THE ROLE OF AQUEOUS ALTERATION IN THE FORMATION OF MARTIAN SOILS J. L. Bandfield[1], A. D. Rogers[2], and C. S. Edwards[3]. [1]Department of Earth and Space Sciences, University of Washington, Seattle (joshband [at] u.washington.edu). [2]Department of Geosciences, Stony Brook University, NY. [3]School of Earth and Space Exploration, Arizona State University, Tempe.

A major focus of martian exploration is to understand how much and under what conditions liquid water has been present throughout martian history. Elemental composition and mineralogy can give a positive indication of the presence of liquid water at the time of formation. Compositional trends are also indicative of alteration under specific conditions and both orbital and in situ observations have provided an increasingly detailed picture of properties such as the pH and abundance of water present [e.g. *1-3*]. Despite the evidence for aqueous processes at many martian locations, martian equatorial dark regions (Surface Type 1 of [*4*]) have been interpreted as dominated by unweathered materials that have not been significantly altered from the source material. The suite of minerals is consistent with a basaltic composition and there was no need to invoke additional processes to explain the origin of these materials.

We have begun to question this result based on detailed observations from a variety of datasets [*5-6*]. Both local and global observations indicate a link between source rocks and dark soils on Mars. Locally derived dark soils have a mineralogy distinct from that of proximal rocky surfaces; most notably a lower olivine content (Fig. 1). This pattern is common for many surfaces across the planet. Detailed measurements at the Gusev Plains indicate a similar mineralogical relationship. However, APXS results [*7*] do not show elemental abundances consistent with significant mineralogical differences (except in S content) between rocks and dark soils (Fig. 2). This apparent disparity can be explained by “cation conservative” weathering. This process can significantly alter the mineralogy of a surface, but water is limited enough to prevent significant transportation of cations away from the source rock. The elemental and mineralogical relationships between rocks and soils appears to indicate that aqueous alteration is an important process in the formation of the martian dark soils that cover much of equatorial Mars.

References: [1] Hurowitz, J.A. et al. (2006) *JGR*, 111, 10.1029/2005JE002515. [2] Poulet, F. et al. (2005) *Nature*, 438, 623-627. [3] Ming, D.W. et al. (2006) *JGR*, 111, 10.1029/2005JE002560. [4] Bandfield, J.L. et al. (2000) *Science*, 287, 1626-1630. [5] Bandfield, J.L. and A.D. Rogers (2008) *Geology*, 36, 10.1130/G24724A.1. [6] Rogers, A.D. et al. (2009) *Icarus*, 200, 10.1016/j.icarus.2008.11.026. [7] Rieder, R. et al. (2004) *Science*, 306, 1746-1749.

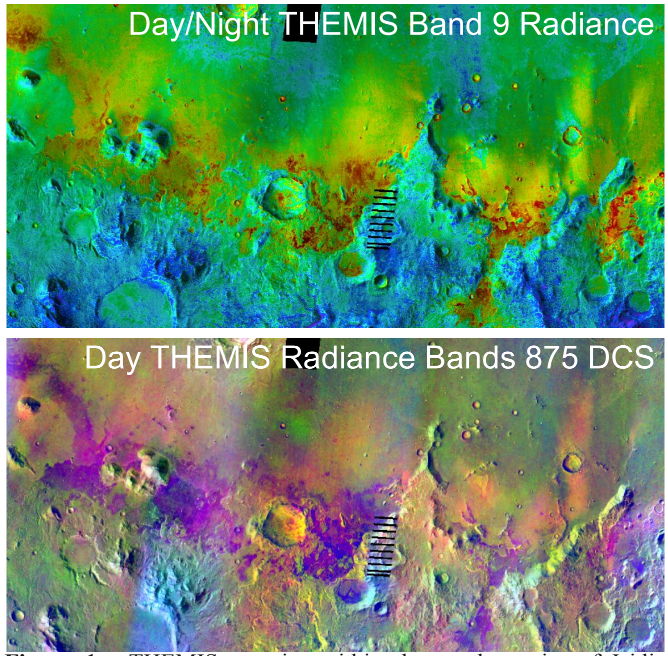

Figure 1. THEMIS mosaics within the southern rim of Isidis Basin, centered near 86E, 4N. The top image shows nighttime radiance in color with daytime radiance for topography. Warmer temperatures (yellow, and red) indicate rockier surfaces. The bottom decorrelation stretch image shows magenta and purple colors that indicate olivine-rich surfaces. Note the correlation of rocky and olivine-rich surfaces. The mosaics are`~300 km across.

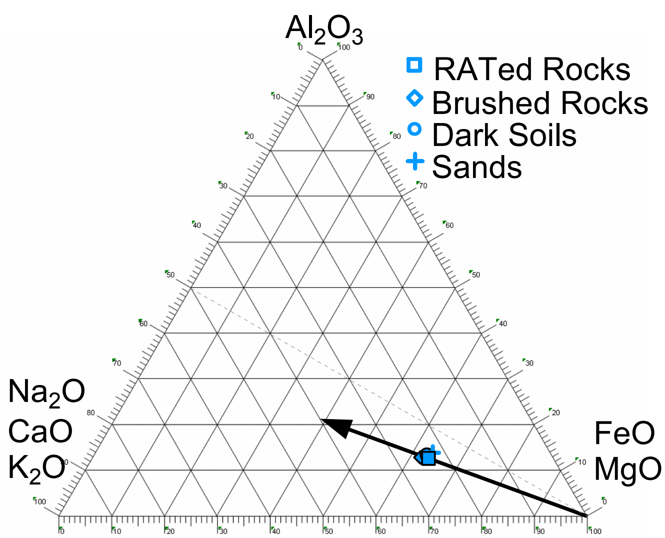

Figure 2. Ternary FeO_T+MgO, Al_2O_3, CaO+Na_2O+K_2O diagram (after that of [*1*]) with the black arrow showing the weathering trend expected under martian conditions. Data are in mole percent from APXS chemistry [*7*] and are averages of rocks and dark soils within the Gusev Plains. The chemical composition of the different materials are similar despite significant differences in mineralogy indicated by mini-TES and Mössbauer measurements.