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Experimental measurements of spectral emissivity of basaltic melt

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Emissivity spectral profiles in the short wave infrared region of spectrum (SWIR) are presented for Etnean molten lavas. Emissivity is a key parameter in remote sensing thermal analysis. Starting from the radiance measured by a remote sensor in a given infrared band, it is possible to evaluate the brightness temperature at the sensor. Generally, this temperature is different from surface temperature. This is due to different causes: the surface is not a black body, thus emissivity contribution is not negligible; part of the radiation emitted by lavas is absorbed, reflected and scattered by the atmosphere. Emissivity values of molten rocks are lacking in literature. The Experimental Volcanology Lab of the University of Wuerzburg, Germany, is equipped with a relatively large rock melting facility equipped with a 20 cm-diameter crucible inductively heated up to and above magmatic temperature. We load the crucible with 0.3 kg ca. of granulated rock from a basaltic bomb erupted at Etna in 2002 and heat it up to 1250 ˚C. Then we gradually lower the temperature while acquiring spectra of the melt surface. A thermo-couple touching the same surface and connected to a data-logger continuously records melt temperatures. The methodology adopted in this experiment is based on the use of a field Spectroradiometer (ASD FieldSpec Pro) to estimate the radiance emitted from basaltic melts at different temperatures in the SWIR. Post processing of radiance spectra using the radiative transfer code MODTRAN allows to distinguish between gas absorptions and emissivity features in the spectral profiles.

Preliminary results show that spectral emissivity signature of Etnean molten lavas varies as a function of temperature. Emissivity differences occur within 1.75 and 2.18 microns and become evident for temperatures above 700 ˚C.