**A STUDY OF TERRESTRIAL VOLCANIC LEACHATES: IMPLICATIONS FOR MARS AQUEOUS ALTERATIONS** C. Popa[1,*], V. Mennella, F. Esposito[1] [1]INAF-OAC Napoli, Italy (Salita Moiariello 16, 80131). *email of the first author: ciprian.popa@inaf.it

**Introduction:** One of the main questions regarding the aqueous alteration on Mars is related to whether the NIR spectral signatures recorded via remote sensing or in-situ instruments are due to materials that resulted from hydrothermal alterations (i.e. volcanic activity) or are the result of a water cycle process, i.e. represent the alterations of the top crust with water from precipitations (laterite, kaolinite-bearing and/or ferruginous cuirasses) on which true pedogenic soils can further develop. In fact, this is the main question whose answer can let us establish whether Early Mars may have had a terrestrial like environment, thus providing the environment for life emergence and further support, or whether Mars was always a dry barren planet, with transient wet episodes strictly related to igneous processes. In order to contribute to the solving of this dilemma we sampled numerous terrestrial volcanic edifices at various depths, in order to build a database for the comparison with Mars spectral datasets.

**Sampling rationale**: We have chosen the volcanic province along the Eastern Carpathians to sample materials tidily related to volcanic aqueous alterations. The region provides a great advantage since the volcanism in the region spans a long period of the Neogene, with an increase in age from south to north (see Figure 1). This situation leads to the fact that the southern volcanic edifices preserve intact volcanic morphological structures and the materials at the surface are pristine pneumatolytic leachate materials, while the northern volcanic edifices are heavily eroded, providing alteration materials with parageneses specific to deeper hydrothermal activities, see Figure 2. In this study we present exclusively the alteration paragenesis related to the acid alterations, which are specific to the upper and midle part of all volcanic edifices (down to about 1500 m from the top of the volcanic edifice). We are not addressing the alkaline type of alteration in this work, which is specific to yet lower part of the volcanic edifices, not readily available for sampling in this volcanic chain. Samples from Solfatara of Pozzuoli, part of the Phlegrean acidic late volcanism, are also added for comparison.

**Lab analyses and comparison to Martian and Terrestrial datasets:** the collected samples were characterized with instrumental methods specific to modern geological laboratories. XRD and IR spectroscopy analyses were performed on all the samples presented in this work, in order to have a precise characterization of the mineral parageneses within the samples. The main characteristic of the samples is that they reflect the original igneous rock, but have most of the Fe, Mg, Ca mineralogy and chemistry completely removed as we get closer to the surface, while the remaining mineralogy and chemistry is dominated by Al and Si poorly crystalline phases. It is these phases that constitute the basis of the spectral features recorded in the spectra taken in our laboratory, spectra measured with relevant techniques similar to the remote sensing methods usually flown in planetary orbits. We compare the whole set of measurements with relevant similar measurements of mineral paragenesis typical for true climatic alterations, taken either from the literature or measured on the materials available in the mineral collection of the Capodimonte observatory. This data set is then compared to datasets from Mars.

**Preliminary results**: this sampling campaign and the subsequent material characterization points to the fact that most of the spectral signatures regarded in many works as belonging to a mineral paragenesis related to climatic cycles on Mars can be reinterpreted as ones belonging to mineral parageneses related to pneumatolytic hydrothermalism, i.e. volcanism occurring very close to the Martian surface, i.e. zones as the ones signed as red rectangles in Figure 2, assuming that the generalized terrestrial model can be extrapolated to Mars. Many places where these analogue parageneses are reported on Mars are also preserving the volcanic edifices as pristine as the youngest terrestrial volcanic edifices on Earth. This comes to show that there is little to no exposure of the lower parts of the volcanic edifices on Mars (i.e. green rectangle zones in Figure 2), hence extremely low erosion rates related to climate factors operated on Mars. This situation, in turn, points to the fact that there is very little terrestrial like similarities between Mars and Earth with respect to water-rock interaction, except the hydrothermal activity related to the volcanism which may be the prevalent one, or even the only aqueous alteration process giving rise to the observed mineral parageneses.

**References:** [1] Iancu, O. G., and Kovacs, M., 2010, Ore deposits and other classic localities in the Eastern Carpathians: Acta Mineralogica-Petrographica, Field Guide Series. [2] Hedenquist, W. (2000) Exploration for Epithermal Gold Deposits; In: Gold in 2000, S. G. Hagemann, P. E. Brown.

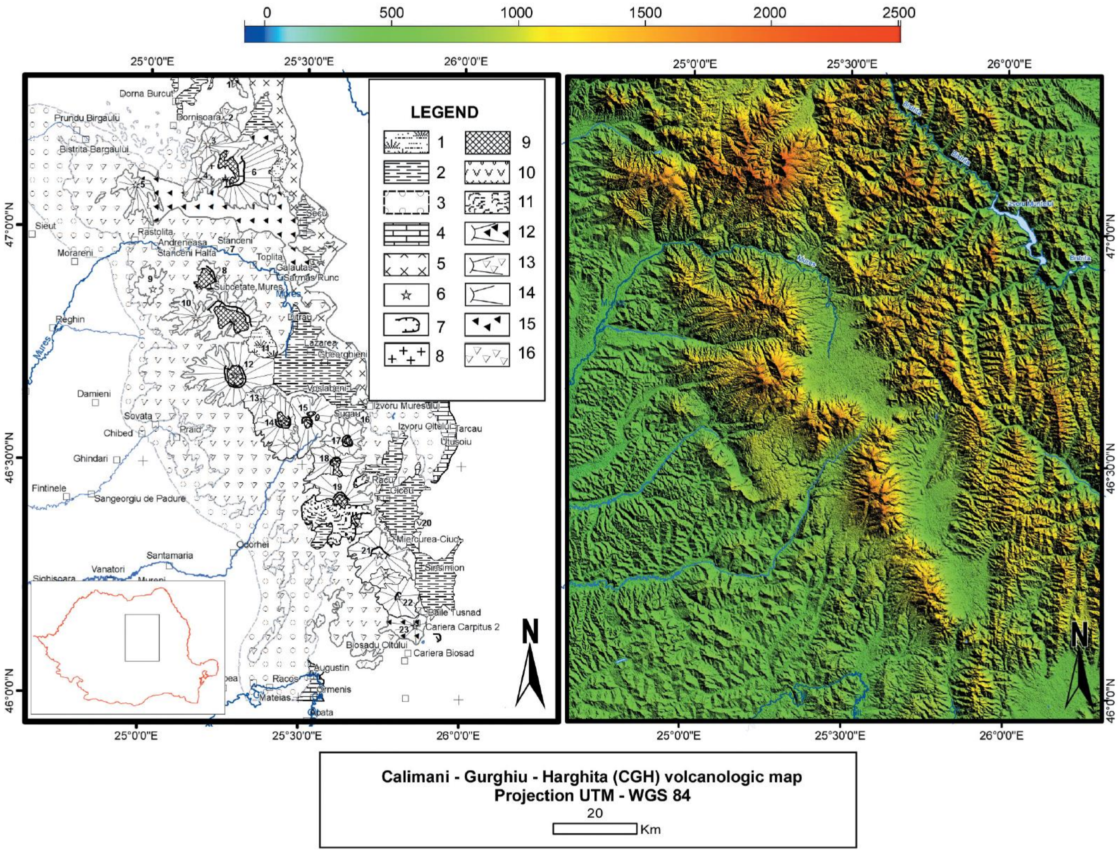


Figure 1 (Left) Sketch of the volcanic edifices along the Eastern Carpathians next the modern topography (right panel) of these edifices. Note that the younger edifices to the south are well preserved (mostly pristine), while the northern ones are heavily eroded., exposing materials up to 1500 m into the volcanic edifices, see also Figure 2. Image taken from [1].

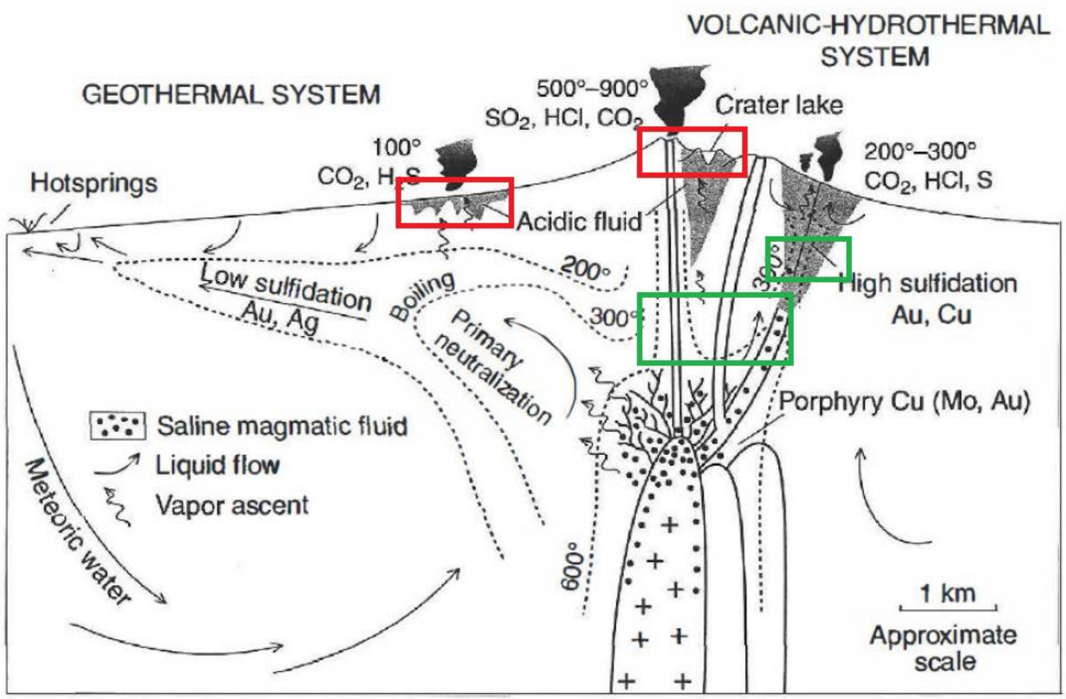


Figure 2 Summarizing model of the terrestrial hydrothermal systems [2]. Areas marked with red rectangles are characteristic to the type of materials available close to the surface and sampled in the southern part of the Eastern Carpathian volcanic edifices, while the green rectangles are characteristic to the type of materials exposed by erosion in the northern part of the volcanic chain.