Enigmatic Linear Patterns of Hydrogen Concentration on Mars

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Chemically or physically bound hydrogen within a meter of the Martian surface has been mapped using neutron spectroscopy [1]. The Neutron Spectrometer, part of the Gamma-Ray Spectrometer on board Mars Odyssey, is able to detect thermal, epithermal and fast neutron fluxes. Each of these have specific energy ranges with epithermal neutron energy ranging from 0.4 – 500 keV. This band is the most sensitive for hydrogen mapping purposes. Regions with high hydrogen concentrations have a low epithermal energy flux.

These concentrations are believed to indicate locations of subsurface water ice. As such the flux maps pinpoint locations where small quantities of liquid water may intermittently form today or where liquid water may have pooled in the past. The possibility of life existing on Mars – either in the distant past or at present – depends on the availability of liquid water.

Epithermal neutron flux maps of the equatorial region east of Schiaparelli Crater in Mars' eastern hemisphere indicate hydrogen ion concentrations in the shallow subsurface with a hydrogen water equivalent of just over 10 percent [1]. Published maps [2] reveal anomalous linear concentrations of hydrogen with a northeast to southwest trend. The width and trend of these linear anomalies match those of the graben between Scylla Scopulus and Charybdis Scopulus, west of Hellas Basin.

These linear ion concentrations suggest structural control of the hydrogen. Structural control of fluids can be attributed to fault activity or structural topography. Terrestrial faults are known to exert a strong control on groundwater flow immediately after earthquake events. Subsurface faults may also act as a barrier to fluid flow, creating a confined channel or aquifer within the width of the graben. Alternatively, the graben may have acted as a topographic control on surface water accumulation in the past. Any seepage of this water into the subsurface may have resulted in a hydrogen ion fingerprint in graben valleys, resulting in the linear patterns observed.

References:

[1] Feldman, W.C. et al. (2002) *Science* 297, 75-78.

[2] Boynton, W.V. et al. (2002) *Science* 297, 81-85.