Chondrule flattening of MET01072 CM chondrite: possible evidence for long-duration slow impact

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Some CM chondrites experienced impacts and show preferred orientation of flattened chondrules (e. g., [1]). Mineralogical study of the MET01072 CM chondrite shows heavy chondrule flattening [2]. The meteorite is suggested to have suffered multiple weak impacts [3]. In the present study, we have carried out water analysis of MET01072 by Karl Fischer titration method, reflectance spectra measurements of visible, near- and mid-infrared range, additional mineralogical observations, and experimental heating of matrix, in order to constrain shock temperature and pressure.

Mineralogical observation indicates that chondrules retain most of olivine phenocryst, thus aqueous alteration degree is CM2.3. It is obvious that impact has taken place after hydration, because many cracks generated upon impact are going thorough hydrous phases such as TCIs and chondrule mesostasis phyllosilicates. Although heavily deformed, TCIs and serpentine in matrix are not decomposed based on synchrotron XRD and TEM observation. Experimental heating of matrix indicates decomposition temperature of the TCIs is 400°C and serpentine is 500°C, suggesting shock temperature was <400°C and pressure was <10GPa [4]. FT-IR analysis shows limited dehydration based on 3-micron band strength in comparison to Murray that is unshocked CM, although water content of this meteorite (~9 wt%) is similar to Murray. All these observations indicate low shock heating temperature, being consistent with previous studies [3, 5]. However, impact induced-cracks are generated only in the direction perpendicular to compression axis, which appears to inconsistent with multiple impacts. Threfore we suggest another interpretation for this meteorite deformation: it underwent single slow impact with long duration. [1] Rubin et al. (2012) GCA 90, 181-194. [2] Nakamura et al. (2012) Japan Geoscience Union Meeting. #PPS05-09. [3] Lindgren et al. (2015) GCA 148, 159-178. [4] Tomioka et al. (2007) MAPS 42, 19-30. [5] Quirico et al. (2015) 78th Meteoritical Society Meeting, #5190.