

**CHEMICAL AND MINERALOGICAL ESTIMATES OF PHYLLOSILICATES IN MARTIAN SOILS AT THE MER LANDING SITES.** I. O. McGlynn<sup>1</sup>, H. Y. McSween<sup>1</sup>, C. M. Fedo<sup>1</sup>, A. D. Rogers<sup>2</sup>, <sup>1</sup>Department of Earth and Planetary Sciences and Planetary Geosciences Institute, University of Tennessee, Knoxville, TN 37996-1410 (imcglynn@utk.edu), <sup>2</sup>Department of Geosciences, Stony Brook University, Stony Brook, NY 11792-2100.

**Introduction:** Phyllosilicates are the most common product of water-rock interactions on Earth but are relatively uncommon on Mars. Orbital remote sensing from the Mars Express and Mars Reconnaissance Orbiter spacecraft have identified iron-bearing clays (chamosite and nontronite) and aluminum-bearing clays (montmorillonite [1], kaolinite, and saponite [2]). The presence of clays in geographically widespread settings indicates significant Noachian aqueous activity. Despite these discoveries, large quantities of clay minerals have not been found on the surface.

For six years the Mars Exploration Rovers (MER) Spirit and Opportunity have surveyed soil targets over long traverses in Gusev Crater and Meridiani Planum, resulting in the most detailed characterization of sediments beyond the Earth. Soils are produced largely by physical weathering unaltered basalts and may have complex provenance incorporating mixing on local, and global scales, trituration by impact gardening, and abrasion from aeolian processes. Evidence of aqueous alteration has been found in from of sulfate salts [3], goethite [4] and hematite [5], and chemical alteration from hydrothermal fluids [6], but are not as pervasive as expected. The purpose of this study is to estimate the phyllosilicate components in soils and evaluate the potential for aqueous alteration in soil formation and identify aqueous-limited alteration pathways.

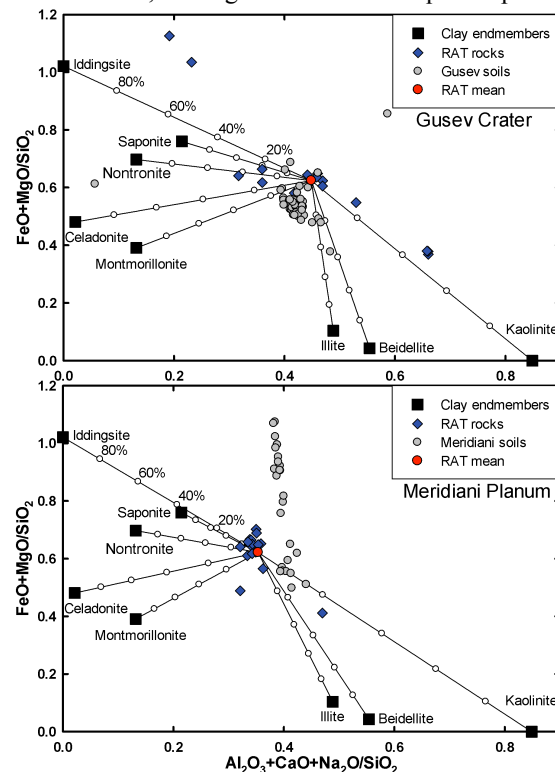
**Unresolved Phyllosilicates:** Sulfur- and chlorine-rich silt-sized dust may contain remnants of Noachian phyllosilicates at quantities insufficient for detection by the MER rovers. Chemical mixing models have been developed to evaluate the dissolution of the easily weathered basaltic component olivine as FeO+MgO, the loss of feldspars as CaO+Na<sub>2</sub>O, and the accumulation of Al<sub>2</sub>O<sub>3</sub> as aluminum-bearing clays such as kaolinite. Uncertainties in protolith compositions can be minimized by plotting the mobility of soluble components relative to presumably immobile SiO<sub>2</sub> or TiO<sub>2</sub>. The average composition of rocks abraded by the rock abrasion tool (RAT) is representative of the unaltered, mostly dust-free, igneous source for each landing site. Common clay minerals can be added to RATed rock means to model basaltic soils with alteration products.

As depicted in figure 1, most undisturbed Gusev soils can be compositionally explained as basalt with a 10-20% clay contribution of celadonite, illite, montmorillonite, or beidellite. Most undisturbed soils in Meridiani Planum cannot be formed from a basalt-clay mixture, indicating the source material may be compositionally distinct from local basalts.

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The quantities of alteration components are evaluated independently with the Mini-Thermal Emission Spectrometer (Mini-TES). Spectra acquired for Gusev soils in from Sols 89-126 indicate 4 wt% phyllosilicates, lower than the modeled mixing composition for Gusev Crater. Reported Mini-TES results for Meridiani Planum soils are 5 wt% phyllosilicates [7], well above the chemical mixing modeled abundance.

Soils in Gusev Crater and Meridiani Planum do not contain large quantities of clay minerals that have been detected remotely in some other locations on Mars. Small quantities of clays may be present at the MER landing sites, not as locally altered products but as Noachian clays intermixed with dust deposits. Any clays formed locally were probably buried by younger volcanic flows, erasing evidence of an aqueous past.



**References:** [1] Bibring J.-P. et al. (2006) *Science*, 312, 400-404. [2] McKeown, N. K. (2009) *JGR*, 114, E00D10. [3] Squyres S. W. et al. (2004) *Science*, 306, 1709-1714. [4] Klingelhöfer G. et al. (2006) *Hyperfine Interactions*, 166, 549-554. [5] Arvidson R. E. et al. (2006) *JGR*, 111, E12S08. [6] Squyres S. W. et al. (2008) *Science*, 320, 1063-1067. [7] Rogers, A. D., and O. Aharonson (2008) *JGR*, 113, E06S14.