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Tyrrhena Terra: hydrated lobates ejecta and plains, as seen by OMEGA/MEx

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Tyrrhena Terra was reported [2; 1; 3; 4] as one of the Martian region displaying outcrops rich in hydrated miner-als, by the identification of a weak 1.9 μm absorption band on spectra acquired by OMEGA, the imaging spectrometer onboard Mars Express. The region is located in cratered Noachian highlands in the southern hemisphere, south of Isidia Planitia and north of Hellas basin. It displays highland terrains partially dissected by fluvial valleys and several intercrater plains. Hydrated minerals are identified in two types of terrains in Tyrrhena Terra: on lobate ejecta blankets and in some plains.

About 20 ejecta blankets showing hydrated minerals were identified with OMEGA in the studied area. The pres-ence of the 2.3 μm absorption band, together with the 1.93 μm band, indicates the possible presence of phyllosili-cates. 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. 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. Py-roxene 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. In addition, CRISM observes phyllosilicates associated with crater ejecta blankets and in mounds and knobs on crater floors [5; 6].
We also identified with OMEGA around 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 be-tween 1 km and 1.5 km in altitude. Here also, pyroxene is identified with OMEGA on every hydrated plain, but OMEGA does not detect olivine on the same outcrops.

These detections suggest a partial alteration of rocks in Tyrrhena Terra, or a spatial mixing of hydrated and unal-tered 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 blan-kets: (1) formation of phyllosilicates and hydrated silicate minerals resulting from impact associated processes; (2) excavation of hydrated materials buried before the impact [3].
The study of hydrated minerals in ejecta can also be important concerning the implication of volatiles for the lo-bate ejecta. 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. 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 observation at high spatial resolution of hydrated

minerals inside the valley flanks, upstream from the alluvial plains, is crucial to understand the location and time of alteration, and would constrain the process of alteration of the ejecta blankets.

References:
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