EPSC Abstracts
Vol. 7 EPSC2012-291-2 2012
European Planetary Science Congress 2012

Phyllosilicate-rich knobs in the Atlantis Chaos Basin, Terra Sirenum

S. Adeli (1), L. Le Deit (1), E. Hauber (1), A. Molina (2), R. Jaumann (1)
(1) Institute of Planetary Research, German Aerospace Center (DLR), Rutherfordstr. 2, 12489 Berlin, Germany (Solmaz.Adeli@dlr.de).
(2) Centro de Astrobiología (CSIC-INTA), Torrejón de Ardoz, Madrid, Spain

1. Introduction

Located in the cratered southern highlands, the 260 km diameter Atlantis basin (177°W-34°S; Fig. 1-a), is one of the regions on Mars where the existence of ancient lakes has been proposed [1-4]. The basin floor is partly occupied by a knob field composed of light-toned materials. Phyllosilicates have been detected in such light-toned deposits in other basins around Atlantis including "Ariadnes Colles" and an unnamed basin located at north-west of Atlantis [5-7]. In this study we analyze the morphology and the mineralogy of these knobs in the Atlantis chaos basin with the aim of determining their possible formation and alteration mechanism.

2. Data and Methods

We used HRSC, CTX, MOC and HiRISE images, as well as MOLA topographic data to analyze the morphology and the stratigraphy of the geological features of the Atlantis basin. We performed crater counting on CTX images to determine the age of certain units.

The CRISM hyperspectral data have been used in order to identify the mineralogical composition of light-toned knobs. The CRISM data have been atmospherically and photometrical corrected via the CAT tool v6.7 under the ENVI software. We produced maps of absorption band depth at 1.9, 2.2 and 2.3 µm [8] to identify and localize the spectra with the diagnostic signatures of phyllosilicates. These selected spectra have been ratioed by neutral spectra extracted from the same data cubes in order to reduce noise and emphasize the absorption bands in the spectra (Fig. 1-f).

3. Morphology and Stratigraphy

The floor of the Atlantis basin is partly dominated by knobs which are the oldest deposited unit in this basin (elevation range: 0 to -500 m). Knobs concentrated at the center of this basin have generally a bigger size than the ones observed at the outer rim of the knob field. In some places, where the knobs are less covered by dust, thin linear ridges of various orientations are visible within the knobs (Fig. 1-b). These features may be filled and cemented fractures resulting from fluid circulations in the subsurface. The shape of the observed knobs may represent the remnant of previously more extended materials, which are more resistant to erosion because of their cementation by fluid circulation, inferred from these hypothesized cemented fractures.

On the basin rim, erosional features such as triangular facets associated with fluvial channels are observed (Fig. 1-c). These features may be related to one or several erosional events that would have occurred after the desiccation of a lake. The unit displaying the triangular facets is located stratigraphically above the knob field and may have been deposited in a lake.

The depressions between the knobs are filled by a unit located in the center and southern parts of the basin floor. This unit has a smooth texture and does not display any traces of water erosion. Crater counting on this unit yields an age of late Hesperian (3.32 ± 0.15 Ga).

At the higher elevations of the basin rim, a unit of 100-200 m thick called the *Electris deposit* [9] has been observed as isolated outcrops on top of the basement on the rim of the basin. A volcanic air-fall origin for this layer has been proposed by [9, 10].

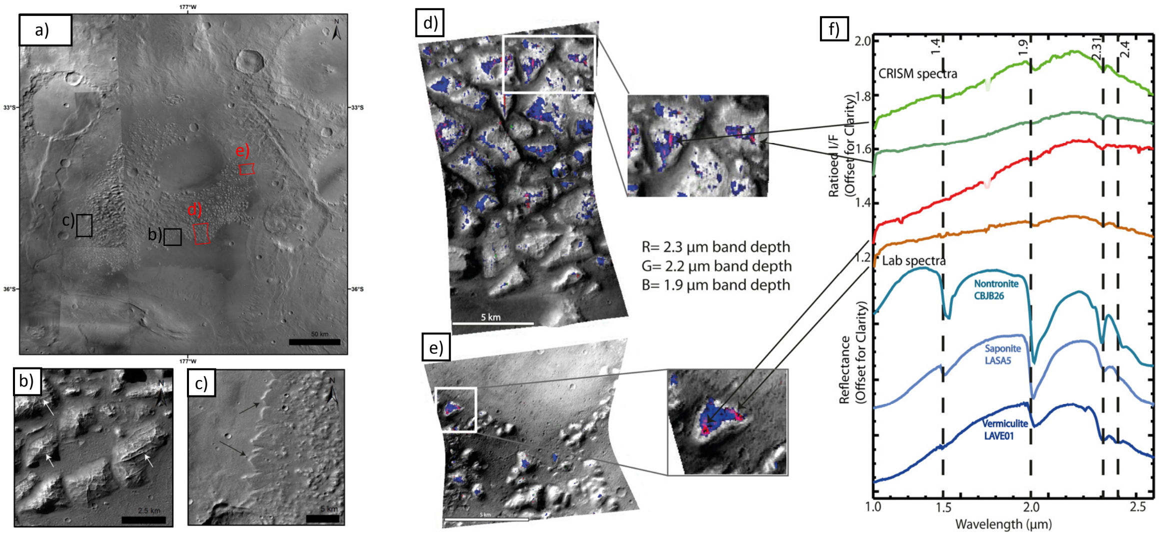

Fig. 1: a) Overview of the Atlantis basin, a mosaic of HRSC images superposed on MOC global map. b) Linear structures (whit arrows) in the knobs. c) Triangular facets (black arrows), supposed to be related to an erosional phase. d) Image of the CRISM observation HRL 8d28 at 1.014 µm, superimposed by a band depth map (red: D2300; green: BD2200; blue: 1900R). Displayed values: red: 0.001 – 0.004; green: 0.001 – 0.031; blue: 0.001 – 0.009. Pink and purple tones represent occurrences of Fe/Mg-phyllosilicates, and blue tones of hydrated phases. The close-up view of fig. 1-d) is shown. e) Image of the CRISM observation FRT 913-a at 1.014 µm, superimposed by a band depth map, with the same RGB parameters than for fig. 1-d). Displayed values: red: 0.001 – 0.003; green: 0.001 – 0.031; blue: 0.001 – 0.006. The close-up view of fig.1-e) is shown. f) CRISM spectra (ratioed I/F) averaged for a 3×3 pixel area of Fe/Mg-phyllosilicates compared to laboratory spectra. Locations of the averaged pixels are indicated by arrows toward Fig. 1-d) and 1-e).

4. Mineralogical Composition

Due to the atmospheric conditions during the data acquisition and to the presence of dust in this region, only a few of CRISM images allow the identification of mineral species at the surface of the knobs. However, we were able to analyze two of them, in which fresh surfaces of knobs were visible (Fig. 1-d, e).

The ratioed spectra of the knobs display absorption bands at 1.41, 1.93, 2.31 µm and a weaker absorption band at 2.39 µm, which is consistent with Fe/Mg-rich phyllosilicates [6]. By comparing the obtained Fe/Mg phyllosilicate signatures with laboratory spectra we suggest that they correspond to Fe/Mg-smectites (nontronite, saponite) and/or vermiculite.

4. Conclusion

Presence of Fe/Mg-rich phyllosilicates in the deposited layers in the Atlantis basin reveals the past existence of water, possibly a lake. *Electris* and knob materials may have a volcanic air-fall origin [9] and have been deposited as a contiguous layer, which has been later altered to clay minerals in a neutral to alkaline environment [11, 12]. This alteration episode may have continued after desiccation of the paleolake, during subsequent aqueous activity that is currently manifested as erosional features all around the Atlantis basin.

Acknowledgements

This research has been partly supported by the Helmholtz Association through the research alliance “Planetary Evolution and Life”.

References

[1] De Pablo, M.A., Fairen E.G.: Intern. J. of Astrobiology, 3, 257-263, 2004. [2] Irwin III R.P., et al.: Science, 296, 2209-2212, 2002. [3] Howard A.D. and Moore J.M.: Geophys. Res. Let. 31, L01702, 2004. [4] Irwin R.P. et al.: J. Geophys. Res., 109, E12009, 2004. [5] Osterloo, M.M., et al.: J. Geophys. Res., 115, E10012, 2010. [6] Glotch, T.D., et al.: Geophys. Res. Let., 37, L16202, 2010. [7] Annex, A.M., and Howard A.D.: LPSC XXXXII, Abstract # 1577, 2011. [8] Pelkey, S.M., et al.: J. Geophys. Res., 112, E08S14, 2007. [9] Grant, J.A. and Schultz P.H.: Icarus, 84, 166-195, 1990. [10] Grant, J.A., et al. : Icarus, 205, 53-63, 2010. [11] Velde, B., et al., in Origin and Mineralogy of Clays, 8-42, Springer, Berlin, 1995. [12] Le Deit, L., et al.: J. Geophys. Res., 117, E00J05, 2012.