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Heating and cooling of minerals analogs of Mercury

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A major result of the MESSENGER mission was to reveal the volcanic hermean surface poor in iron [Peplowski et al., 2016], but unexpectedly rich in volatile elements [Nittler et al., 2011]. The high abundance of sulfur on Mercury is particularly interesting, because its sublimation is suggested to trigger the formation of hollows [Blewett et al., 2013]. Laboratory experiments whose aim is to study the evolution of sulfides in the conditions of Mercury's surface are in progress [Varatharajan et al., 2018]. However, to understand the spectral properties of the surface, it is relevant to consider how minerals can be affected by the hermean environment. The effects of temperature and space weathering on minerals have been already studied [e.g. Suto et al., 2006; Helbert et al., 2013; Brunetto et al., 2014] but rarely on retrieved Mercury‚s composition analogs [Morlok et al., 2017]. Here we focus on the effects on minerals analogs of the extreme variations of temperature occurring on Mercury.

We preliminarly consider a plagioclase An80 [Serventi et al., 2014] as a Mercury's minerals analogs under different states (powder, pellet and slice). Other analogs are about to be tested (e.g. ion-irradiated forsterite and nepheline half covered with a thin film of carbon [Carli et al., 2018]). To simulate the hermean temperature conditions (80-700 K), we used a LINKAM (nitrogen purged) cell to heat and cool our samples which allows to measure VIS-IR (0.4-15 μm) spectra as a function of temperature. We have two setups for our spectroscopic measurements: 1) a visible-near infrared spectrometer Maya2000 Pro coupled with a microscope through optical fibers; 2) a near to mid infrared spectrometer coupled with an Agilent microscope, installed at the SMIS (Spectroscopy and Microscopy in the Infrared using Synchrotron) beamline of the synchrotron SOLEIL.

An ongoing analysis for the plagioclase samples showed: 1) a darkening of the samples when increasing T; 2) a shift towards greater wavelengths for the Christiansen feature and several Reststrahlen bands (RB) (e.g. at $\sim$9.0 and $\sim$10.5 μm) as a function of increasing T; 3) a decreasing of the bands depth when increasing T; 4) a shape changing for some RB; 5) a monotonous spectral slope variation with increasing T. Most of these spectral variabilities are in agreement with studies on the emissivity of the other minerals (e.g. [Helbert et al., 2013b]) and are similar to those of the space weathering [Brunetto et al., 2015], except the fact that they are reversible. A more complete analysis will be presented.

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