

Title: In-Situ Mineralogy of the Orbitally Defined Clay- and Sulfate-Bearing Units in Gale Crater, Mars

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Gale crater was selected as the Mars Science Laboratory *Curiosity* rover's landing site, in part, because of orbital detection of secondary minerals in ~3.5 Ga sedimentary rocks. Secondary minerals include Fe/Mg-smectite, hydrated Mg-sulfate, and hematite. The observed transition from clay minerals to hydrated Mg-sulfate going up stratigraphic section through the Mount Sharp Group was interpreted to signify a change in climate that may have occurred across Mars. The CheMin X-ray diffractometer on *Curiosity* has analyzed dozens of drill samples from units with secondary mineral absorptions from orbit. Quantitative mineralogical results from CheMin demonstrate spatially abrupt changes in mineral assemblages that may be from variations in depositional, early diagenetic, and late diagenetic environments. We hypothesize that smectite is a marker of fluvial-lacustrine depositional environments and that Fe(II)-carbonate, hydrated Mg-

sulfate, gypsum, and halite represent early diagenetic products of near-surface groundwater freezing/evaporation in eolian environments. We present a late-diagenetic groundwater mixing model in which warm, oxic and acidic basinal brines ascended through fluvial-lacustrine and some eolian strata to cause the formation of Fe(III)-oxides, -oxyhydroxides, and -smectite and mobilization of transition metals. These warm brines mixed with cool, reducing groundwater at a local aquiclude called the Amapari Marker Band, causing high concentrations of Fe, Zn, and Cl.