TYRRHENA TERRA: HYDRATED LOBATE EJECTA AND PLAINS. D. Loizeau[1], S. Bouley[2], N. Mangold[3], S. Meresse[2], F. Costard[2], F. Poulet[1], V. Ansan[3], S. Le Mouelic[3], J.-P. Bibring[1], B. Gondet[1] and Y. Langevin[1], [1]IAS-CNRS, Univ. Paris XI Orsay, 91405 Orsay, France (damien.loizeau@u-psud.fr), [2]IDES-CNRS, Univ. Paris XI Orsay, 91405 Orsay, France, 3LPGN-CNRS, Univ. Nantes, 44322 Nantes, France.

Introduction: The Phyllosian period of Mars [1] displays rocks that are altered at different levels, containing phyllosilicates of various natures, revealing that liquid water played a strong role in their formation. However, debates currently exist to know if this alteration was conducted at the surface in concert with active hydrologic cycle, or in the subsurface in a hydrothermal or warm, wet crust environment. Here, we display new results in the Tyrrhena Terra region, which is of interest to address this issue.

Tyrrhena Terra is located in cratered Noachian highlands in the southern hemisphere, south of Isidia Planitia and north of Hellas basin (Fig. 1). This region displays highland terrains partially dissected by fluvial valleys and several intercrater plains.

This region was reported [2; 1; 3; 4] as one of the Martian region displaying outcrops rich in hydrated minerals, by the identification of a weak 1.9 µm absorption band on spectra acquired by OMEGA, the imaging spectrometer onboard Mars Express. In addition, CRISM observes phyllosilicates associated with crater ejecta blankets and in mounds and knobs on crater floors [5; 6].

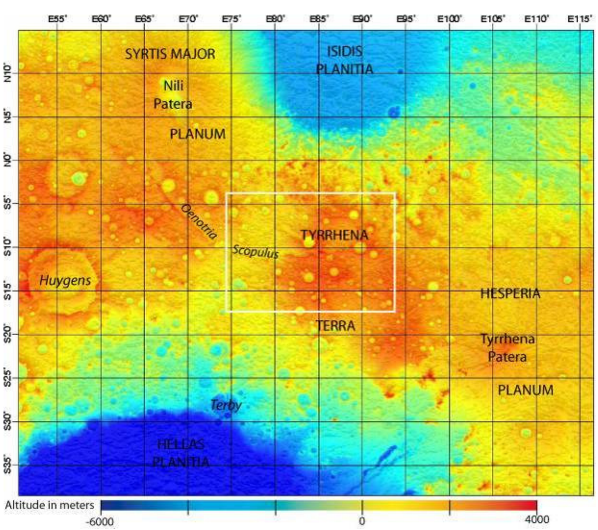

Figure 1: Location of the studied area in Tyrrhena Terra (white box), on MOLA topography.

Identification of hydrated minerals:

We used several OMEGA cubes, which provide coverage of the studied area of ~90%. The 1.9 µm band, due to the combination of H-O-H bending and stretching overtones [7; 8], is used to identify and map the hydrated deposits. Hydrated minerals are identified in two types of terrains in Tyrrhena Terra: on lobate ejecta blankets and in some plains.

Lobate ejecta. About 20 ejecta blankets showing hydrated minerals were identified with OMEGA in the white box of figure 1. The presence of the 2.3 µm absorption band, together with the 1.93 µm band, indicates the possible presence of phyllosilicates.

Most of these ejecta blankets are located on the eastern, higher part of the studied region, above 2000 m in altitude. Their diameter varies from ~2 to ~26 km. They are well delimited and are contrasted compared to the rest of the highlands on THEMIS IR night imagery, as shown by the example Fig. 2b. The other, non-hydrated, ejecta blankets of the region do not show such a contrast. As the dust cover is very low throughout the region, the difference in the THEMIS IR nighttime imagery would come from a difference in the ejecta material or preservation [3].

The hydration as seen by OMEGA appears preferentially on the surrounding ejecta and not inside the crater (Fig. 2a). Pyroxene is also detected on the ejecta blankets. On another hand, most ejecta are devoid of olivine as detected by OMEGA, although it is detected on many intercrater plains of the region.

Hydrated plains. We identified with OMEGA ~10 areas showing outcrops of hydrated minerals in the studied region, not associated to crater ejecta. They generally correspond to plains at the end of valley networks located on the higher plateaus, or plains cut by valleys. Their typical size is 10 to 20 km x 50 to 100 km. Most of them are located between 1 km and 1.5 km in altitude. Fig. 3 shows in red boxes the location of two of those plains.

Here also, pyroxene is identified with OMEGA on every hydrated plain, but OMEGA does not detect olivine on the same outcrops.

Interpretation:

These detections suggest a partial alteration of rocks in Tyrrhena Terra, or a spatial mixing of hydrated and unaltered materials (for example a pyroxene-rich cap over a hydrated unit, or an intricate mixing of altered and unaltered materials).

Two hypotheses can be drawn at this stage for the origin of the hydrated minerals restricted to the ejecta blankets: (1) formation of phyllosilicates and hydrated silicate minerals resulting from impact associated processes; (2) excavation of hydrated materials buried before the impact [3].

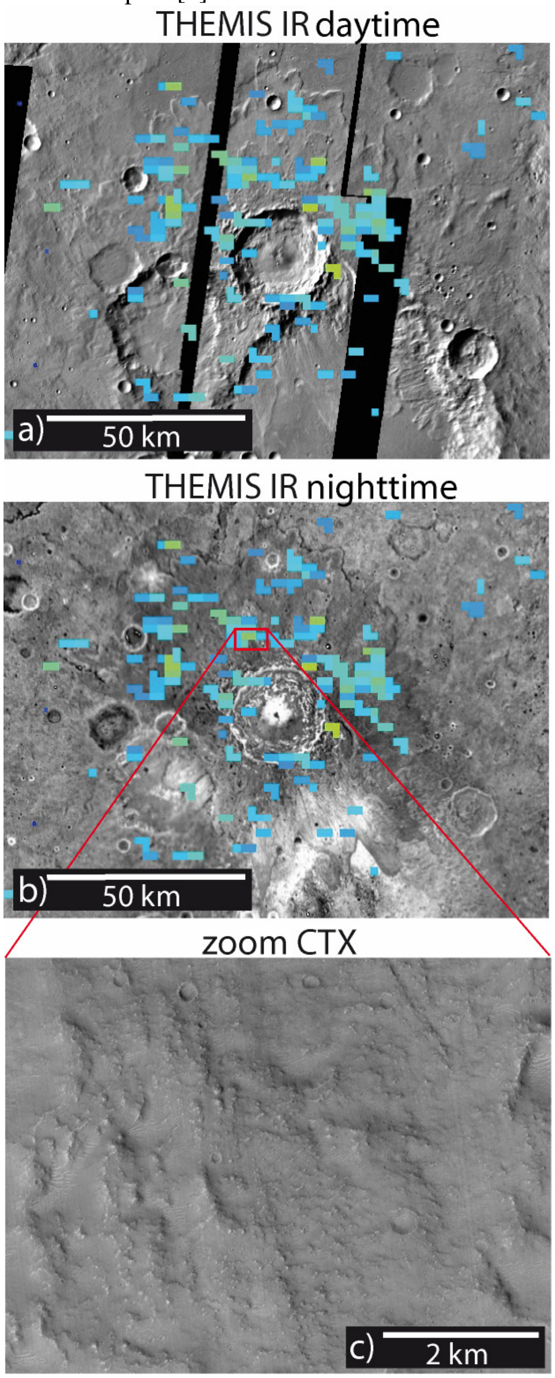

Figure 2: Identification of the 1.93 µm absorption band (in blue) in OMEGA spectra on a crater ejecta blanket on THEMIS infrared imagery, and a zoom on a CTX image on the same blanket.

The study of hydrated minerals in ejecta can also be important concerning the implication of volatiles for the lobate ejecta. Notice that the studied region is located in Noachian terrains, but most craters are not of Noachian age. They are surrounded by fresh ejecta without high erosion and relative low density of craters (Fig. 2c). This shows that, if formed by hydrothermal alteration during the impact, the hydrated minerals would be recent, while an excavation would limit the age of the alteration to the age of the terrain, i.e. Noachian. In addition, the observed alteration is located on the ejecta blankets, while hydrothermal models due to the impact predict alteration in the crater center, but do not find alteration possible on distal ejecta.

The observation of the hydrated minerals in alluvial plains suggests that this material was collected material from the highlands or formed in situ by weathering [9].

The correlative study of those two types of hydrated outcrops of the region could help to explain the origin and time of alteration in Tyrrhena Terra.

References:

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