**RATING THERMAL METAMORPHISM IN C2 CHONDRITES WITH INSOLUBLE ORGANIC MATTER**

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**Introduction:** CI, CM, CR and C-ung chondrites are usually classified as types 1 and 2 chondrites. However, some of them experienced heating processes in their parent bodies, challenging the usual definition of petrologic types. Shock processes and solar heating have been invoked to account for this thermal metamorphism [1]. The composition and structure of Insoluble Organic Matter (IOM) is a potential tracer of the extent and nature of the thermal metamorphism of chondrites, and has been successfully applied to type 2 and type 3 chondrites [2,3]. Here we report a study over 38 CMs, 5 C2-ung, 9 CRs. Raman and FTIR analysis of IOM provided information on both the composition and polyaromatic structure, which were compared to petrologic and mineralogic data.

**Results and discussion:** Raman spectroscopy was performed with a Jobin-Yvon LabRaman micro-spectrometer on raw matrix grains (514 nm excitation). FTIR measurements were collected with a Hyperion 3000 Bruker micro-spectrometer on IOM grains with a 4 $cm^{-1}$ spectral resolution. IOM were extracted with the CsF/HCl method [4], at IPAG and at Carnegie Institute. The Raman spectra of all chondrites display the so-called G and D bands superimposed onto a fluorescence background of variable intensity. The Raman parameters derived from these spectra point to three groups of chondrites: (i) group 1: chondrites thermally processed; (ii) group 2: chondrites with no (detected) thermal processing, and (iii) group 3: a mix of chondrites that experienced mild thermal metamorphism and atypical chondrites. Along with Raman data, we use the $CH_2/CH_3$ ratio derived from IR spectroscopy, and the H/C ratio [3,5]. Our data indicate that the following chondrites were heated: PCA 91008, WIS 91600, Sutter's Mill, Y 86270, PCA 02012, EET 83355, EET 87552, EET 96029, MAC 88100, Tagish Lake, Cold Bokkeveld and QUE 93005. These conclusions are consistent with the degree of hydration measured either as bulk H or as structural OH in clays [3,6]. Atypical chondrites are Bells, Essebi and GRA 95229: they have Raman parameters possibly consistent with a thermal processing, but their IOM compositions do not support any thermal processing. Finally, petrographic studies have proposed that the extent of aqueous alteration in CM chondrites was controlled by shocks of very low intensity [7]. Such shocks might have modified IOM compositions, but our data do not reveal a clear correlation between IR compositional tracers and petrologic subtypes. We will discuss the implications of this lack of a clear correlation.

**References:** [1] Nakato A. et al. 2008. *EPS:* 60, 855-864. [2] Bonal et al. *GCA*: 71, 1605-1623. [3] Alexander et al. 2013. *GCA*: 123, 244-260. [4] Cody and Alexander 2005. *GCA*: 69, 1085-1097. [5] Orthous-Daunay et al. 2013. *Icarus*: 223, 534-543. [6] Garenne et al. *GCA*: 137, 93-112. [7] Lindgren et al. 2014. *GCA*: 148, 159-178.