe and S.

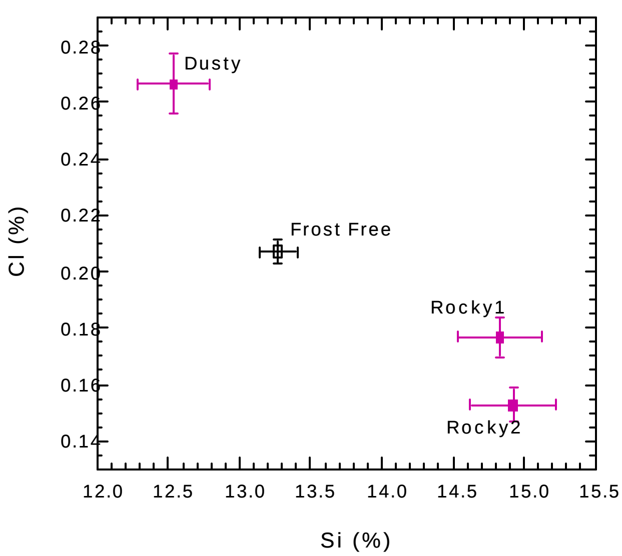

Fig. 3. Cl and Si abundances for regional types.

Two further composition comparisons between the Dusty and Rocky regions are shown in figures 3 and 4.

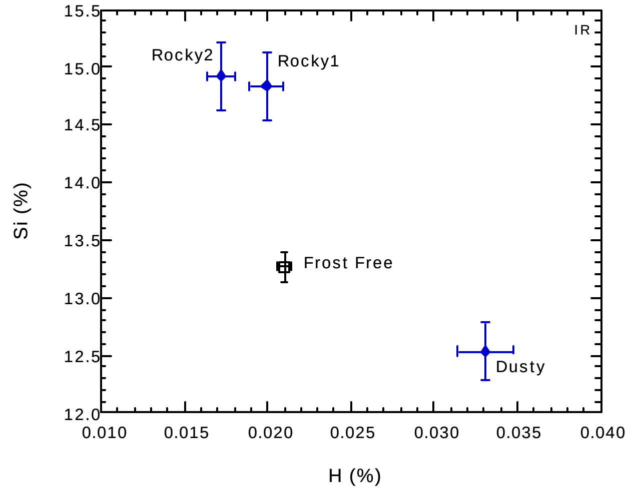

Fig. 4. Si and H abundances for the regional types.

Discussion: The variations among these three regions are compared to the Pathfinder APXS results [3] for soil and rock compositions in Table 2. However, Pathfinder results represent only a very small spatial region compared to the size of the regions analyzed by the gamma ray measurements.

Table 2. Rock and dust trends for several elements for our results and from the Pathfinder APXS [3].

Element	Pathfinder	Our Results
K	Rock > Soil	Rocky2>Dusty>Rocky1
Cl	Soil > Rock	Dusty>Rocky1, Rocky2
Si	Rock > Soil	Rocky1, Rocky2>Dusty
Al	Rock > Soil	Rocky1>Rocky2, Dusty

Often, similar regions are not the same. However, the use of several large regions of a similar type allows us to study variations for several elements, including some, like U, AL, and S, with poor counting statistics.

References: [1] Mellon M. T. et al. (2002) *LPS XXXIII*, Abstract #1416. [2] Bandfield J. L. et al. (2000) *Science 287*, 1626-1630. [3] Bruckner J. et al. (2001) *LPS XXXII*, Abstract #1293. *This work was supported by NASA's Mars Odyssey Program. We thank the GRS team members at the University of Arizona for preparing the database and for their assistance.