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An experimental flow-through assessment of acidic Fe/Mg smectite formation on early Mars

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Abstract Text:

Orbital observations have detected the phyllosilicate smectite in layered material hundreds of meters thick, intracrater depositional fans, and plains sediments on Mars; however, the detection of carbonate deposits is limited. Instead of neutral/alkaline conditions during the Noachian, early Mars may have experienced mildly acidic conditions derived from volcanic acid-sulfate solutions that allowed Fe/Mg smectite formation but prevented widespread carbonate formation. The detection of acid sulfates (e.g., jarosite) associated with smectite in Mawrth Vallis supports this hypothesis. Previous work demonstrated smectite (saponite) formation in *closed hydrologic systems* (batch reactor) from basaltic glass at pH 4 and 200°C (Peretyazhko et al., 2016 GCA). This work presents results from alteration of basaltic glass from alkaline to acidic conditions in *open hydrologic systems* (flow-through reactor). Preliminary experiments exposed basaltic glass to deionized water at 190°C at 0.25 ml/min where solution pH equilibrated to 9.5. These initial high pH experiments were conducted to evaluate the flow-through reactor system before working with lower pHs. Smectite at this pH was not produced and instead X-ray diffraction results consistent with serpentine was detected. Experiments are in progress exposing basaltic glass from pH 8 down to pH 3 to determine what range of pHs could allow for smectite formation in this experimental open-system. The production of smectite under an experimental open-system at low pHs if successful, would support a significant paradigm shift regarding the geochemical evolution of early Mars: Early Mars geochemical solutions were mildly acidic, not neutral/alkaline. This could have profound implications regarding early martain microbiology where acid conditions instead of neutral/alkaline conditions will require further research in terrestrial analogs to address the potential for biosignature preservation on Mars (Johnson et al., 2016, LPSC).

Session Selection:

Nature and Evolution of Climate and Water on Early Mars

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