VNIR SPECTROSCOPIC MEASUREMENTS OF SAMPLES FROM BASALTIC IMPACT CRATER ROCKS. C. Carli[1], L. Pittarello[2], F. Capaccioni[1]; [1]Iasf-INAF, Roma (Via fosso del Cavaliere 100, 00133, Roma, Italy; cristian.carli@iasf-roma.inaf.it), [2]Department of Lithospheric Research, University of Vienna (Althanstrasse 14, A-1090, Vienna, Austria, lidia.pittarello@univie.ac.at).

Introduction: VNIR reflectance spectroscopy is one of the most important tool used to study the surface composition of extraterrestrial planets. In the last decades it was used to recognized the presence of different silicates on the surface of Mars, Moon and asteroids. VNIR spectra reveal a clear heterogeneity between different areas on the surface of other bodies, where the composition is still a mater of debate, like Mercury. The CF transition of Fe ions, principally, permit to identify several silicates like olivine (ol), pyroxene (px), plagioclase (pl), or glassy materials [1,2,3,4].

Different texture characteristics and grainsize of rock samples could also contribute to the spectral shapes differentiating the information of the rock composition [5,6]. Improving our capability to correlate spectra of similar rocks with different spectroscopic information will give us an important tool to map the surface's composition.

Impact cratering is an important geological process affecting the morphology as well as the petrography and mineralogy of the original surface.

Studying samples from different craters on volcanic materials can help to distinguish and better understand the compositional and/or petrographic influence on reflectance spectroscopy data of shocked basalts for improving our capability of interpretation of high spatial resolution orbiters and rovers.

In this study we report a preliminary spectra characterization and interpretation of some powder of samples from impact craters on basaltic regions from the south of Brasil (Paranà Basin region).

Crater's geological contest: Paranà volcanic basin is one of the largest and most extensive flood basalt provinces on Earth. The Parana´ flood basalts belong to the Serra Geral Formation (SGF) and are related to the opening of the South Atlantic Ocean, dated at about 133–132 Ma [7]. Tholeiitic basalts dominate the western portion of Parana´ state, with some minor rhyodacites.

The Vargeao Dome is a 12.4 km-diameter circular structure, whereas the Vista Alegre structure is a 9.5 km-diameter circular impact structure located 100 km to NW of Vargeao crater. Both craters are excavated in the SGF and the central uplift is marked by the occurrence of material related to the mesozoic eolian sandstone of the Pirambóia/Botucatu Formations, normally ~ 800 m below the basalt of the SGF[7,8].

The common impact features are occurrence of shattar cones, both in sandstone and in basalt, and shocked minerals in the polymict breccia.

Sample description: *Vargeao Dome*. Unshocked samples of basalt and rhyodacite collected outside the structure and samples of the lithology within the crater were studied. In detail we selected: 1) a basalt sample characterized by a fine-grained groundmass and intergranular texture, with very few phenocrystals and preserved glass, the mineral association is pl, px (pigeonite and augite), and few amounts of opaque minerals; 2) a rhyodacite sample, characterized by a holocrystalline matrix of quartz and phenocryst of pl (oligoclase), K-feldspar and few amount of a biotite and amphibole, representative of the acid member of the SGF, overlapping the basalt in this area; and 3) a brecciated volcanic rock which fills the crater, characterized by a reddish and oxidized clastic-melt matrix mostly composed of pl, px (augite) and few quartz, and huge (hundreds of μm to m) rounded aggregates of basaltic composition and smaller (mm-sized) sandstone clasts.

Vista Alegre crater. The samples studied are: 1) unshocked basalt belonging to the SGF and collected outside the structure, with similar petrographic and chemical composition (except an higher content in TiO_2) to the above described basalt, but characterized by a bigger grain-size of the groundmass; 2) a bomb-like object, included as clast in the polymict breccia, completely glassy, with few relicts of px and some fine recrystallized pl; 3) a polymict breccia containing clasts of basalt, other volcanic rocks, glass and few fragments of quartz-sandstones, suspended in a strongly altered fine-grained matrix, composed of volcanic pl and px, few calcite, and melt drops, partially to completely replaced by clay minerals.

Methods: Reflectance spectra were measured on rock powders (<0.06mm) and slab samples. Powders and slabs were prepared from the rock portion adjacent to the thin section used for petrographic and chemical analyses. On slab samples, the measured surface was slightly polished using a silicon carbide abrasive to remove the asperities left by the saw, but does not produce a mirror-like surface.

The bidirectional reflectance spectra were measured with a Fieldspec-Pro spectrophotometer mounted on a goniometer in use at SLAB laboratory at IASF-INAF, Rome. The spectra were acquired with 1 nm spectral sampling between 0.35 and 2.50 μm with i=30° and e=0°. The source used was a QTH lamp. The calibration was performed with Spectralon optical standard (registered trademark of Labsphere, Inc.). The illuminated spot was ~ 0.5 cm^2.

Spectroscopic data: *Vargeao crater.* The rhyodacite is the only no basaltic sample in this set of measurements and it shows a different behavior of other samples with a higher reflectance and an absorption band at 0.895 μm indicative of few Ca-amphiboles (Fig.1a). At longer wavelength the spectrum is flat with absorption bands indicative of hydrated alteration. The other two samples are distinctive characterized by a 1 and 2 μm bands indicative of Fe^{2+} in clinopyroxene (cpx) with augitic composition. Those bands are deeper in the pseudotachylite breccia than in basalt sample, which have a lower reflectance and a flatter shape versus longer wavelength likely correlate with the presence of finer crystal size and opaque minerals (Fig.1a).

Vista Alegre crater. These samples are all basaltic, with the only difference in TiO_2 content (3.2 wt.% basalt, 1.6 and 1.3 wt.% for bomb and breccia, respectively). Few amount of alteration is well characterized by the presence of two bands of 1.4 and 1.9 μm indicative of water in clay minerals (Fig.1b).

The spectra are dominated by an electronic absorption band at ~1.03 μm indicative of a cpx probably higher in Ca [2] respect to the augite of Vargeao samples, in agreement also with the absence of the 2 μm band. A weaker absorption bands are presents at 0.52 and 0.72 μm for the basalt and the basaltic bombs, whereas 0.72 μm is absent in the polimyct breccia, indicative of Ti^{3+} CF and $Fe^{2+} \rightarrow Fe^{3+}$ IVCT (Fig.1b).

Moreover a change in the slope in the IR region of these spectra is clearly present with a reddening from the breccia to the bomb to the basalts.

Conclusion and future steps: In this preliminary study we have begin a VNIR characterization of samples from area of two different impact craters located on basaltic lava field, which could be an useful investigation to better understand the spectra differences of shocked samples in craters. Measured of cut-rock samples will be also investigated, in particular the brecciated ones, which are heterogeneous in a cm-scale. To improve the interpretation of these samples a more precisely mineralogical characterization will be done, in addition to the already done study of mineral associations and deformation features and bulk rock chemistry, to relate the process that inferred the spectra characteristics described above. Subsequently, a more systematic sampling will be necessary to have a more abundant set of basaltic samples affected by different shocked features to understand how those characteristics can affect the VNIR spectral data of samples with similar bulk rock composition.

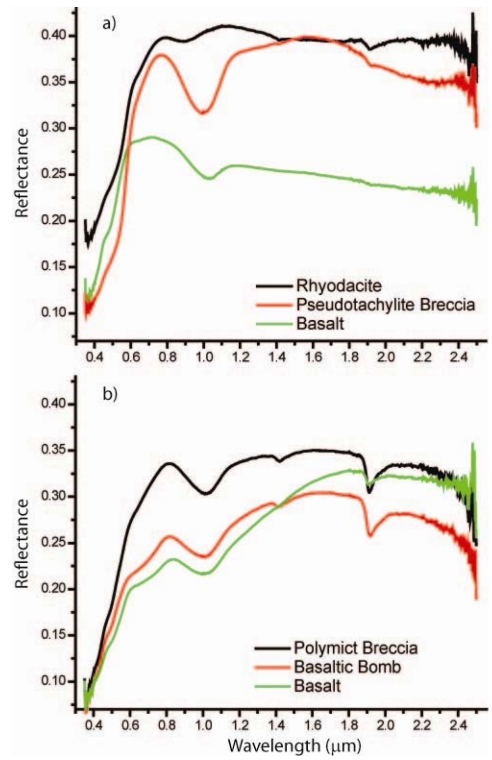

Fig. 1 - spectra of < 0.06 mm powders of Vargeao crater (a) and Vista Alegre crater (b).

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