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Calcium Pyroxenes at Mercurian Surface Temperatures: Investigation of In-Situ Emissivity Spectra.

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Several observations point to the possibility that Ca-rich (and low-Fe) clinopyroxenes could be common constituent minerals of the surface of Mercury. The upcoming ESA-JAXA BepiColombo mission to Mercury will carry on board the Mercury Radiometer and Thermal Infrared Spectrometer (MERTIS) that will provide surface emissivity spectra in the wavelength range from 7-14 μm. This spectral range is very useful to identify the fine-scale structural properties of several silicates including pyroxenes.

The extreme daily surface temperature range of Mercury (70 to 725 K) that significantly affects the spectral signature of minerals will make the interpretation of MERTIS observations challenging. It has been shown that spectra of clinopyroxenes with similar calcium content display a deepening of the main absorption bands, and a shift of the band minima toward higher wavelengths with increasing temperatures. Similar shifts can also be observed at constant temperature with increasing iron content in the M2 site. Therefore, the thermal expansion induced by the increasing temperature simulates the presence of a larger cation (e.g., iron vs. magnesium) within the mineral structure. Interestingly, each band shifts by a different amount, representing a marker for the real chemistry of the sample. A detailed study of the described mineral behavior is fundamental to localize those spectral bands sensitive to the daily temperature range of the Mercury surface. In combination with the temperature measurements obtained independently by the radiometer channel of MERTIS this will help to further constrain the mineralogical interpretation of the MERTIS spectral data.

Here we present high-temperature (up to 750 K) laboratory emissivity spectra of several augitic pyroxenes with different calcium contents and very different magnesium to iron ratios. The spectra were derived from individual well-preserved natural crystals of several pyroxenes of less than 125 ?m in size, which approaches the presumable size of Mercurian regolith particles. The emissivity measurements of the heated samples under vacuum have been conducted using the Mercury simulation chamber at the Planetary Emissivity Laboratory (PEL) in Berlin.