Multi-spectral analyses (LIBS, Raman and VIS/NIR) of planetary analog material on volcanic deposits (Vulcano Island, Italy)

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The 5^{th} international Vulcano Summer School was a great opportunity to collect spectral data in an environment characterized by a large variety of volcanic and hydrothermal altered products. Our main goal was to investigate the in situ spectral response of a vast assortment of volcanic and hydrothermal deposits and compare these results with data collected in laboratory experiments. The Vulcano island was a perfect location for collecting data on several volcanic products characterized by a wide range of composition from basalt to rhyolite and considering also the products of Sulphur produced in the fumaroles area. In order to collect results considering the chemistry and the mineral contents we used a combination of three instruments. For investigating the mineralogical content, we performed measurements with a portable spectro-radiometer (PSR+3500) which collect results in the visible and near infrared spectral range (350 — 2500 nm) with a spot size of 3 by 3 mm. Moreover, we used a RaPort handheld Raman instrument by EnSpectr equipped with a 532 nm (same wavelength as used for the ExoMars2020 rover mission). The in situ chemical analysis were performed with a commercial handheld LIBS instrument (SciAps Z 300) which uses a laser to ablate a small amount of sample material and to produce a plasma spark whose spectral analysis permits rapid multi-elemental analysis in the field. The preliminary analysis of the acquired VIS/NIR spectra in comparison with the spectral libraries provided by PDS (https://speclib.rsl.wustl.edu/) implies a remarkable enrichment in alteration minerals in this area. So far, next to iron bearing oxides and clay minerals, several sulfates could be identified. The spectra analyzed show a nice transition from more iron-bearing lava blocks to material dominated by sulfates such as Alunite and Jarosite. Both minerals appear to be rich in K in the studied area, which was also seen in the LIBS data. The handheld Raman spectroscopy confirmed the VIS/NIR data for mineral recognition and was also able to identify traces of biomolecules such as carotenoids on the colonized rock surfaces, which are of highest interest for the characterization of the habitability and the search for life on Mars. This survey is a key point for testing the instrument responses in an environment which is a potential analogue of Mars. Therefore the investigated area provides a unique training ground for instruments and techniques foreseen for future robotic missions to Mars (e.g. Mars2020 and ExoMars2020 rovers).