ASTROBIOLOGY RELEVANT HYPOTHESES FOR THE ORIGIN OF QUARTZ-BEARING MATERIALS IN EOS CHASMA: TESTS FOR THE 2009 MARS SCIENCE LABORATORY. V. E. Hamilton[1], S. L. Cady[2] and P. J. Boston[3], [1]Hawai'i Institute of Geophysics and Planetology, University of Hawaii, 1680 East-West Road, Honolulu, HI 96822 (hamilton@higp.hawaii.edu), [2]Department of Geology, Portland State University, 1721 SW Broadway, 17CH, Portland OR 97201, [3]Earth and Environmental Sciences Department, New Mexico Institute of Mining and Technology, 801 Leroy Place, Socorro, NM 87801.

Introduction: The goals of the 2009 Mars Science Laboratory are to assess the biological potential of the landing site, characterize the geology and geochemistry of that environment, and investigate processes of relevance to past habitability, including the role of water. With the Mars Exploration Rover *Opportunity*'s verification [1] that hematite identified from orbit [2] in Meridiani Planum is water related, the utility of orbital mineralogical information in targeting environments with potential evidence for past water and habitability has been demonstrated. We propose that quartz-bearing materials in Eos Chasma may be indicative of an environment that is characterized not only by aqueous processes, but also once may have been habitable. Relative to other lithologies that contain aqueous minerals, microcrystalline quartz-bearing lithologies (e.g., quartz cherts) have the potential for long-term preservation of chemical and physical evidence of biologic activity.

Quartz-bearing materials in Eos Chasma: [3] recently described the identification of quartz-bearing materials in Eos Chasma from Thermal Emission Imaging System (THEMIS) data (**Fig. 1**). (Initial results are consistent with quartz, not opaline silica, as the dominant phase.) Hypotheses for the origin of these materials include felsic volcanism and a variety of processes involving water. The occurrence and observed distribution of these quartz-bearing materials immediately adjacent (<10 km) to olivine-rich materials is difficult to explain by igneous processes alone. Furthermore, fluvial features are abundant in Eos Chasma, indicating the past presence of water.

Origins of quartz: In terrestrial environments, quartz may be produced by: evolved (felsic) igneous activity, precipitation from hydrothermal fluids, replacement of evaporites/carbonates, and diagenesis of abiotically or biologically precipitated opaline silica. These processes can produce different quartz varieties that range in degree of crystallinity from microcrystalline and microfibrous forms in cherty (silica-rich) rocks to well-crystallized epithermal vein-filling quartz. The occurrence of massive amounts of well-crystallized to microcrystalline varieties of hydrothermally precipitated quartz or microquartz formed as a result of diagenesis/replacement of opaline silica or evaporites/carbonates on Mars could provide substantial information about aqueous processes, past climate, and habitability. Quartz-rich deposits that formed below the upper temperature limit of life could preserve chemical and morphological fossil records if life emerged on Mars.

Tests for MSL: As was the case with the orbital identification of hematite on Mars, several mechanisms could explain the presence of quartz-bearing deposits, many of which involve aqueous deposition/replacement and the potential to retain biosignatures. In the same way that the MER *Opportunity* elucidated the origin of hematite in Meridiani Planum, the MSL payload can test hypotheses for the origin of quartz *in situ.* Questions that could be addressed include: *What is the distribution of the quartz in relation to macroscopic textural features of the rock? What is the structure and chemistry, hence variety, of the quartz? What other minerals are present? Are any precursor opaline phases present? What is the potential to preserve chemical or morphological biosignatures?*

Landing Site Locations: Several 20 km-diameter landing ellipses fit within Eos Chasma such that quartz-bearing materials would be located at the edge of the ellipse, and thus within "go to" distance of the MSL rover. Three example ellipses are listed below.

N. Lat	E. Lon	Elev (km)	TI (SI)	Albedo
-13.9°	317.2°	-3.9	345	0.12
-12.4°	320.3°	-4.0	419	0.11
-10.9°	321.7°	-4.1	482	0.11

References: [1] Squyres, S.W. et al. (2004) *Science, 306,* 1709-1714. [2] Christensen, P.R. et al. (2000) *JGR, 105,* 9623-9642. [3] Hamilton, V.E. (2005) *Eos Trans. AGU, 86(52),* Fall Meet. Suppl., Abstract #P24A-08.

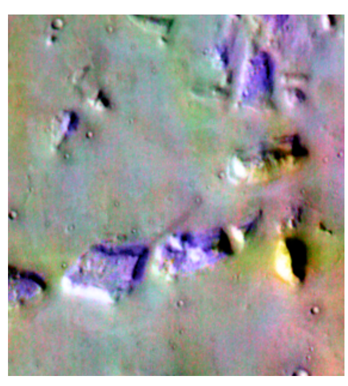

Figure 1. *THEMIS decorrelation stretch (RGB=bands 8/7/4) showing olivine-rich (violet) and quartz-bearing (yellow) outcrops in Eos Chasma (adjacent to ellipse 2). Image width = ~32 km..*