RECENT HYDRATED MINERALS IN NOCTIS LABYRINTHUS CHASMATA, MARS. P. Thollot[1], N. Mangold[1], S. Le Mouélic[1], R. E. Milliken[2], L. H. Roach[3], J. F. Mustard[3], [1]Lab. de Planétologie et Géodynamique, UMR6112, CNRS et Université de Nantes, 2 rue de la Houssinière, BP 92208, 44322 Nantes cedex 3, France, patrick.thollot@univ-nantes.fr, [2]Jet Propulsion Laboratory, Caltech, MS 183-301, 4800 Oak Grove Dr., Pasadena, CA 91109, USA, [3]Dep. of Geological Sciences, Brown University, 324 Brook St., Box 1846, Providence, RI 02912, USA.

Introduction: Hydrated minerals on Mars are most commonly found in terrains dating to the first billion years of the planet's history. However, the identification of a Late Amazonian alteration layer has been reported recently by [1]. This layer, outcropping as a light-toned rock unit, was related to a smooth volcanic plain [2] with similar crater model age, suggesting interaction of water with volcanic ashes as a formation process. In this study, we examine spectral and imaging data over Noctis Labyrinthus in search for other occurrences of hydrated minerals.

Data: Mineralogy was determined from data acquired by CRISM [3], a visible and near-infrared hyperspectral imager that measures reflected sunlight from 0.4 to 4.0 µm in 544 channels at a spatial resolution of ~18 m/pixel. CRISM reflectance (I/F) data was downloaded from the PDS and processed through the CRISM Analysis Tools (CAT) to remove atmospheric contribution. We looked for absorption bands diagnostic of hydrated minerals, such as the 1.9 µm H_2O band, featured by sulfates and phyllosilicates. Some of the CRISM cubes analyzed show contamination by water ice clouds hanging over the canyons. However, these clouds are thin and only slightly alter surface spectral features. We carefully ratio spectra of outcrops of interest to nearby dusty areas in order to remove the clouds signature.

Observations: CRISM data reveals hydrated minerals in two distinct chasmata of Noctis Labyrinthus, west of the Valles Marineris canyon system. These are shown in Fig. 1 as North (NC) and South (SC) Canyon.

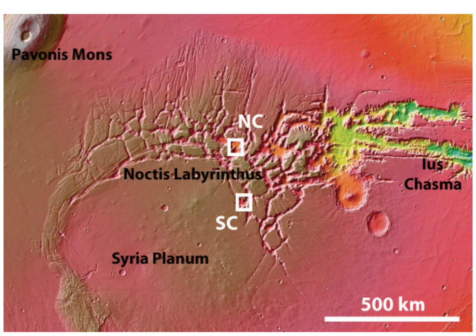

Fig. 1 Context of the study area (MOLA map)

Geologic context. NC floor is flat with high thermal inertia and bears HCP spectral signatures [2]. Several landforms can be observed that suggest a volcanic origin, such as a circular vent breached by a lava channel, a collapsing fracture zone and pitted cones. The model crater age determined by [2] is <100 My.

SC features pyroxene bearing plains but no obvious volcanic landforms. We focus on a ~5x6 km large, ~400 m deep depression, surrounded by two tongue-shaped pyroxene-rich units, of which one features a light-toned layer surrounding its base. We note that a ~600 m crater with widespread ejecta disturbs the stratigraphy over a significant part of the depression.

Hydrated Mineralogy. Fig. 2 shows a RGB composite of CRISM data over NC. Light-toned outcrops are present, and seem stratigraphically "sandwiched" between darker units. We dub respectively "blue" and "green" the units shown by arrows on Fig. 2, based on their color on the RGB composite. Absorption bands at 1.4, 1.75, 1.9 and 2.2 µm, allow us to differenciate the blue and green unit based on spectral signatures of hydrated materials. As shown in Fig. 3, possible spectral matches for the blue unit include sulfates such as gypsum and bassanite while the green unit signatures suggest the presence of hydrated silica (opal).

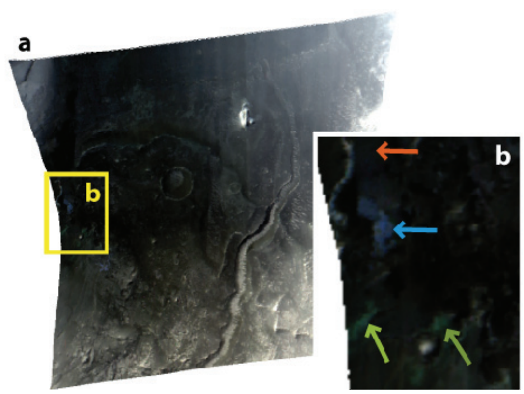

Fig. 2 CRISM RGB composite (R: 2.2 µm, G: 1.75 µm, B: 1.1 µm) of NC area. Arrows point toward units from which spectra shown on Fig. 3 were extracted.

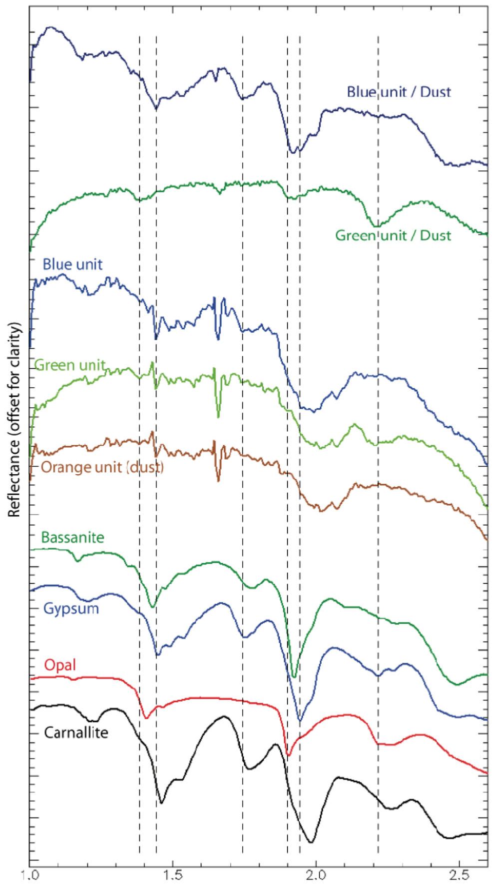

Fig. 3 CRISM spectra (blue, green, orange) and ratios (upper two spectra) compared to reference spectra [4] (lower four spectra). The 1.65 µm band is an artifact of CRISM data.

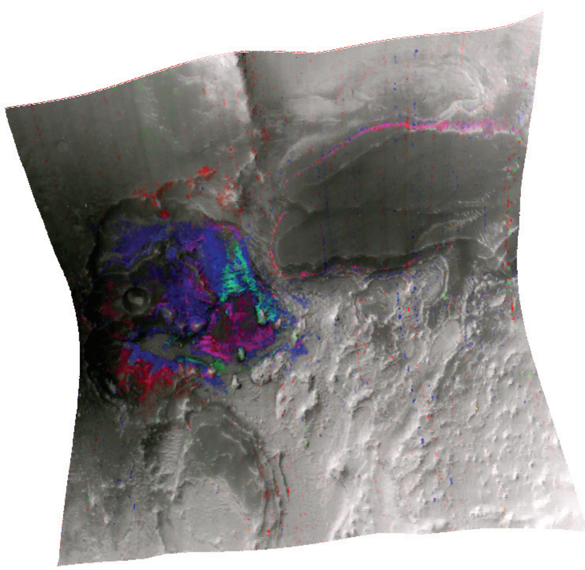

Fig. 4 Overlain on IR albedo, color mapping in SC of absorption bands diagnostic of hydrated minerals (R: 2.2 µm, G: 2.1 µm, B: 1.9 µm).

Fig. 4 shows a mapping of spectral criteria [5] for hydrated minerals in SC (Red: Si-OH bond in hydrated amorphous silica or Al-OH in aluminous phyllosilicates, Green: 2.1 µm band in several H_2O-bearing sulfates [6], Blue: 1.9 µm band from combinations of H_2O fundamental bands). Several units appear spectrally distinct, with possible matches such as hydrated silica and/or Al phyllosilicates (red to magenta in Fig. 4), Fe/Mg phyllosilicates (blue) and Fe/Mg sulfates (sea green).

Discussion: NC geology and mineralogy bears resemblance to that of the chasma examined by [1]. Emplacement of the light and dark toned units may have occurred from airfall of volcanic ash. Interaction of ashes with volcanic gases such as SO_2 and a source of water would have formed hydrated sulfates and hydrated silica. These altered deposits may be linked to the surrounding volcanic activity, then suggesting a young alteration (<100 My).

Further examination of topography and morphology in SC shows the Fe/Mg sulfates to be interstratified between hydrated silica and/or phyllosilicates. It is difficult to constrain the age of these deposits as the area shows an eroded surface. In any case, as the original deposits fill a late Hesperian chasma, their age is younger than that of most hydrated minerals on Mars, which date from the Noachian to early Hesperian [7], [8].

Conclusion: With respect to their formation process, recent alteration minerals in Noctis Labyrinthus chasmata may be different from widespread deposits observed elsewhere on Mars. Their recent age would imply that their formation did not require a martian climate that is different from that of today.

Whether formation processes were similar or local and unique to each chasma, comparing the geologic contexts will give more insight on the formation processes of these alteration minerals.

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