DECIPHERING THE PARENT BODIES OF HEATED CMs

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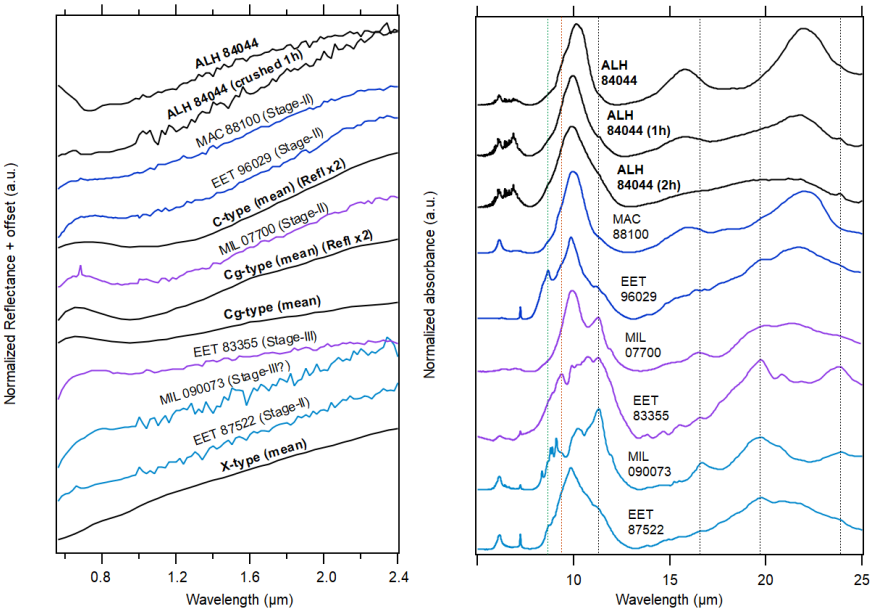
Introduction: Linking meteorites and asteroids is an important step in retracing past planetary dynamics. Here we explore the reflectance spectra of Stage-II and III heated CM chondrites, and Elephant Moraine (EET) 83355, in search for asteroidal analogues. To better understand the observed spectral features, we compared the reflectance data with IR transmission spectra, and that of an artificially amorphized (crushed) unheated CM chondrite, Allan Hills (ALH) 84044. Reflectance spectra are mainly from [1], and a couple IR transmission spectra are from [2]. Otherwise, the samples and spectra were prepared and measured following the protocols of [2] and [3]. For comparisons with asteroid spectra, we used mean spectral types by [4]. The sample grinding was done for a combined total of 1 and 2 hours using a Fisher Bioblock Scientific Model Mixer Mill 200. The petrographic grades of our samples (figure below) are from [5,6,7 and references therein].



Summary of the VNIR reflectance spectra (left) and IR transmission spectra (right) studied in this work.

Results and Discussion: We find that artificially crushed ALH 84044 mimics somewhat the reflectance spectra of Stage-II heated chondrites, such as EET 96029 and MacAlpine Hills (MAC) 88100. This indicates that the loss of the characteristic 0.7-μm and 0.9-μm features of serpentine (typical of unheated CMs) occured due to amorphization. Miller Range (MIL) 07700 and EET 83355 have similar reflectance spectra to the aforementioned, but with possibly broader and more pronounced 0.9-1.0-μm absorption bands. This is probably partially due to the additional contribution of olivine, which is more present in these meteorites based on our IR spectra. The four aforementioned meteorites resemble mean C-type and Cg-type asteroid spectra. On the other hand, other heated CMs, such as EET 87522 and MIL 090073 have spectra that are close to the X-type asteroid mean. This implies that some C, Cg and X-types (and spectrally similar asteroids) may be the parents of Stage-II and III heated serpentine-rich meteorites (e.g. CMs, partially consistent with [8]). This further implies that some C, Cg and X-type asteroids have surfaces rich in amorphized serpentine. Based on the thermal history of CMs [5,6] and the processes involved in space weathering [9], this amorphization is probably collisional in origin or solar-induced. Consequently, one could speculate that some of these asteroid surfaces were once Cgh/Ch-like (parents of unheated CMs [10]) that suffered prolonged or more intense space weathering, and/or significant impact events.

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