ERIDANIA BASIN, MARS: EVOLUTION OF ELECTRIS TERRAIN, CHAOS, AND PALEOLAKE. K. B. Golder and M. S. Gilmore, Dept. of Earth and Environmental Sciences, Wesleyan Univ., 265 Church St., Middletown, CT 06459, (kgolder@wesleyan.edu).

Introduction: The Eridania basin in the southern hemisphere of Mars is hypothesized to have contained a large paleolake that has been identified as the source of the large outflow channel, Ma'adim Vallis [1]. Found within the confines of the paleolake boundaries are 5 degraded impact basins which contain concentrations of chaotic terrain, including: Ariadnes Colles, Atlantis Chaos, Gorgonum Chaos, and two unnamed basins (Fig. 1). Chaos is typified by accumulations of angular mesas and knobs separated by fractures [2], which have been interpreted to be the result of subsurface collapse due to breaching of a confined aquifer with a general spatial association to large outflow channels [3]. Chaos within Eridania are not directly related to any outflow features , and also lie at the lowest elevation points within the basins (Fig. 1), therefore require a different interpretation for their formation mechanism. The evolution of the basin, its surrounding environs, the paleolake, and the chaotic terrain all have a bearing on the interpretation of the local geologic history.

Methods: Building upon previous geological maps [4,5], we performed high-resolution mapping utilizing a CTX basemap, supplemented with HRSC, HiRISE, MOLA, THEMIS IR day- and nighttime images, to refine unit descriptions, spatial distribution, and contact determination (e.g. Figs. 1, 2 A-C) [6].

Paleolake Extent: [1] used the overflow points of Ma'adim, boundary/slope transition points within the basin interiors, and the termination points of valley networks to identify the upper limits of the paleolake. Defined by the 1100 and 1250 m contours, and using the termination points of valley networks in CTX data, we confirm the paleoshoreline proposed by [1] and identify a second lower level shoreline at ~800 m [7]. We interpret this to correspond to the drawdown of the lake. Below 950 m, any water in the basins would be confined to that basin and only have been released into a transient lake or the groundwater system.

With the exception of Gorgonum, which contained a late-stage ice covered lake [8], there is no clear evidence for standing water in the basins (e.g., shorelines) post-chaos. This suggests that if water was present in the basins, it did not persist, perhaps corresponding to a more evaporative environment. This may explain the presence of the sulfate mineral admixture with phyllosilicates [9]. Similar conditions have been invoked for the evolution of nearby Columbus crater [10].

Electris Terrain and Chaos: [11] identified Electris deposits in the region of Eridania, which they described as a regional ashy airfall deposit that reached thicknesses in excess of several hundred meters. These deposits are generally characterized by a surface expression that includes isolated plateaus and mesas with scalloped margins (Fig. 2 A). [12] revisited their early work associated with the Electris deposits within Eridania, and found that the chaos knob fields were likely reworked exposures of Electris material. Work performed by [7] identified a clear relationship between the Electris, Bright Electris, and Chaos terrains (Fig. 2 B,C,D), signifying unit relationships and the the development of chaos knob fields.

Constraints on Chaos Formation: Various models have been proposed for the creation of chaos, most of which require a triggering mechanism to release stored subsurface volatiles. Aquifer models [e.g., 3, 13] call for water pressure build-up in pore spaces of a confined aquifer, followed by rupturing of a capping cryosphere layer through erosion. The triggering mechanism in this case can be impact, volcanism or build up of hydraulic head due to aquifer recharge through multiple events, as predicted by [14]. Other models call for release of water liberated from subsurface hydrated minerals due to volcanism [15,16,17]. Another model calls for the burial by sediment of a preexisting ice sheet that gradually increases pressure and temperature conditions to the point of melting the ice lens [18]. Continued melting would lead to overburden collapse, forcing high-pressure expulsion of the confined waters. Further modification processes would comprise deflation and erosion of the units [19].

Based on our work we can place constraints on the likely formation mechanisms associated with the chaotic terrain within Eridania. Simple collapse is ruled out as the basins lack distinct outflow features. Basal melting of an ice-lens due to sediment load [18] would require significantly more overburden within the basins than is present, though initiation of melting in the deep interior of the basins may have occurred. The presence of limited dehydrated mineral phases (e.g. sulfates and less-hydrated smectites), present in Ariadnes Colles [9], favors the interpretation for liberation of water from minerals due to volcanic heating, either on the surface or in the subsurface. Coupled with significant etched terrain exposures within the basin interiors which lack clear sources external to the basins, it is possible that volcanic activity triggered water release by heating up subsurface ice made available postdrawdown of the lake, and subsequent surface disruption, forming the chaotic terrains. Additional changes to the chaos fields would have occurred through deflation and erosion.

Geologic History: Stratigraphically the earliest activity in the region consisted of the emplacement of Noachian basement material. This was followed by the impact events that formed the primary subbasins, which were draped by the Electris airfall deposits. These deposits were then altered in the presence of surface and subsurface waters to form the Bright Electris deposits. This alteration process was restricted below 1100 m, corresponding to the upper levels of the paleolake [7]. Channel morphology and the location of channel termination points along with basin topography offer evidence for several lake stands, related to both the initial filling and then drawdown of the lake. Subsequent deformation due to the coupled processes of erosion, subsidence, and dehydration ultimately formed the chaos knob fields.

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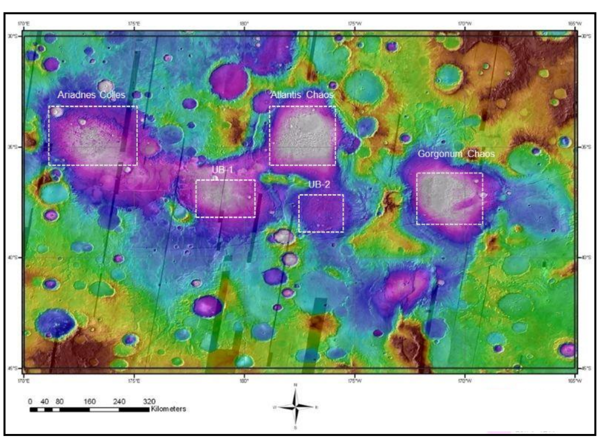

Figure 1: Location map of chaos knob fields in the eastern subbasin of Eridania. Chaos is concentrated within the basin interiors and centrally located, with each field initiating no higher than ~600 m.

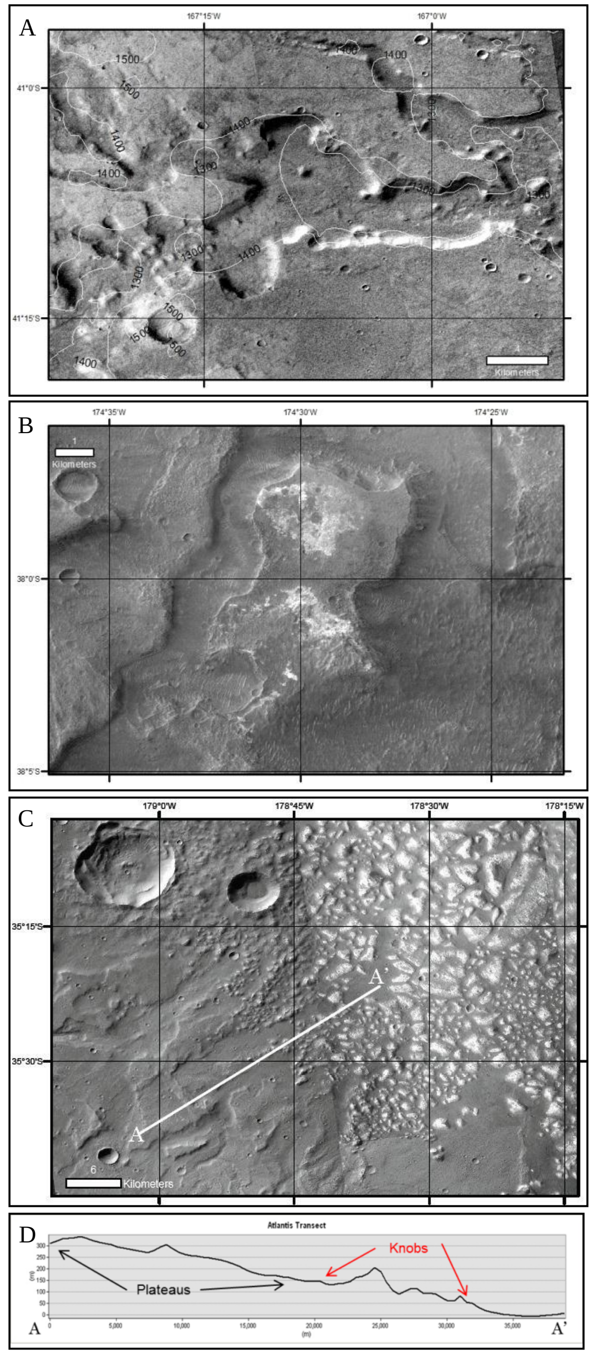

Figure 2: A. Type section of Electris terrain from [6]. B. Bright Electris outcrop exposed within and along the scarp of Electris plateau. C. Electris plateaus and chaos knob field within Atlantis Chaos, with direct modification of Electris plateaus apparent as they dip into the basin interior, following the transect highlighted in D.