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Spectroscopic and minero-petrological investigation of boninites from Cyprus as potential analogues of Mercury lavas

Despite the clearly different formation conditions regarding oxygen fugacity, water contribution and iron abundance in
the source region, terrestrial boninites and komatiites are considered promising analogues for Mercury's lavas based on MESSENGER Mission data [1]. This study aims to compare terrestrial boninites with Mercury lavas, considering spectroscopic, petrological, and mineralogical characteristics. We are investigating samples coming from three distinct locations (labeled PAR, ARA, ATH) within the Troodos massif, Cyprus island. We selected representative samples for each locality and performed X-ray Fluorescence (XRF), scanning electron microscopy (SEM), electron microprobe (EPMA) analysis and reflectance spectroscopy in the spectral ranges covered by the VIHI imaging spectrometer (0.4-2.0 μm) [2] and the MERTIS spectrometer (7-14 μm) [3] onboard the ESA's BepiColombo mission. XRF bulk composition analysis gave average values (wt%) of major elements (SiO_2 53.2, Al_2O_3 12.2; FeO 7.9; MgO 12.55; CaO 8.5) that are in good agreement with the average compositions of Mercury's geochemical terranes [1,4]. SiO_2 and Al_2O_3 contents fall right in the ranges of Mercury's terranes; MgO content in our samples is slightly lower and CaO higher; the only major difference is the higher FeO content, as expected. The spectroscopic and compositional differences observed between the samples, reflect their different mineralogy. Samples PAR show vitrophyric texture with olivine (Fo_{89}) and clinopyroxene ($En_{48}Wo_{38}Fs_{14}$) phenocrysts in glassy groundmass. Plagioclase crystals are not detected. Minor weathering is visible with the presence of sporadic calcite grains. Samples ARA are composed of clinopyroxene ($En_{47}Wo_{30}Fs_{13}$) in albitic groundmass ($Ab_{98}An_2$). Weathering is clearly visible with the presence of clinochlore replacing olivine. ATH sample is holocrystalline and composed by euhedral clino- ($En_{48}Wo_{42}Fs_{10}$) and ortho-pyroxene ($En_{82}Wo_4Fs_{14}$) crystals surrounded by plagioclases (from $Ab_{97}An_3$ to Ab_7An_{93}). Olivine is not observed and some portions are composed only of clay minerals. VNIR spectra show an absorption band at ~1 μm which is associated with olivine and pyroxene. Some samples show also clear absorption features at ~1.4 μm, ~1.9 μm and 2.3 μm due to terrestrial hydrated alteration phases. Taking into account the differences intrinsic in the acquisition methods and in the objects under analysis [e.g. 5], we tried a preliminary comparison between laboratory reflectance spectra of boninite samples and MASCS/MESSENGER Mercury data [6]. This comparison will be implemented with ongoing measurements including VNIR reflectance analysis with different acquisition angles and on smaller grain sizes and TIR emittance spectroscopy investigation. These new data, in combination with minero-petrologic characterization, could also facilitate future comparisons with mineralogical data expected from SIMBIO-SYS/VIHI and MERTIS spectrometers.

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