VOLATILE-DRIVEN MORPHOLOGIES RELATING TO ZONES OF HIGH WEH IN XANTHE TERRA.

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Introduction: The Mars Odyssey Neutron Spectrometer has detected concentrations of hydrogen within the upper few decimeters of the martian surface using counts of thermal, epithermal, and fast neutrons [1]. Hydrogen concentrations are interpreted in terms of mass fractions of H_2O , which is most likely in the form of ice at the highest latitudes and subsurface deposits of chemically/physically bound H_2O and/or OH in the low to middle latitudes. A map of WEH concentrations can be seen in Figure 1.

Prominent low to mid-latitude regions having moderate hydrogen concentration include western Xanthe Terra (Fig. 2), northeast of Vallis Marineris and centered near Shalbatana Vallis, and eastern Hellas Planitia in the southern hemisphere. Both regions are densely cratered and contain extensive and widespread channel systems. Relatively small impact craters (100's of meters in diameter) and channels (10's of meters in relief) can provide important clues to the history of volatiles within the upper few meters of crustal materials. In addition, relatively thin mantles (a few meters), and/or stacks of these, that display evidence for ductile flow (such as lobate fronts) may also be used to investigate the concentration of volatiles in the upper few meters of crustal materials.

Impact craters in the eastern Hellas region have been thoroughly surveyed for evidence of volatile related degradation [2]. Numerous morphologies indicative of the deposition and flow of volatile-rich sediments are present on the walls and floors of craters in

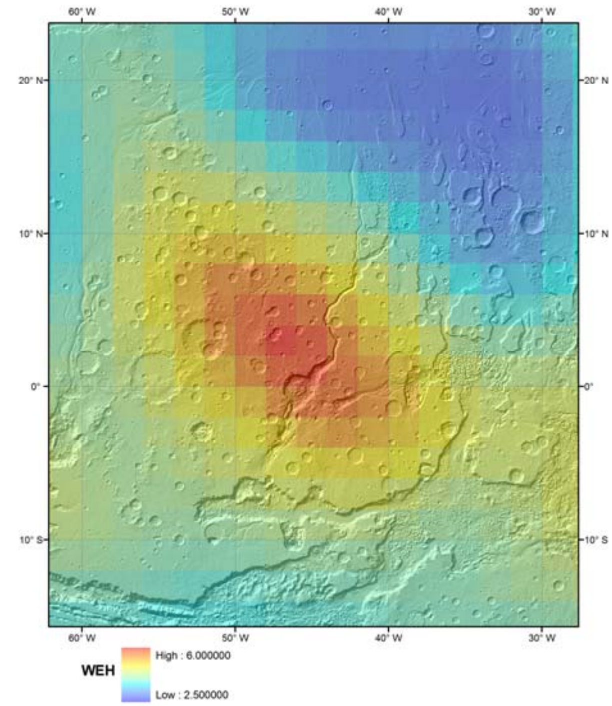

Fig. 2. WEH map over MOLA 128 pix/deg hillshade showing region of relatively high WEH in western Xanthe Terra.

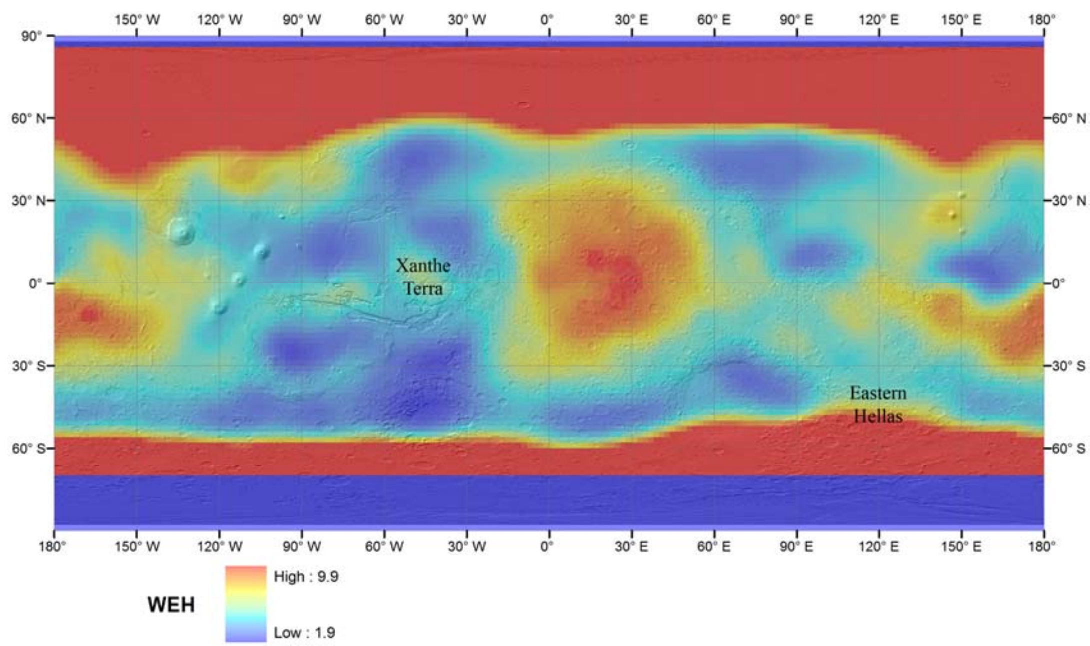

Fig. 1. Water Equivalent Hydrogen map of Mars overlaying a MOLA 128 pixel/degree hillshade map.

this region, including lobate flows, narrow channels, wider valleys, gullies, arcuate ridges, debris aprons, and mantling deposits. These features may have formed by the release of fluids with various degrees of viscosities ranging from that pure water, to hyperconcentrated brines, and/or debris flows, and in some cases, by gravity driven ductile deformation of icy materials. The aim of this project is to utilize new high-resolution images from the MRO CTX and HiRISE instruments, as well as the Mars Odyssey THEMIS VIS instrument, to analyze the morphologies of craters and small channels in Xanthe Terra to look for similar evidence of water-rich degradation (cf. Figs. 3 and 4).

Background: Xanthe Terra is host to numerous features generally thought to have formed due to the release of large amount of ground volatiles such as outflow channels [3], chaotic terrain [4], and smaller channels [5]. Large-scale fluid release and resultant surface flow is interpreted to have been the result of aquifer destruction during multiple stages of chaotic terrain formation and plateau subsidence [3]. Outflow channel activity may have included both catastrophic and non-catastrophic events [4].

Approach: An ArcGIS database has been assembled for the Xanthe Terra region which includes Viking MDIM 2.1 and THEMIS IR basemaps, MOLA 128 pixel/degree elevation maps, water equivalent Hydrogen (WEH) maps (Fig. 1), and all current THEMIS VIS, CTX, and HiRISE images. We will use the GIS software to analyze the morphologies and morphometries of small scale, potentially volatile-driven morphologies in craters and channels.

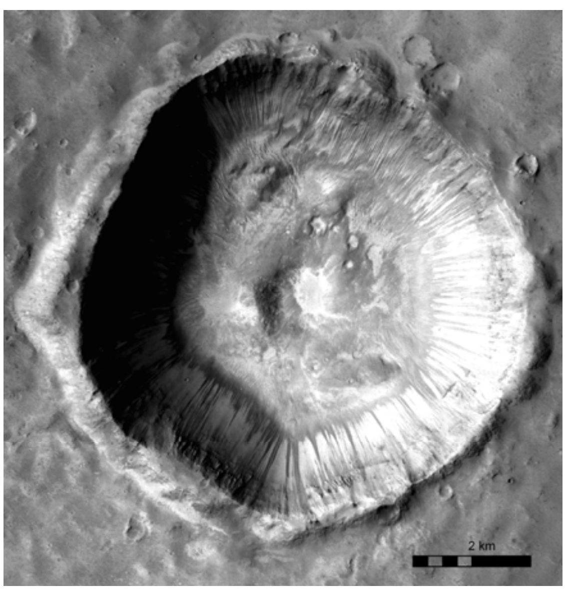

Fig. 3. Small crater within CTX image P19_008536_1890 showing potentially fluvial features on its walls, centered at 8.8°N, 314° E.

Since the neutrons can only detect WEH in the upper few decimeters of the surface, we will analyze small-scale features visible in CTX and HiRISE images. Large scale features indicative of volatile-driven activity such as outflow channels and chaotic terrain are found in regions mapped as having low WEH; therefore, only features on a scale similar to the known depth of the WEH layer can be examined to find a correlation.

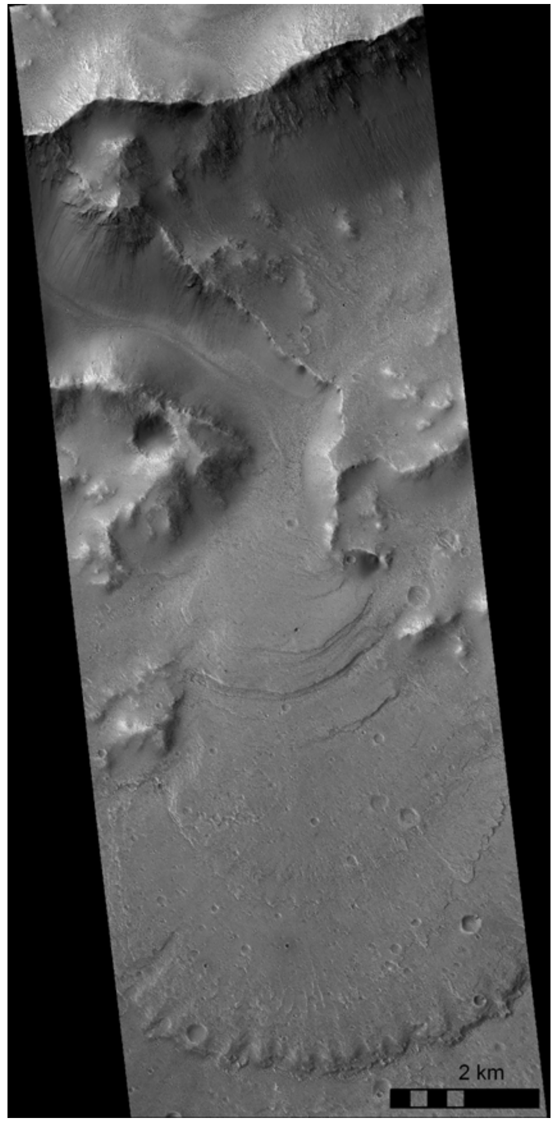

Fig. 4. Depositional fan along the northern rim of a crater in HiRISE image PSP_007732_1825, centered at 2.7° N, 308.3° E.

References: [1] Feldman, W.C., et al., JGR-Planets, (109), 2004. [2] Berman, D.C., Crown D.A., and Bleamaster, L.F., III, Icarus, in press, 2009. [3] Nelson, D.M. and Greeley, R., J. Geophys. Res. 104 (E4), 8653-8669, 1999. [4] Rodriguez, J.A.P, et al., Icarus 175, 36-57, 2005. [5] Rodriguez, J.A.P., et al., Icarus 191, 545-567, 2007.