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NIR and mid-IR spectroscopy on silicate glasses for the characterization of magmatic bodies on terrestrial planets.

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Silicates are the main constituent of terrains on terrestrial planets in the solar system. Silicate glasses represent the amorphous phase of silicate crystals. Typically, volcanic rocks are afanitic or porphyric rather than holocrystalline: the fraction of amorphous material is therefore major than the fraction of crystalline material. Other works focus on the spectral characterization of silicates, but it is important to study silicate glasses properties to better interpret available and future remotely sensed spectra from past and future missions.
In this study, emissivity and reflectance spectra have been investigated on different series of silicate glasses, having a wide compositional range and representing different earth-like magmatic series, with a systematic variation in silica content and alkaline character. Glasses were synthesized starting from natural rocks and then crushed to powders, which were sieved to obtain different granulometry classes. Spectral characterization was performed in two different laboratories for two different ranges: at the Planetary Emissivity Laboratory (DLR, Berlin), mid-IR data at different temperatures have been acquired. Here, reflectance (fresh and after heating at 700 [U+25E6] C, spectral range 1-18 μm) and emissivity (150 [U+25E6] C, 300 [U+25E6] C, 450 [U+25E6] C, 700 [U+25E6] C; spectral range 5-16 μm) spectra were collected. At the Institute for Space Astrophysics and Planetology (IAPS-INAF, Rome): near-IR spectra (fresh sample, spectral range 0.35-2.5 μm) have been acquired in reflectance.
Results show that the shift of the spectra, by taking Christiansen feature (CF) as a reference point, well relates with the silica content, the SCFM factor and/or the degree of polymerization state via the NBO/T parameter: the more evolved is the composition, the more polymerized the structure, the shorter the wavelength at which CF is observable. Alkaline character influences mid-IR region, while granulometry of powders strongly influences spectral resolution. For what concerns near-IR reflectance, it is observed how the spectra are heavily influenced by iron content, iron speciation (Fe III/ Fe tot) and occurrence of magnetite nanolites.