

PEDOGENETIC PROCESSES ON MARS AND TERRESTRIAL ANALOGUES. A.C. Tangari¹, L. Marinangeli¹, E. Piluso², L. Pompilio¹, and F. Scarciglia², ¹IRSPS-DISPUTER, Università G. d'Annunzio (Via dei Vestini 31, 66013, Chieti, Italy, a.tangari@unich.it), ²Biology, Ecology and Earth Science Department (DIBEST), Università della Calabria (Via P.Bucci 87036 Arcavacata di Rende (CS), Italy).

Introduction: In the last years, numerous investigations of the Martian surface confirmed the presence of hydrated phyllosilicates, primarily Fe/Mg smectite and Al-bearing phyllosilicates (i.e., kaolinite and montmorillonite) [e.g., 1-6]. Having the capability of adsorbing a variety of chemical specimens due to their peculiar crystalline structure, clay minerals have remarkable implications in understanding the fluid/rock interaction processes, as well as for the preservation of organic molecules and life markers on Mars. The understanding of the formation processes of the identified hydrated minerals on Mars is critical to reconstruct the water/climate history of the planet.

Clays can be formed by direct precipitation from water or by alteration processes of exposed rocks. The present work is focused on the reconstruction of the alteration processes responsible of the formation of clay-rich soils on Mars based on the study of terrestrial analogues. We compared the mineralogy observed in CRISM data of Ganges-Capri-Eos Chasmata region (Fig.1) with soils sampled on the Etna volcano (Sicily) using an integrated approach of remote sensing coupled with pedological, petrographical and mineralogical investigations. The main goal is to find possible analogies between some Andosols developed on the basaltic substrate of Etna, and the Martian rocks based on their spectral response and formation processes.

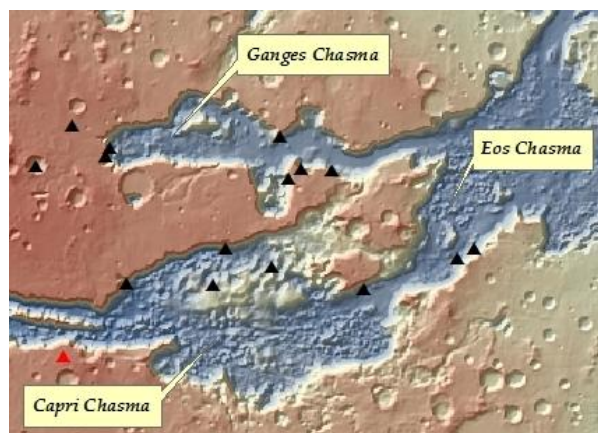


Figure 1: Location of the sites investigated with CRISM data (black triangle). The red triangle shows the location of the CRISM frt0000a51a, shown in figure 2 and discussed in the text.

Mars' soils mineralogy: Several studies have reported in the study area, the presence of olivine and other basaltic components, sulfates, iron oxides, hy-

droxides, and phyllosilicates. We focused our investigation in the Ganges, Capri and Eos Chasmata region (fig. 1) areas, located East of Valles Marineris, where the Plateau Phyllosilicates formation has been mapped [7;8].

We analyzed Compact Reconnaissance Imaging Spectrometer for Mars (CRISM) data, in the near-infrared range in order to locate the occurrence of phyllosilicates-rich materials. 50 full resolution CRISM images were processed using the standard procedure, as described in [9], and selected spectra were evaluated and compared with spectral libraries.

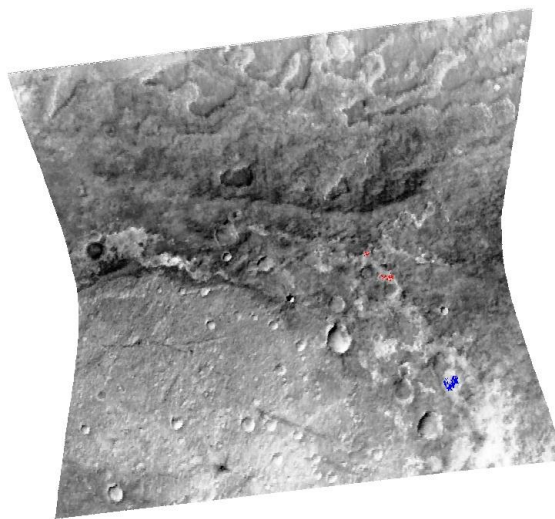


Figure 2: Full resolution frt0000a51a CRISM tile, with the locations of the regions of interest #1 (red) and #2 (blue) where clay minerals have been identified.

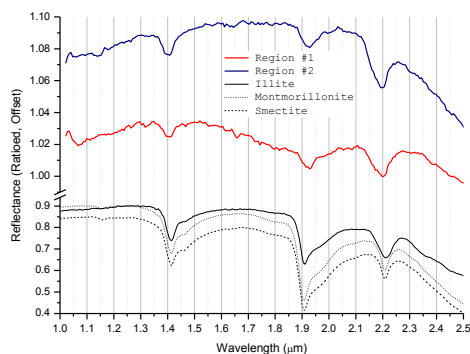


Figure 3: Spectra extracted from Regions #1 and #2 of Figure 2 compared to spectra of clay minerals from standard libraries.

Based on our preliminary analyses, phyllosilicates are not so widespread in this site East of Valles Marineris. We found a unique occurrence in light toned deposits outcropping to the Eastern margin of Valles Marineris (Fig. 1). Spectra extracted from some regions of interest found in frt00a51a CRISM tile (Fig. 2) show diagnostic features of smectite, illite and montmorillonite (Fig. 3). Surrounding areas are dominated by signatures of basaltic composition.

The observed clay deposits are located within the channel and a small crater depression. Given the limited distribution, the hypothesis of clay minerals formation as result of alteration processes of the basaltic substrata at places seems to be more consistent. However, further investigation is on-going to better characterise the geologic context of the study region and the origin of these hydrated minerals.

Etnean soils analogue: We focused our research on M. Etna, because: 1) etnean alkaline basalts are compositionally similar to basalts found at the Martian surface [10, 11]; 2) putative Martian soils are therefore

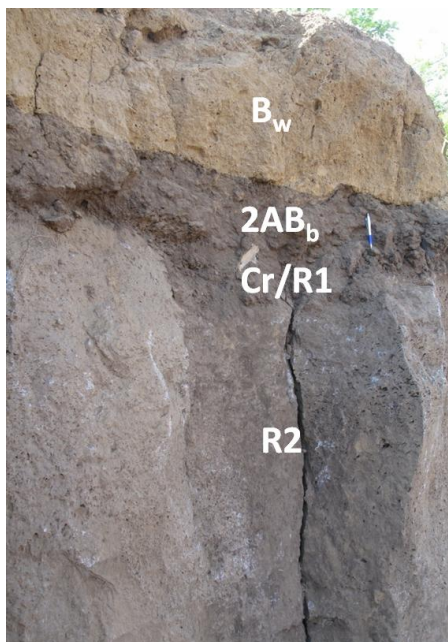


Figure 4: Soil profile AC1 (Acireale, Mount Etna) shows the presence of four different horizons. From top to bottom: cambic horizon Bw with some illuvial concentration of silicatic clay; transitional buried horizon 2ABb, composed by organic and mineral materials; Cr/R1, lava flow; R2, basaltic bedrock.

developed on basaltic rocks; 3) similar morphologies can be described for both a complex volcano on Earth and some places in the area surrounding Valles Marineris. Furthermore, the Martian site, is composed

by a series of parallel depressions or "chasmata", interconnected with each other, similar to those present on Etna mount. The development of these morphologies was been the result of the erosive action of lava flows.

We sampled n.13 soil profiles (Fig. 4) from several localities on the Etna volcanic site. Each profile has been described in the field and samples from each horizon collected for subsequent analyses in the lab.

Field studies were focused on the main morphological features, such as: type of genetic horizons and thickness, boundary characteristics (pattern and distinctness), aggregation structures, texture, color, consistence and pedogenetic features (coatings, concretions, nodules, etc.) Laboratory analyses include bulk and clays mineralogy characterization using X-ray diffraction (XRD) on oriented specimens of the clay fraction ($< 2 \mu\text{m}$).

An example of the XRD pattern of the sampled soil substratum is shown in Fig.5. The mineral paragenesis is rather similar to the Martian ones, confirming that this site is a compelling analog to better understand the alteration and pedogenetic processes on Mars.

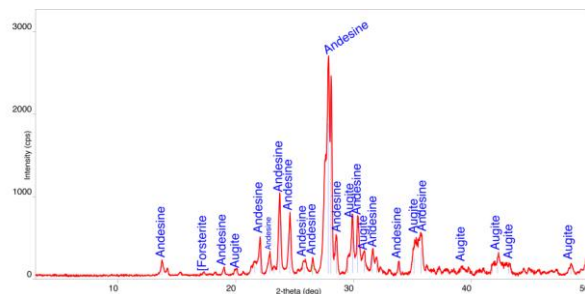


Figure 5: Example of the XRD pattern of the sampled substrata of the altered volcanic complex of Etna.

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