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Morphological and spectroscopic analysis of light-toned materials in southeastern Gorgonum Chaos, Mars

David Haack (1,2), Solmaz Adeli (1), Ernst Hauber (1), Ralf Jaumann (1,3)

(1) Institute of Planetary Research, Deutsche Zentrum für Luft- und Raumfahrt, Rutherfordstrasse 2, 12489 Berlin, Germany, (2) Institute of Earth and Environmental Science, Universität Potsdam, Karl-Liebknecht-Str. 24-25, 14476 Potsdam, Germany, (3) Planetary Sciences and Remote Sensing Group, Institute of Geological Sciences, Freie Universität Berlin, Malteserstr. 74-100, 12249 Berlin, Germany

Gorgonum Chaos is an eastern sub-basin of the hypothesized Eridania paleolake system in the southern highlands of Mars [1]. The basin morphology is characterized by a bowl-shaped floor and numerous fluvial valleys and erosional features at its rim [2]. Its floor consists of light-toned material which forms hundreds of meters thick deposits and are observable at numerous outcrops throughout the basin [3,4]. This light-toned material contains hydrated minerals such as phyllosilicates and indicates a genesis in which considerable amounts of water were involved. Therefore, the analysis of these materials and their reshaped surface is crucial to understand the evolution of Gorgonum Chaos and the role of liquid surface water in its current morphology.
In the southeastern portion of Gorgonum Chaos, erosion reshaped the basin floor that currently displays km-scaled depressions with inverted fluvial valleys and impact craters. These features are completely embedded in highly polygonised bedrock of light-toned units. To study the morphological context between light-toned material and relief, CTX, HiRISE and HRSC images were used.
The light-toned material was most likely deposited during the Late Noachian – Early Hesperian and makes up the majority of the basin floor. The spectroscopic analysis of this unit via CRISM data revealed the abundant presence of phyllosilicates which were most likely deposited in a standing body of water. Al-phyllosilicates and sulfates were detected in a unit that forms the upper layer of lacustrine sediments and is at least 150 m thick. This estimation is a result of the analysis of DEMs that are based on HiRISE datasets.
Approximately during the Noachian-Hesperian transition the hypothesized Eridania paleolake desiccated and fluvial systems and impacts started to modify the surface. Deposits have accumulated later in these fluvial valleys or craters when liquid surface water was present after the desiccation of Eridania. These deposits contain considerable amounts of chlorides that may have cemented the sediments and increased their competence.
During a period of aeolian erosion and deposition throughout Hesperian the formation of hydrated minerals was reduced to marginal amounts. The depressions with inverted structures as sinuous ridges and circular mesas were formed and partially refilled with new sediments. They are of low competence and reminiscent of loess-like sediments [5]. The mineralogical and morphological characteristics of these younger deposits are consistent with conditions of very limited presence of water.
In the Amazonian all features were covered with a thin layer of ultramafic air fall material of probably volcanic origin. The olivine in this latest unit is stable only under anhydrous conditions over long periods of time. This indicates the complete absence of water during their deposition.
The stratigraphic sequence of all units and their mineralogical composition indicate an environmental transition in this region from wet conditions during the Late Noachian over rather dry environments during Hesperian to ultra-arid conditions in the Amazonian and today.

[1] Irwin et al., Science (2002)
[2] Howard & Moore, JGR (2011)
[3] Wendt et al., Icarus (2013)
[4] Adeli et al., JGR-Planets (2015)
[5] Grant et al., Icarus (2010)