EXPLORING THERMAL PROCESSING OF THE MILDLY AQUEOUSLY ALTERED CM2 EET 96029 USING SULPHIDE MINERALOGY AND CARBON STRUCTURE.

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Introduction: EET 96029 is one of the least aqueously altered CMs yet described with attributes such as chondrule mesostasis glass, gehlenite bearing CAIs and amorphous material in the matrix [1]. Mildly altered CMs are rare but important for reconstructing the earliest history of parent body aqueous alteration [2]. In addition to aqueous processing, many CMs are also affected by post-hydration thermal metamorphism [3]. It is important to establish the degree of heating in CMs to disentangle features that could be a result of either a pristine nature with only minor aqueous alteration, or dehydration caused by post-aqueous thermal processing. Carbon can be a useful tool for reconstructing CM thermal history since it gradually increases in structural order with heating [4]. Sulphide composition and microstructure is another measure that can be used to trace thermal events in CMs [5]. Here we have used both Raman spectroscopy of carbon and petrography of sulphides to determine if EET 96029 is near pristine or has been thermally metamorphosed.

Methods: BSE imaging and quantitative elemental ED X-ray analyses of sulphides was carried out on a polished thin section of EET 96029 using a field emission Zeiss Sigma SEM operated at 20 kV. Carbon in powdered samples of EET 96029 and six other CM meteorites chosen for comparison (Cold Bokkeveld, Murchison, LON 94101, PCA 91008, QUE 93005 and SCO 06043) was analysed using a Renishaw inVia Raman microscope operated with a 514 nm laser. The collected Raman spectra were processed using automated fitting procedures [6].

Results and discussion: Grains of pentlandite are rare or absent in EET 96029, possibly owing to the mild aqueous alteration [7]. However, nine out of eleven analysed sulphides are composed of pyrrhotite with µm-sized lamellae of pentlandite, which implies heating to 300-750 °C [5]. The processed Raman spectra were plotted in a carbon D (FWHM) *vs* D/G (intensity) diagram. The data show that PCA 91008 is more thermally altered than the rest of the samples; it has a higher D/G (intensity) and a lower D (FWHM), consistent with previous studies [4]. EET 96029 has a slightly higher D/G (intensity) than the other 5 CMs, which is possibly a sign of mild heating, although this interpretation is tentative as carbon is fairly insensitive to mild thermal metamorphism. We conclude that EET 96029 is one of the least aqueously altered CMs yet described but its sulphide petrography, and possibly its carbon structure, implies that it has undergone mild heating. This meteorite therefore suggests that aqueous alteration and thermal metamorphism were not necessarily coupled, which has important implications for our understanding of parent body internal structure and evolution.

References: [1] Lindgren and Lee 2015. Abstract#1760 46th LPSC [2] Hewins et al. 2014. *GCA* 124:190-222 [3] Nakamura 2005. *J. Min. Pet. Sci.* 100:260-272 [4] Quirico et al. 2014. *GCA* 136:80-99 [5] Kimura et al. 2011. *MAPS* 46:431-442 [6] Sparkes et al. 2013. *App. Spec.* 67:779-788 [7] Zolensky et al. 1995. *GCA* 59:4707-4712. **Acknowledgements:** NASA ANSMET, NHM London, UK-STFC.