Three years into exploration of sediments in Gale crater on Mars, the Mars Science Laboratory rover Curiosity has provided data on several modes and episodes of diagenetic mineral formation. Curiosity determines mineralogy principally by X-ray diffraction (XRD), but with supporting data from thermal-release profiles of volatiles, bulk chemistry, passive spectroscopy, and laser-induced breakdown spectra of targeted spots. Mudstones at Yellowknife Bay, within the landing ellipse, contain ~20% phyllosilicate that we interpret as authigenic smectite formed by basalt weathering in relatively dilute water, with associated formation of authigenic magnetite as in experiments by Tosca and Hurowitz [Goldschmidt 2014]. Varied interlayer spacing of the smectite, collapsed at ~10 Å or expanded at ~13.2 Å, is evidence of localized diagenesis that may include partial intercalation of metal-hydroxyl groups in the ~13.2 Å material. Subsequent sampling of stratigraphically higher Windjana sandstone revealed sediment with multiple sources, possible concentration of detrital magnetite, and minimal abundance of diagenetic minerals. Most recent sampling has been of lower strata at Mount Sharp, where diagenesis is widespread and varied. Here XRD shows that hematite first becomes abundant and products of diagenesis include jarosite and cristobalite. In addition, bulk chemistry identifies Mg-sulfate concretions that may be amorphous or crystalline.

Throughout Curiosity's traverse, later diagenetic fractures (and rarer nodules) of mm to dm scale are common and surprisingly constant and simple in Ca-sulfate composition. Other sulfates (Mg,Fe) appear to be absent in this later diagenetic cycle, and circumneutral solutions are indicated. Equally surprising is the rarity of gypsum and common occurrence of bassanite and anhydrite. Bassanite, rare on Earth, plays a major role at this location on Mars. Dehydration of gypsum to bassanite in the dry atmosphere of Mars has been proposed but considered unlikely based on lab studies of dehydration kinetics in powdered samples. Dehydration is even less likely for bulk vein samples, as lab data show dehydration rates one to two orders of magnitude slower in bulk samples than in powders. On Mars, exposure ages of 100 Ma or more may be a significant factor in dehydration of hydrous phases.
Primary Selection:
T132. Mineralogy of Diagenesis on Earth and Mars: In Honor of Nicholas J. Tosca, 2015 MSA Awardee

Abstract Title:
DIAGENETIC MINERALOGY AT GALE CRATER, MARS

Preferred Presentation Format:
Oral

Discipline Categories:
Planetary Geology

Abstract Submission Fee:
Paid (gsa-2015AM-4363-5274-0688-6422)

Presenting Author
David Vaniman
Planetary Science Institute
1700 East Fort Lowell Road, Suite 106
Tucson, AZ 85719
Phone Number: 805-328-1590
Email: dvaniman@psi.edu
Student? N

David Blake
NASA Ames Research Center
MS 239
NASA Ames Research Center
Moffett Field, CA 94035
Phone Number: N/A
Email: david.blake@nasa.gov
Student? N

Thomas F. Bristow
NASA Ames Research Center
MS 239
Exobiology
Moffett Field, CA 94035
Phone Number: 650-604-4665
Email: thomas.f.bristow@nasa.gov
Student? N

Steve Chipera
Chesapeake Energy
Oklahoma City, OK 73154
Phone Number: 405-431-9846
Email: steve.chipera@chk.com
Student? N

Ralf Gellert
University of Guelph
Dept. of Physics
Guelph, ON N1G 2W1
Canada
Phone Number: 519-824-4120 x53992
Email: rgellert@uoguelph.ca
Student? N

Douglas W. Ming
NASA Johnson Space Center
Mail Code KX
NASA Johnson Space Center
Astromaterials Research and Exploration Science Directorate
Houston, TX 77058
Phone Number: 281-483-5839
Email: douglas.w.ming@nasa.gov

Richard Morris
NASA Johnson Space Center
Houston, TX 77058
Phone Number: 281-989-1362
Email: richard.v.morris@nasa.gov
Student? N

E.B. Rampe
NASA Johnson Space Center
Astromaterials Research and Exploration Science
Houston, TX 77058
Phone Number: 281-483-0216
Email: elizabeth.b.rampe@nasa.gov
Student? N

William Rapin
IRAP/UPS
Toulouse,
France
Email: william.rapin@irap.omp.eu
Student? N