Abstract #268081

AQUEOUS ALTERATION ON MARS: EVIDENCE FROM LANDED MISSIONS

MING, Douglas W., Astromaterials Research and Exploration Science Division, NASA Johnson Space Center, Mail Code XI, NASA Johnson Space Center, Houston, TX 77058, MORRIS, Richard V., Astromaterials Research and Exploration Science Division, NASA Johnson Space Center, Mail Code XI, Houston, TX 77058, CLARK III, Benton C., Space Science Institute, Boulder, CO 80301, YEN, Albert S., Jet Propulsion Laboratory, California Institute of Technology, Pasadena, CA 91109 and GELLERT, Ralf, Department of Physics, University of Guelph, Guelph, ON N1G 2W1, Canada, douglas.w.ming@nasa.gov

Mineralogical and geochemical data returned by orbiters and landers over the past 15 years have substantially enhanced our understanding of the history of aqueous alteration on Mars. Here, we summarize aqueous processes that have been implied from data collected by landed missions. Mars is a basaltic planet. The geochemistry of most materials has not been “extensively” altered by open-system aqueous processes and have average Mars crustal compositions. There are few examples of open-system alteration, such as Gale crater’s Pahrump Hills mudstone. Types of aqueous alteration include (1) acid-sulfate and (2) hydrolytic (circum-neutral/alkaline pH) with varying water to rock ratios. Several hypotheses have been suggested for acid-sulfate alteration including (1) oxidative weathering of ultramafic igneous rocks containing sulfides, (2) sulfuric acid weathering of basaltic materials, (3) acid fog weathering of basaltic materials, and (4) near-neutral pH subsurface solutions rich in Fe$^{2+}$ that rapidly oxidized to Fe$^{3+}$ producing excess acidity. Meridiani Planum’s sulfate-rich sedimentary deposit containing jarosite is the most “famous” acid-sulfate environment visited on Mars, although ferric sulfate-rich soils are common in Gusev crater’s Columbia Hills and jarosite was recently discovered in the Pahrump Hills. An example of aqueous alteration under circum-neutral pH conditions is the formation of Fe-saponite with magnetite in situ via aqueous alteration of olivine in Gale crater’s Sheepbed mudstone. Circum-neutral pH, hydrothermal conditions were likely required for the formation of Mg-Fe carbonate in the Columbia Hills. Diagenetic features (e.g., spherules, fracture filled veins) indicate multiple episodes of aqueous alteration/diagenesis in most sedimentary deposits. However, low water-to-rock ratios are prominent at most sites visited by landed missions (e.g., limited water for reaction to form crystalline phases possibly resulting in large amounts of short-range ordered materials and little physical separation of primary and secondary materials). Most of the aqueous alteration appears to have occurred early in the planet’s history; however, minor aqueous alteration may be occurring at the surface today (e.g., thin films of water forming carbonates akin to those discovered by Phoenix).

Abstract ID#: 268081
Password: 861649
Meeting: 2015 GSA Annual Meeting in Baltimore, Maryland, USA (1-4 November 2015)
Session Type: Topical Session
Primary Selection: T177. When Water Meets Rock: Aqueous Alteration in the Solar System
Abstract Title:
AQUEOUS ALTERATION ON MARS: EVIDENCE FROM LANDED MISSIONS

Preferred Presentation Format:
Oral

Discipline Categories:
Geochemistry Mineralogy/Crystallography Planetary Geology

Abstract Submission Fee:
Paid (gsa-2015AM-9870-3237-6511-2337-6511-2339)

Presenting Author
Douglas W. Ming
NASA Johnson Space Center
Mail Code XI
NASA Johnson Space Center
Astromaterials Research and Exploration Science Division
Houston, TX 77058

Phone Number: 281-483-5839
Email: douglas.w.ming@nasa.gov

Richard V. Morris
NASA Johnson Space Center
Mail Code XI
Astromaterials Research and Exploration Science Division
Houston, TX 77058

Phone Number: 281-483-5040
Email: richard.v.morris@nasa.gov

Student? N
Benton C. Clark III
Space Science Institute
Boulder, CO 80301

Phone Number: 7209745888
Email: bclark@spacescience.org

Student? N
Albert S. Yen
California Institute of Technology
Jet Propulsion Laboratory
Pasadena, CA 91109

Email: albert.s.yen@jpl.nasa.gov

Student? N
Ralf Gellert
University of Guelph
Department of Physics
Guelph, ON N1G 2W1
Canada

Phone Number: 519 824 4120
Email: ralf@physics.uoguelph.ca