EVIDENCE FOR VOLCANISM IN AND NEAR THE CHAOTIC TERRAINS EAST OF VALLES MARINERIS, MARS. Tanya N. Harrison, Malin Space Science Systems (harrison@msss.com; P.O. Box 910148, San Diego, CA 92191).

Introduction: Martian chaotic terrain was first described by [1] from Mariner 6 and 7 data as a "rough, irregular complex of short ridges, knobs, and irregularly shaped troughs and depressions," attributing this morphology to subsidence and suggesting volcanism as a possible cause. McCauley et al. [2], who were the first to note the presence of large outflow channels that appeared to originate from the chaotic terrains in Mariner 9 data, proposed localized geothermal melting followed by catastrophic release as the formation mechanism of chaotic terrain. Variants of this model have subsequently been detailed by a number of authors [e.g. 3,4,5]. Meresse et al. [6] documented possible cinder cones, some with potential associated flows, on the floor of Hydraotes Chaos. No other volcanic features have previously been documented within or around Hydraotes and the other chaos regions at the eastern end of the Valles Marineris system.

Here I present observations of volcanic features associated with some of these chaotic regions, including small shield volcanoes and extensive lava flows, as imaged by the Mars Reconnaissance Orbiter (MRO) Context Camera (CTX). At the time of writing, CTX has acquired nearly complete coverage of Valles Marineris and its associated chaotic terrains (Fig. 1). I systematically inspected all CTX images along the entire chasmata and chaos system to look for potential volcanic landforms such as cones, vents/shields, and lava flows.

Observations and Interpretations:

Volcanoes. A cluster of domical features in the southeastern portion of Hydraotes Chaos are visible in CTX B19_017212_1809_XN_00N033W near 0.44°S, 33.18°W (Fig. 2a). This area is the lowest elevation point in all of the chaotic terrains. These features exhibit fissures at their summits and appear to have associated flows, which bank up upon blocks on the chaos floor. Some also display cones with summit craters on their flanks, and a number of similar cones are visible in the general vicinity. These domical features are unique to Hydraotes compared to the rest of Valles Marineris and the chaotic terrains, where no such features are observed. They are also morphologically distinct from the cones documented by [6]. Based on morphology and the presence of associated flows, I interpret the domical features to be small shield volcanoes.

Lava flows. Dark-toned flows appearing to have originated from fractures around the margins of multiple chaotic regions are visible in CTX images (Figs. 1,2). These fractures have widened since the formation of the flows. The flows overtop and/or bank up upon pre-existing topography such as crater ejecta blankets (Fig. 2c). Flows are also observed originating from fractures within some craters in the vicinity of the chaos regions. Potential lava flows are observed on a portion of the floor as Hydaspis Chaos, possibly associated with fissures on the chaos floor. As in Hydraotes, these flows bank up against blocks on the chaos floor, implying that if the flows are volcanic in origin, the volcanism occurred after the formation of Hydaspis Chaos.

The dark-toned material has retained more small (sub-km) craters than the surrounding plateau material, suggesting that it is more resistant to erosion [7]. This, paired with the observation that the margins of the flows are not significantly eroded, supports the interpretation that these are lava flows (as opposed to mudflows).

Cones/Mounds. Multiple small cones with summit craters were identified in Hydraotes Chaos using CTX (some of these were previously documented by [6]). In some places, mounds lacking summit craters occur in association with cone clusters. Similar cones were also identified to the south in Aurorae Chaos, near the mouth of Ganges Chasma, and in central and eastern Coprates Chasma (some of the latter were also noted by [4]). Cones with and without summit craters are also observed to the north in Chryse Chaos. These may potentially be rootless cones and/or cinder cones, as suggested by previous authors where cones had been identified [e.g. 4,6].

Discussion: None of the lava flows are observed to have flowed from fractures into the topographic lows of the chaotic terrains themselves, suggesting that volcanic activity associated with these fractures ceased before the formation of the chaotic terrain as we see it today. Evidence for volcanic activity after the formation of the chaotic terrains lies in the observations of shield volcanoes, cones, and flows on the floor of Hydraotes and cones, fissures, and flows on the floor of Hydaspis. These features are unique to these chaos regions however, suggesting that this latter period of volcanic activity was much more limited in extent.

While these observations imply that volcanism occurred in the region before and after the formation of the chaotic terrains, it does not directly hold any implications for the formation of the chaotic terrains. The

spatial distribution of the fractures and lava flows relative to the chaos may suggest that volcanism played a role in chaos formation, as these features are not observed farther away from the chaos regions.

References: [1] Sharp R. P. et al. (1971) *JGR, 76,* 331–342. [2] McCauley J. F. et al. (1972) *Icarus, 17,* 289–327. [3] Carr M. H. (1979) *JGR, 84,* 2995–3007. [4] Lucchitta B. K. et al. (1994) *JGR-Planets, 99,* 3783–3798. [5] Rodriguez J. A. P. et al. (2005) *Icarus, 175,* 35–57. [6] Meresse S. et al. (2008) *Icarus, 194,* 487–500 [7] Edgett K. S. (2009) *GSA, 41,* 708.

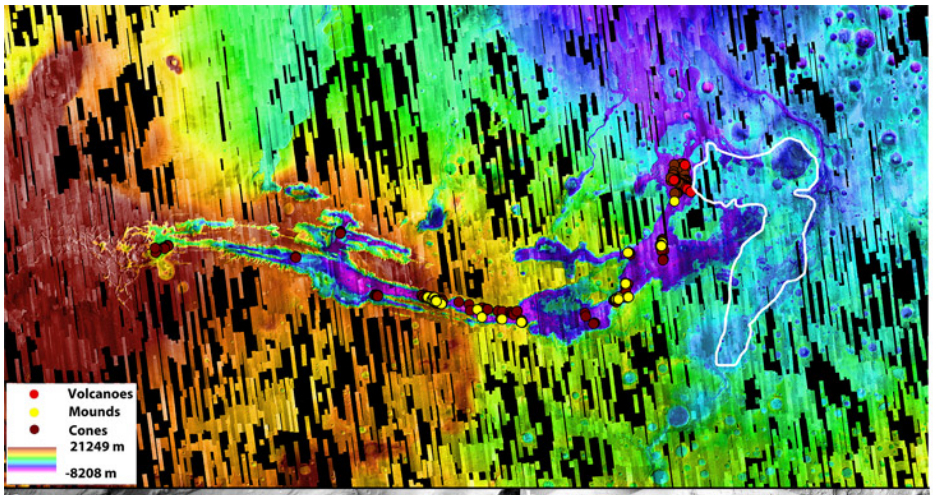

Fig. 1 - MOLA topographic data masked using CTX coverage of the Valles Marineris region as of 11 Dec 2011. Red dots denote features identified as volcanoes, yellow as cones, and maroon as mounds. The white line denotes the region in which lava flows associated with fractures have been identified.

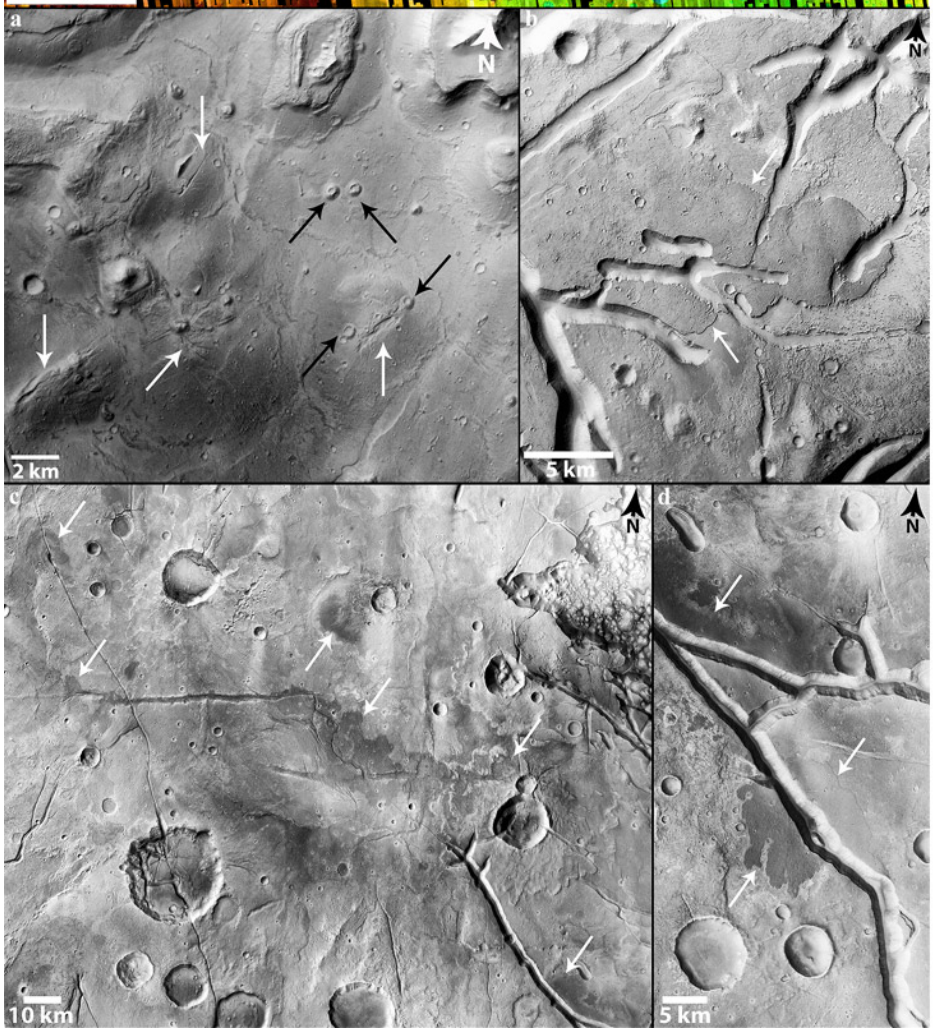

Fig. 2 - (a) Features identified as shield volcanoes (white arrows) and cones (black arrows) on the floor of Hydraotes Chaos near 0.44°S, 33.18°W. Subframe of CTX B19_017212_1809_XN_00N33W. **(b)** Lava flows originating from fractures within Pyrrhae Chaos near 11.22°S, 27.70°W. Examples of flow margins denoted by white arrows. Mosaic of subframes of CTX P17_007718_1696_XN_10S027W and P17_007573_1695_XN_10S027W. **(c)** Extensive lava flows west of Iani Chaos (white arrows) centered at ~2.3°S, 21.8°W. Mosaic of subframes of CTX images P19_008522_1782_XN_01S023W, B17_016104_1760_XN_04S023W, B11_013915_1780_XN_02S022W, B17_016460_1779_XN_02S022W, G04_019862_1777_XN_02S022W, B09_013137_1777_XN_02S021W, G07_020785_1782_XI_01S021W, G05_020363_1781_XI_01S021W, and G10_022130_1784_XI_01S020W. **(d)** Lava flow associated with a fracture immediately west of Iani Chaos, centered near 3.25°S, 20.52°W. Subframe of CTX G09_021774_1767_XI_03S020W.