JOURNAL OF GEOPHYSICAL RESEARCH, VOL. 115, E00D17, doi:10.1029/2009JE003353, 2010

Stratigraphy of hydrated sulfates in the sedimentary deposits of Aram Chaos, Mars

Kimberly A. Lichtenberg,[1] Raymond E. Arvidson,[1] Richard V. Morris,[2] Scott L. Murchie,[3] Janice L. Bishop,[4] David Fernandez Remolar,[5] Timothy D. Glotch,[6] Eldar Noe Dobrea,[7] John F. Mustard,[8] Jeffrey Andrews-Hanna,[9] and Leah H. Roach[8,10]

Received 31 January 2009; revised 1 December 2009; accepted 17 December 2009; published 10 June 2010.

[1] Sedimentary deposits within the 280 km wide crater containing Aram Chaos (~3°N, 339°E) have been differentially eroded by wind to expose a stratigraphic column 900–1000 m thick that unconformably overlies the chaos bedrock. A detailed stratigraphic and mineralogical description of the deposits is presented based on data from the Mars Reconnaissance Orbiter Compact Reconnaissance Imaging Spectrometer for Mars, Context Imager, and High Resolution Imaging Science Experiment. Two sedimentary units overlie the basement chaos material representing the original plains fill in Aram Crater: the first and oldest is composed of (1) a 50–75 m thick dark-toned basal unit containing ferric hydroxysulfate intercalated with monohydrated-sulfate-bearing materials, (2) a 75–100 m thick light-toned unit with monohydrated sulfates, and (3) a 175–350 m thick light-toned resistant capping unit with nanophase ferric oxides and monohydrated sulfates. After a period of wind erosion, these deposits were partially and unconformably covered by the second sedimentary unit, a 75–100 m thick, discontinuous dark-toned unit containing crystalline hematite and polyhydrated sulfate material. These sedimentary deposits were formed by evaporite deposition during at least two distinct rising groundwater episodes fed by regional-scale recharge. Later groundwater event(s) formed the polyhydrated materials, indicating that environmental conditions changed to a higher water-to-rock ratio. Wind has continued to shape the landscape after the last wetting event to produce the features and exposures observed.

Citation: Lichtenberg, K. A., et al. (2010), Stratigraphy of hydrated sulfates in the sedimentary deposits of Aram Chaos, Mars, *J. Geophys. Res.*, *115*, E00D17, doi:10.1029/2009JE003353.

1. Introduction

[2] The discovery from orbit of layered sedimentary hydrated sulfate deposits in analyses of Mars Express Observatoire pour la Minéralogie, l'Eau, les Glaces et l'Activité (OMEGA) data [*Gendrin et al.*, 2005; *Arvidson et al.*, 2006], subsequently confirmed and extended in analyses of Mars Reconnaissance Orbiter (MRO) Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) data [*Murchie et al.*, 2009; *Roach et al.*, 2009], has revolutionized our understanding of the evolution of Mars. The measurements obtained by the Mars Exploration Rover Opportunity during its exploration of the top of a thick sequence of sulfate-rich deposits in Meridiani Planum provide a detailed view of the depositional environment of these types of deposits. Specifically, results point to an acid-sulfate-dominated lacustrine system alternating with more arid conditions in which aeolian deposits accumulated [*Squyres et al.*, 2004; *Grotzinger et al.*, 2005; *Tosca and McLennan*, 2006]. With continued groundwater rise on a regional level the deposits were cemented and preserved [*Arvidson et al.*, 2006; *Andrews-Hanna et al.*, 2007].

[3] In this paper we build on previous studies of Aram Chaos [*Gendrin et al.*, 2005; *Glotch and Christensen*, 2005; *Massé et al.*, 2008b; *Noe Dobrea et al.*, 2008] by contributing (1) detailed mapping of the layered deposits using a combination of MRO Context Imager (CTX) with 5 m/pixel data [*Malin et al.*, 2007], High Resolution Imaging Science Experiment (HiRISE) data with 0.31 m/pixel observations [*McEwen et al.*, 2007], Mars Orbiter Laser Altimeter (MOLA) data at ~465 m/pixel [*Smith et al.*, 2001], and Mars

[1]McDonnell Center for the Space Sciences, Department of Earth and Planetary Sciences, Washington University, Saint Louis, Missouri, USA.
[2]NASA Johnson Space Center, Houston, Texas, USA.
[3]Johns Hopkins University Applied Physics Laboratory, Laurel, Maryland, USA.
[4]SETI Institute, Mountain View, California, USA.
[5]Centro de Astrobiología, INTA-CSIC, Madrid, Spain.
[6]Department of Geosciences, State University of New York at Stony Brook, Stony Brook, New York, USA.
[7]Planetary Science Institute, Tucson, Arizona, USA.
[8]Department of Geological Sciences, Brown University, Providence, Rhode Island, USA.
[9]Department of Geophysics, Colorado School of Mines, Golden, Colorado, USA.
[10]Now at Frontier Technology, Inc., Beverly, Massachusetts, USA.

0148-0227/10/2009JE003353