## Investigating the chloride-rich deposits in the highlands of Terra Sirenum: implication on bio-signature preservation


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### Introduction

Chloride-bearing deposits have been widely identified on the southern highlands of Mars, mostly within Noachian-aged terrains [1]. These deposits were mainly detected by using multispectral thermal infrared imagery from the Thermal Emission Imagery System (THEMIS) instrument [1, 2], and locally by using the hyperspectral data of Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) [1-4]. The chloride-salts may have formed as evaporates in local ponds fed by runoff or groundwater [2, 5]. On Earth, chloride-salts form in alkaline and hypersaline conditions, and they can preserve traces of life, e.g., salt crystals which can preserve amino acids for 4-40 Ma [6]. The salt deposits on Mars are paleo-environmental indicators, thus their capacity of preserving surface and/or near-surface life evidence turns them into a highly interesting target of remote sensing as well as *in situ* investigations by future missions.

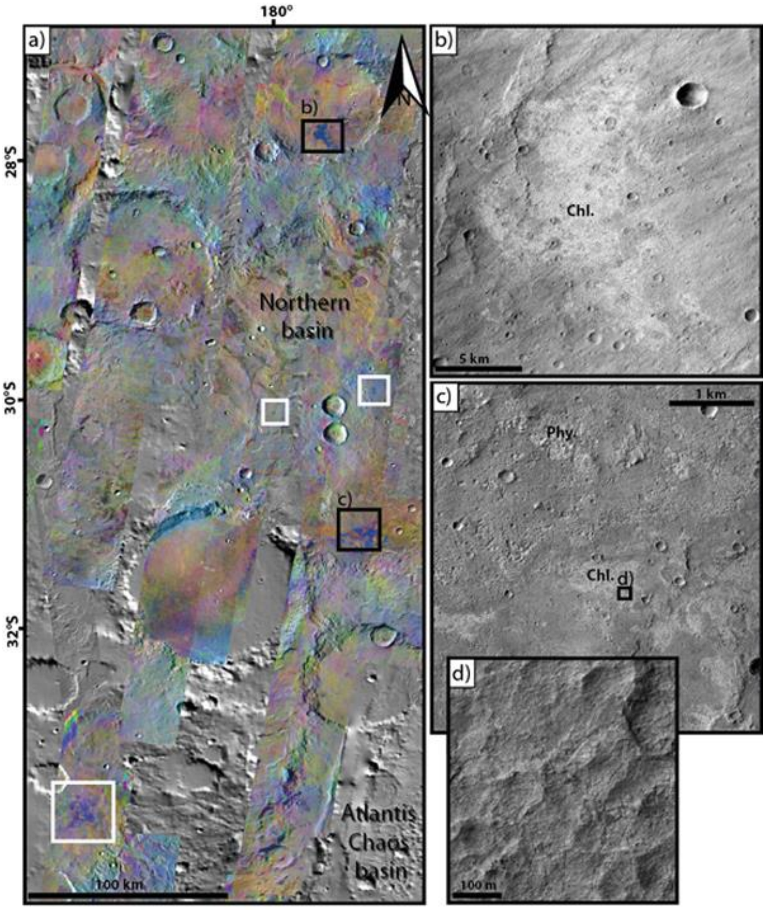


Figure 1: (a) Mosaic of false-color THEMIS TIR radiance data that are displayed in 8/7/5 DCS bands as red/green/blue overlying a MOLA hillshade map. Chloride salts appear in blue (white and black boxes), located in the northern Atlantis basin. (b) Chloride-rich materials deposited on the floor of a crater. (c) Chloride-bearing deposits in the northern basin. (d) Example of the texture of the chloride-bearing materials.

### Terra Sirenum-regional setting

Terra Sirenum is located in the southern mid-latitudes and shows wide-spread chloride-rich material [3, 7]. This region has a rich aqueous and geologic history, including the large Eridania paleolake [7, 8], the E-W-trending Sirenum Fossae grabens, possible evidence of volcanism, such as wide lava flows, and local, small volcanos [9]. Terra Sirenum is mineralogically diverse, providing unique insights into Mars' aqueous processes. Analyses of remote sensing data over the region indicate the presence of both Fe- or Mg-rich phyllosilicates and chloride salts. Moreover, there have been also indications of local Amazonian fluvial activities in this area, as reported by [10].

**Chloride-bearing deposits**

Here, we present the preliminary results of our study focused on chloride-rich material in Terra Sirenum. Most of these deposits have been previously mapped as chloride-rich by [2]. Here we used imagery (HRSC, CTX, HiRISE), topographic (HRSC, HiRISE), and spectroscopic (THEMIS, CRISM) data to investigate the origin, formation mechanism, and chronology of these deposits at two sites in more detail. The first site has been previously studied by [7] and is located in a basin north of Atlantis basin (Figure 1). The second site is located in a basin east of Gorgonum Chaos. The reported chloride-bearing materials are found in local depressions and appear within light-toned deposits ranging in width from a few tens of meters to a few kilometres (Figure 1-b) with polygonal fractures that are a few tens of meters wide with an irregular plan-view shape that does not follow a regular geometrical pattern (Figure 1-d). The deposits rich in chloride are found in proximity to phyllosilicate-bearing deposits. The stratigraphic relationships indicate that the phyllosilicates are part of the ancient highland crust and that the salts were deposited at a later time. Thus, the formation of chloride-bearing deposits is likely caused by a later water activity. This relation between chloride-bearing and phyllosilicate-rich deposits has also been observed in other areas in Terra Sirenum [e.g., 2, 3, 7, 11] and been interpreted as result of water accumulation in ponds, brine concentration by water evaporation, and precipitation [2].

At both sites, the light-toned material is exposed due to erosion and degradation of a wide-spread low-albedo upper layer. Inverted channels are clearly observable within the area where the dark upper layer has been removed and the light-toned material is present. Where higher resolution images (CTX or HiRISE) are available, we can observe that several of these inverted channels are linked to a valley or channel in the dark upper layer, indicating their pre-erosion formation. On the floor of a few of these inverted channels, there are locally exposed thin layers of light-toned material, with similar texture and polygonal features to the previously reported chloride-bearing deposits. If these deposits are chloride-rich, this would rise the question whether chlorides precipitated in these areas contemporaneous to the pre-erosion and wide-spread light-toned material deposition, or later due to local aqueous processes in Terra Sirenum, most likely the same activity which formed the channels. Understanding the morphological and chronologic constraints of chloride-salt formation would improve our knowledge about the ancient and perhaps recent chemical environments on Mars, which would be of high importance for the search for possible ancient, yet preserved bio signatures as well as for identifying potential currently habitable sites on the surface or near sub-surface of Mars.

**Future work**

We aim to address the above question by providing a geological map of the area, analyzing spectroscopic data, identifying the stratigraphic relation of the various light-toned materials in this area, and the dark upper layer, assessing the digital terrain models, investigating the source of water for the inverted channels, analyzing the model age of the dark upper layer to constrain the inverted channels and light-toned material formation time.

**References**


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