DID PERIGLACIAL LAKES DEVELOP WITHIN MARTIAN OUTFLOW CHANNELS? J. Alexis P. Rodriguez[1,2], A. G. Fairén[3],V. C. Gulick[1,4], V. R. Baker[5], T. Platz[2], and N. Glines[1,4]. [1]NASA ARC, MS 239-20, Moffett Field, CA, 94035 (Alexis.Rodriguez@nasa.gov), [2]PSI, Tucson, AZ, [3]Centro de Astrobiología, 28850 Madrid, Spain, [4]SETI Inst., 189 Bernardo Ave., Mountain View, CA 94043, [5]Dept. of Hydrology & Water Resources, University of Arizona, Tucson, AZ.

Using Mars Reconnaissance Orbiter (MRO) Context (CTX) image data in combination with Mars Orbiter Laser Altimeter (MOLA) surface topography, we have characterized and mapped the geomorphology of Chryse Chaos, an extensive region of chaotic terrain located in northern Simud Valles. Here, we propose that the development of this chaotic terrain was mostly the result of degradational processes of an active permafrost layer, produced by the sudden emplacement of a massive lake in the region during the Middle Amazonian. The site could preserve some of the youngest lacustrine sediments on Mars, and thus, comprises an outstanding site for exobiological studies.

Introduction: Southern circum-Chryse is situated along the highland-lowland boundary and contains the largest and most complex system of outflow channels on the planet [1,2]. These channels likely formed as a consequence of Late Hesperian catastrophic flooding [2]. The deepest channel sections consist of broad, nearly flat surfaces adjoined by extensive zones of highland collapse, known as the chaotic terrains, and connect the Valles Marineris canyons to the planet's northern lowlands [1]. Large-scale groundwater outbursts from the upper crustal regions resulted in chaos formation [3] and along with the sudden drainage of massive lakes within the Valles Marineris [4], were likely sources for the enormous catastrophic floods during the Late Hesperian.

These floods would have been significantly larger than any documented terrestrial counterpart [5] and would have locally propagated over zones of reversed channel gradient [6]. Late Hesperian outflow channel floods may have generated a temporary ocean within the planet's northern lowlands [5], and at least two large lakes; one within Shalbatana Valles [7] and the other within Hydraotes Chaos [8]. Recent work by Rodriguez *et al.*, [9] reveals evidence for a Middle Amazonian stage of catastrophic flooding and wet-based glaciation in southern circum-Chryse. The catastrophic floods documented in their work are based on the recognition of bedforms analogous to landforms in Channelled Scablands and terrestrial glaciers. The scale and morphology of these features indicate that the water depths of the Middle Amazonian catastrophic floods would have been significantly shallower than those produced during the Late Hesperian, and thus, might have resulted in ponding and lake formation in zones of reversed channel gradient.

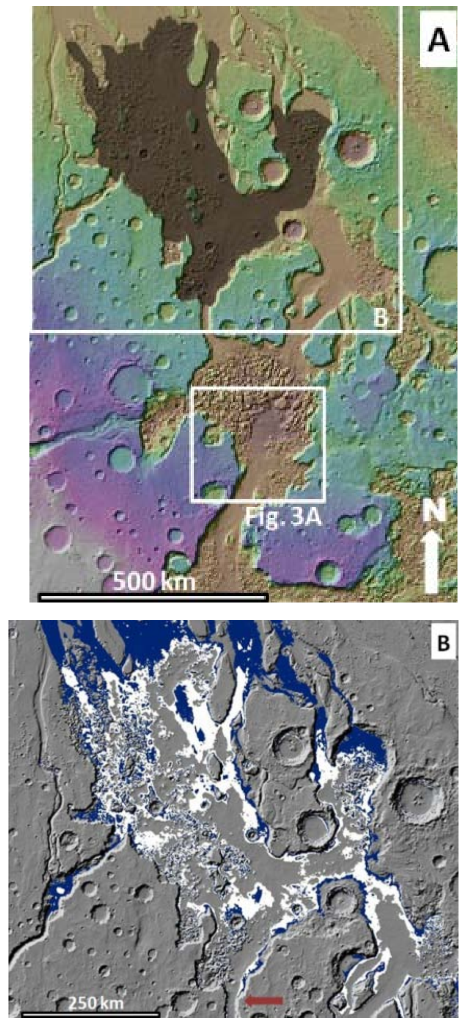

Figure 1. (A) Location of Chryse Chaos (darkened surface). **(B)** Close-up view on Chryse chaos showing the elevation range (white, -3800 to -3900 m) that marks the transition into the outflow channel floors in Simud and Tiu Valles (blue).

2. Geomorphologic analyses and interpretative synthesis: Chryse Chaos consists of extensive knobby fields and undulating smooth plains, which to the north transitions into Simud and Tiu Valles channel floor materials (Fig. 1A). The contact between these two terrains mostly consists of an abrupt slope break, ~100 meters in relief between -3800 and -3900 m (Fig. 1B). The western part of the chaotic terrain, located in Simud Valles, marks the contact between the outflow channel and eastern Xanthe Terra. The margins of the highlands facing the chaotic terrain are extensively modified by irregular re-entrants (Fig. 2A, B). Interior highland mesas are similarly modified (Fig. 2A). The northern margin of the chaotic terrain consists of a ~100 m in relief knobby break-in-slope that marks the transition into the northern reaches of channel floor materials in Simud and Tiu Valles (Fig. 1).

We interpret these morphologies as resulting from the thermal impact on pre-existing permafrost produced by the rapid ponding of water in the region. This would have resulted from the inability of the catastrophic floods to overpass the regional reversed channel gradients. Basal scarp materials within the chaos exhibit linear erosional marks that can be traced along the highland margins as well as around some mesas (Fig. 2B).

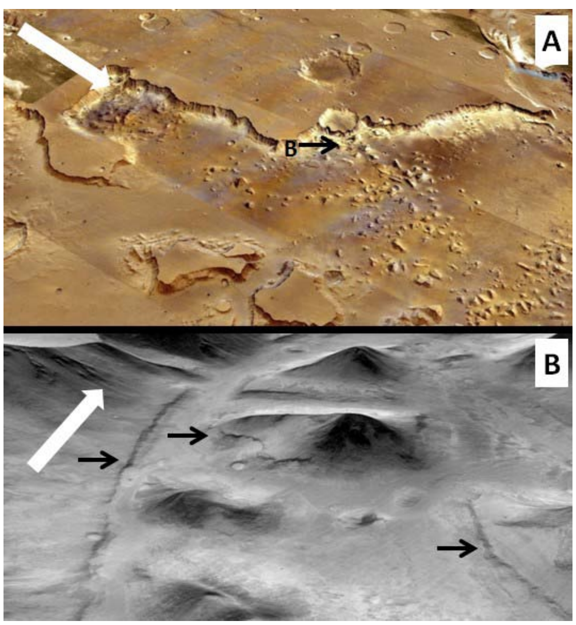

Figure 2. (A) View of eastern Chryse Chaos showing a complex system of reentrants that modify the margin of the highlands and mesas. **(B)** Remnants of possible shoreline scarps. White arrows show north.

We interpret these linear features to be shorelines developed in soft sediments shed during retreat along permafrost-rich scarp materials. In addition, lake formation under cryogenic conditions would have likely resulted in extensive freezing around the perimeter of the water body, where zones of shallow water would have frozen more rapidly. Assuming that the -3900 m elevation represented the maximum level of the lake (Fig. 1B) because there is no evidence for spillover beyond north of the northern end of the slope break, then there would have been a point of spill into a narrow branch of mid-Simud Valles connecting the chaotic terrain to Hydraotes Chaos (red arrow in Fig. 1B). Lake drainage in this direction is supported by the identification of lobate deposits in southern Hydraotes Chaos consistent with flow towards the south (Fig. 3A,B), which, based on our crater count statistics, are also of Middle Amazonian age. The absence of erosional bedforms associated with this flow stage suggests that at the time of drainage, outflow from the lake occurred rapidly as a debris flow that deposited sediments along its path of propagation.

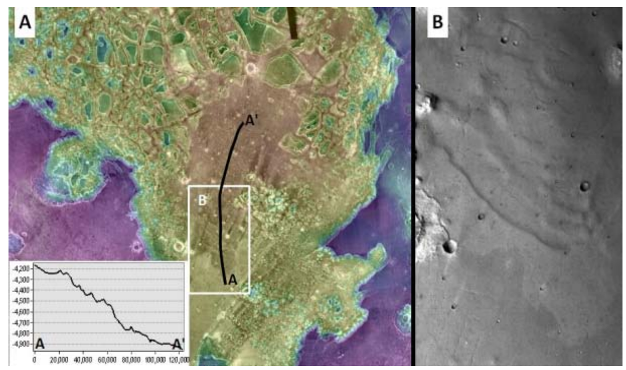

Figure 3. (A) THEMIS night IR and MOLA of Hydraotes chaos. **(B)** Rippled lobated flow front extending over 120 km and 1 km ~700 m in elevation from the basin's floor (HRSC: H2024_0001_ND3).

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