TERRESTRIAL CARBONATITES AS POTENTIAL ANALOGUES TO MARS. L. Marinangeli[1,2], F. Liberi[1,2], L. Pompilio[1,2], M. Cardinale[1,2], E. Piluso[3], G. Rosatelli[1], A. Tranquilli[1] and M. Pepe[3], [1]DISPUTER, Università d'Annunzio Chieti-Pescara, Via dei Vestini, 31, 66100 Chieti, Italy, lucia.marinangeli@unich.it [2]International Research School of Planetary Sciences, Pescara, Italy, [3]Dipartimento di Scienze della Terra, Università della Calabria, Arcavacata di Rende (CS), [4] CNR-IREA, Milano, Italy

Introduction: The most common cause of carbonates formation on Earth is the chemical deposition from Ca-rich waters in sedimentary basins, mostly in shallow water. The lack of widespread exposure of carbonates on the Mars' surface in areas where geomorphological and sedimentological mapping confirm the presence of water for a long period of the Martian history, led us to look for a potential different origin of the carbonates identified on CRISM data [1, 2, 3]. We suggest the presence of carbonatites on Mars and we compare the capabilities of analytical tecniques for mineralogical analysis to recognise these peculiar type of rocks [4, 5]. Carbonatites are igneous rocks containing more than 50 percent of carbonate minerals and associated silicate minerals as olivine, pyroxene and phyllosilicates.

Carbonatites are associated with alkali silicate rocks that are usually of nephelinitic or melilititic affinity. The Martian carbonates are often present in layered rocks and in association with hydrated Fe-Mg silicates (clays family) and kaolinite-group minerals at places [1]. This mineralogical association is very similar to an water-altered carbonatite.

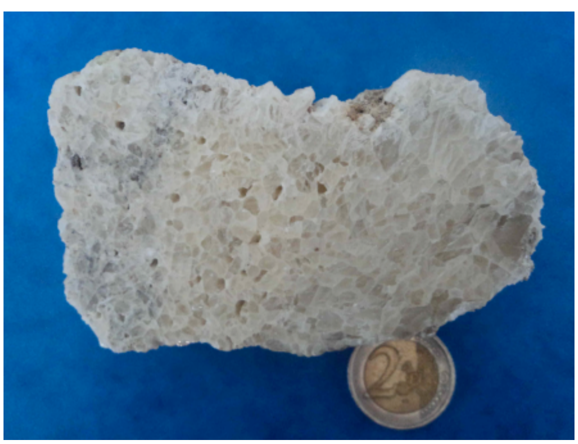

Figure 1. A late-Pleistocene intrusive carbonatite sample from Mt. Vulture (Italy).

The carbonatite samples and analysis results: We have compared the compositional and mineralogical affinity of some carbonatite samples (Figure 1) from different alkaline-carbonatite complexes from Uganda, Spain and Italy both intrusive and extrusive rocks. These samples are officially recognised carbonatites [6]. The mineralogy described for the carbonate and phyllosilicate rich rocks on Mars, using the XRD (Figure 2) and IR analyses. The mineral assemblage has been defined through petrographic analyses as well. It is important to stress that only with XRD analysis some minerals diagnostic of carbonatitic assemblage (i.e. melilite and monticellite) were clearly identified with XRD.

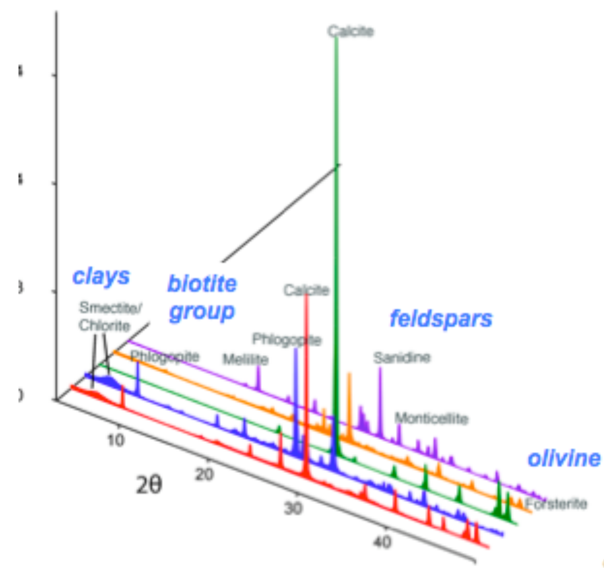

Figure 2. Mineralogical content from XRD analysis.

The same samples both as fresh cut and powder form have been analysed with an IR lab spectrometer. Figure 3 shows the acquired spectra compared.

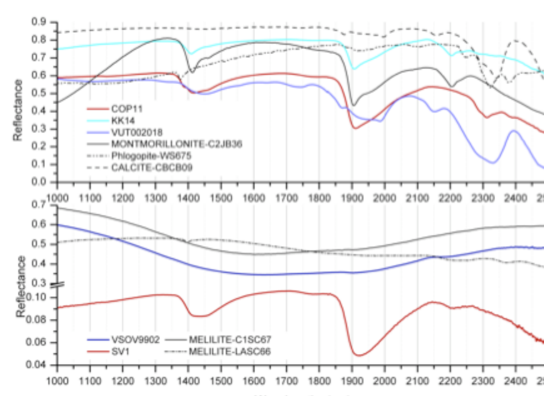

Figure 3. Mineralogical content from IR analysis.

We can clearly distinguish the spectral signatures of phyllosilicates, but other diagnostic minerals and sometimes even the calcite is not well visible. So, it is very important to use the XRD to analyse the martian samples in situ and to discriminate different origin of carbonatic rocks.

Looking for carbonatites on Mars, a potential candidate: The Elorza crater located close to the northern rim of Valles Marineris, shows an unusual central buldge resembling a volcanic vent (Figure 4).

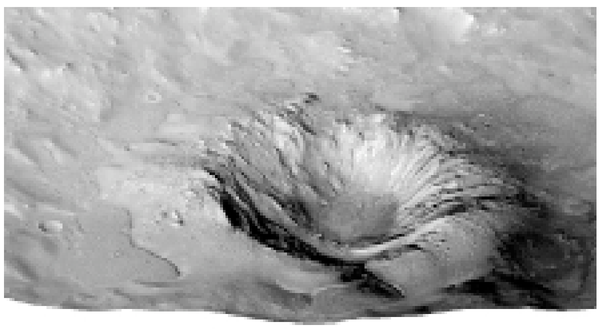

Figure 4. 3D view of the central buldge of Elorza crater (CTX over MOLA).

The analysis of the CRISM data clearly show the signature of carbonate in outcrops along the buldge rim (Figure 5). It is compelling the similarity between the CRISM spectra and those acquired on the terrestrial carbonatites. Thus, Elorza may represent a potential site for a martian carbonatitic volcanic event.

Final consideration: The relationships between carbonatites and the associated silicatic rocks are complex and still controversial. However, there is no doubt that carbonatites and primitive silicate volcanic rocks are mantle derived [7]. The implication of the potential presence of this type of rocks on Mars, deserves further investigations to better explain the association of carbonates and silicate volcanic rocks on Mars and the mantle-crustal dynamics of the planet.

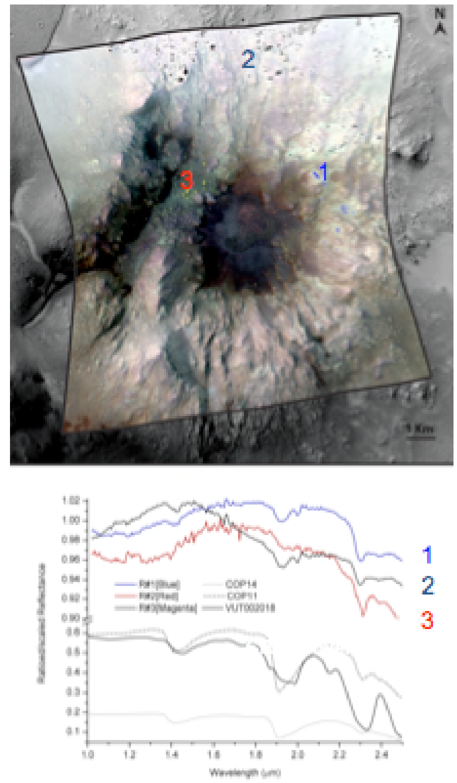

Figure 5. CRISM data of the Elorza crater compared to terrestrial carbonatites spectra.

References: [1] Michalski and Niles, 2010, Nature Geoscience, 751-755. [2] Helmann et al., 2008, Science, 322, 1828-1832. [3] Morris et al., 2010, Science, 329, 421-424. [4] Liberi F. et al., 2013, LPS, XLIV, #1997. [5] Marinangeli et al., 2013 Geophysical Research Abstracts, Vol. 15, EGU2013-9750. [6] Woolley A.R. and Kjarsgaard B.A., 2008, Geological Survey of Canada, Open File 5796. [7] Bell et al., 1999, Journal of Petrology 39, 1839-1845.