

## **IN SITU MEASUREMENT OF HYDRATION OF MARTIAN SOILS AND ROCKS USING THE SCATTER COMPONENT OF THE XRF SPECTRUM**

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Neutron spectra from the Mars Odyssey orbiter provide evidence for widespread hydrogen in Martian equatorial latitudes; its concentration is equivalent to 2 - 10% water in the top 1 m of the surface material. Infra-red absorption features mapped by the Mars Express orbiter suggest the existence of mono- and poly-hydrated sulfates. The spatial resolution of these methods is  $\sim 1$  km. The first detailed in situ analysis on Mars was performed using XRF and alpha particle backscatter on 12 rock and soil samples during the Pathfinder mission. Excess oxygen detected in some rocks by Pathfinder's alpha mode was attributed to water content up to 4%; however the sampling depth of only 1  $\mu\text{m}$  leaves open the possibility that the observed effects may reflect surface alteration.

The alpha particle X-ray spectrometers (APXS) on board the Mars Exploration Rovers employ simultaneous PIXE and XRF for in situ elemental analysis. We are using the Rayleigh/Compton scatter ratio of the exciting photons to probe for the presence of light elements that are invisible to the APXS. The R/C value is extracted by fitting the X-ray spectra, and it is simulated by a Monte Carlo calculation which takes the APXS element concentrations as input. Calibration measurements using a suite of geostandards establish a quantity K which is the ratio of measured and simulated scatter ratios.

The average K value for typical basaltic soils and rocks agrees closely with the calibration. This outcome is to be expected, since the presence of water-soluble olivine shows that these soils are "dry", and it provides strong support for our method. However, significant departures are observed for the K values of several bright, white sub-surface soils, all of which have very high sulfate content, and some of which have iron predominantly in the ferric state. From our results we can extract the water fraction (which ranges as high as  $\sim 20\%$ ). The results are in good agreement with optical and mineralogical evidence, and they help to constrain the mineralogy. This is an important step forward in the search for water reservoirs on Mars.