MAPS OF ELEMENTAL ABUNDANCES ON THE SURFACE OF MARS.

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Introduction: In this work we present maps of K, Th, Si, Fe, Cl, and H abundance distribution over the low and middle latitudes of Mars. The distribution of the elements in the polar regions are difficult to map quantitatively, as the very high ice content both dilutes the elemental abundance as well as significantly alters the flux of thermal neutrons, which are the excitation source of all but the first two elements in the list above.

Data Processing: Maps of the two radioactive elements, K and Th, are made directly from their decay constants and the observed gamma-ray flux. The abundances of the other four elements, which produce gamma rays following the capture of thermal neutrons, are first calculated as element/Si ratios, which removes the uncertainties in the flux of thermal neutrons at the surface. The ratios are converted to elemental abundances by multiplying by Si abundances determined via fast neutron interactions. (The fast neutron flux at the surface can be estimated from the orbital measurements.) The Si map is normalized to a Si abundance of 21.1% at the location of the Mars Pathfinder landing site

Results: The data show that Mars has a significant contrast in elemental composition over different regions.

Silicon. Silicon shows only modest variation over the surface. It ranges from about 18% Si (+/- 0.4%) to 23% Si (+/- 0.8%) with the lower values being associated with the Tharsis volcanoes and other basaltic lava flows.

Iron. Iron shows a much greater than expected range in composition. The northern lowlands have higher iron content; most areas are in the range of 11% to 14.5% Fe, which overlaps the low end of the SNC meteorite range. The highlands, on the other hand, have much lower Fe content; most areas are in the range of 8 to 11% Fe, which is much lower than in the SNC meteorites

Hydrogen. Hydrogen shows a wide variation in abundance in the low to middle latitudes. Excluding the regions where H increases toward the poles due to sub-surface ice, we see a variation from about 0.85% to 7.5% H_2O. The areas of greatest enrichment are the dusty region of Arabia as well as the region antipodal to Arabia.

Chlorine. Chlorine also shows a wide range in composition. There is a region of remarkably high Cl content, up to 1.1% Cl, west of Tharsis in a region called Madusa Fossae. This region is thought to be an ignimbrite, or ash-fall deposit, and the high Cl abundance is probably associated with this formation. It is remarkable in that even though this region is being eroded by winds, the high Cl is confined to this one area. The Cl distribution over the remaining area shows a correlation with the distribution of H, suggesting both are associated with weathering.

Potassum. Potassium is strongly enriched in the region of Mars that corresponds to the TES surface type-2 region (andesite or weathered basalt) and is much less abundant elsewhere. The lowest K abundance, around 0.25 % K occurs in the regions of basaltic lava flows.

Thorium. Thorium shows a similar distribution to K and is strongly correlated with it. The K/Th ratio, however, is not constant, as normally expected from igneous processes, suggesting that weathering may be at least partly responsible for the distribution of these elements.