Heating saponite, serpentine, and a carbonaceous chondrite spectral analogue under vacuum to track the spectral variability of the 2.7 µm band. S. Sidhu[1], D. Applin[1], E.A. Cloutis[1], A. Maturilli[2], and J. Helbert[2]. [1]Centre for Terrestrial and Planetary Exploration, 515 Portage Avenue, R3B 2E9, Winnipeg, Manitoba, Canada, sidhu-s13@webmail.uwinnipeg.ca. [2]Institute for Planetary Research, German Aerospace Center DLR, Rutherfordstr. 2, 12489 Berlin, Germany.

Introduction: The scientific significance of carbonaceous chondrites has been established as windows into our early Solar System [1]. The presence of phyllosilicates in CM2 carbonaceous chondrites indicates a history of aqueous alteration [2, 3]. Carbonaceous chondrites (CCs) exhibit spectral similarities to several C-complex asteroids, which may act as parent bodies [4, 5]. Several CCs (and therefore their parent body asteroids) have undergone thermal alteration following aqueous alteration [6, 7]. Here we present the reflectance spectra of heated saponite, serpentine, and a spectral analogue created at the Centre for Terrestrial and Planetary Exploration (C-TAPE) laboratory at the University of Winnipeg, Canada. The intent is to understand how thermal metamorphism affects their spectroscopic properties.

Experimental details: We heated powdered samples (<45 µm) of saponite (C-TAPE ID: SAP104), serpentine (C-TAPE ID: Jeffery-1), and a carbonaceous chondrite spectral analogue created in-house, MUD008 (see **Table 1**). The heating experiments were conducted at the Planetary Spectroscopy Lab (PSL) at DLR, Berlin. Samples were heated up to 900°C using PSL's external emissivity chamber under vacuum (~0.07 mbar). Samples were heated in 100°C increments for 1 hour at each increment. A Bruker Vertex 80v FTIR spectrometer equipped with the Bruker A513 bi-directional reflectance accessory was used to collected data under vacuum (~0.1 mbar). Data were collected at a viewing geometry of i = 30° and e = 0°, and relative to Spectralon® 99% diffuse reflectance standard in the VISNIR (0.4-1.1 µm) and InfraGold in the IR (1.1-5.0 µm). Data were collected at a resolution of 4 cm^{-1}, and spectra were average over 500 scans.

Table 1: Samples used in this study.

Sample	C-TAPE ID	Notes
Saponite	SAP104	<45 µm
Serpentine	Jeffery-1	<45 µm
MUD008	MUD008	<45 µm. 90.02 wt. % saponite, 9.98 wt. % carbon lampblack

Results: Results for all three samples mentioned in Table 1 are briefly reported in this abstract (see **Figures 1** and **2**).

SAP104: The reflectance spectra in the VISNIR displays a general decrease in reflectance as temperature increases. Similarly, the spectra in the IR (1.1-5.0 µm) display a decrease in reflectance above 300°C. The OH absorption feature at ~2.7 µm decreases in depth with increasing temperature, qualitatively displaying the shallowest band at 900°C. Other H_2O/OH features at ~1.4 and 1.9 µm behave consistently with the ~2.7 µm feature and decrease in depth with increasing temperature. Metal-OH features at ~2.3 µm are also reduced in depth as temperatures increase.

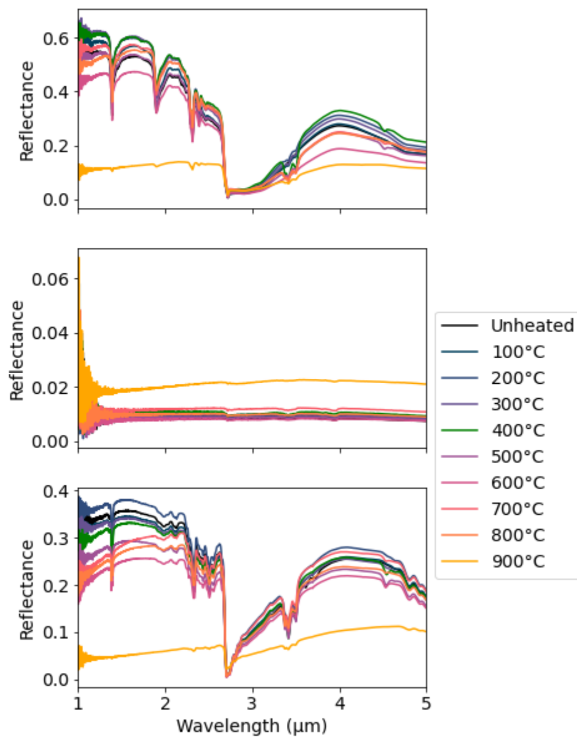

Figure 1: IR (1-5 µm) spectra heated saponite (top), MUD008 (middle), and serpentine (bottom).

Jeffery-1: Similar to the spectra of SAP104, the reflectance of Jeffery-1 generally displays a decrease with increasing temperature in both the VISNIR and IR, although some variability does occur between 100-300°C in the IR. H_2O/OH associated features at ~1.4, 1.9, and 2.7 µm all decrease in depth with increasing temperature. The metal-OH feature at ~2.3 µm also decreases with increasing temperature.

MUD008: Unlike the other two samples, the reflectance values of MUD008 increase with temperature in both the VISNIR and IR. Spectrally, MUD008 is dark and mostly featureless; VISNIR displays Fe^{2+}/Fe^{3+} associated features such as a red-slope below ~0.8 µm and a broad feature at ~1.0 µm.

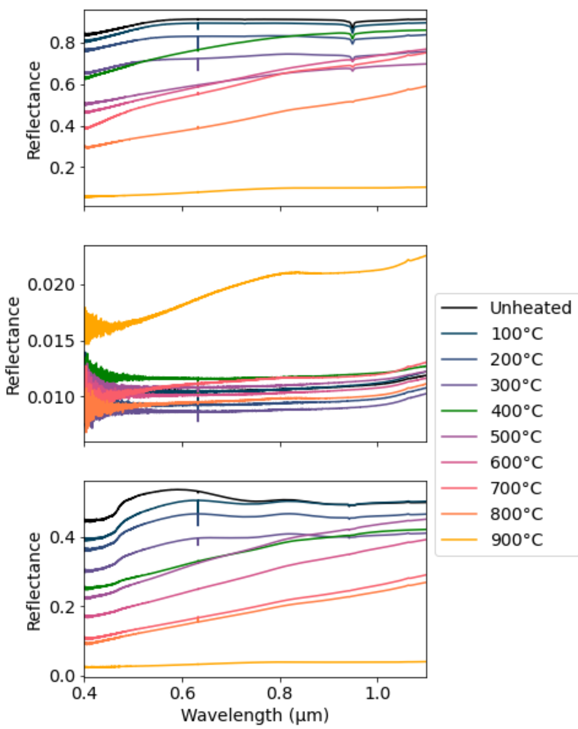

Figure 2: VISNIR (0.4-1.1 µm) spectra of heated saponite (top), MUD008 (middle), and serpentine (bottom). Spectral artifact at ~0.64 µm.

Discussion: Our results show that several H_2O/OH absorption features at ~1.4, 1.9, and 2.7 µm decrease with increasing temperatures in the phyllosilicates saponite and serpentine. The Mg-OH absorption feature at ~2.3 µm also decreases in strength with increasing temperature. MUD008 is a spectral analogue created by mixing saponite and carbon lampblack (see **Table 1**). Gas chromatography-thermal conductivity, reflectance spectroscopy, and X-ray diffraction measurements show a relatively large concentration of dolomite (20-30 wt.%) in SAP105 (saponite sample used to create MUD008). Upon heating, this likely leaves behind a residue of Mg-, Ca-, and small amounts of Fe- oxides, the latter of which have strong VNIR spectral features. Previous experiments have shown dolomite to thermally decompose at temperatures exceeding 700°C at standard pressures [8, 9], which may be consistent with our data.

Future work: These results are part of an ongoing study to investigate the spectral and mineralogical variations of CCs as a result of heating under vacuum conditions. Immediate future work includes conducting XRD analysis on the heated samples which will help us interpret the spectral variations observed. Future planned studies include heating experiments on a wide range of CCs.

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