ORGANO-CARBONATE ASSOCIATION IN CARBONACEOUS CHONDRITES.

Q. H. S. Chan[1], M. E. Zolensky[1] and M. Fries[1]. [1]ARES, NASA Johnson Space Center, Houston, TX 77058, USA, E-mail: hschan@nasa.gov.

Introduction: Carbonaceous chondrites (CCs) are primitive meteorites that contain a large variety of carbon- and nitrogen-bearing compounds, which have been widely investigated for life's origins in past decades. While ~2 wt% of bulk CC is organic matter, carbonates only make up <0.2 wt% [1]. Organo-carbonate associations in aqueous setting allow the adsorption of organic matter onto carbonate mineral surfaces, which make carbonate an effective medium for the accumulation and concentration of organic matter [2-4]. This study examines the organo-carbonate association in CCs using μ-Raman imaging.

Samples and Analytical Methods: We prepared polished thin sections of five CM2s: Jbilet Winselwan (an unusual CM, hereafter, Jbilet), Murchison, Nogoya, Santa Cruz, and Wisconsin Range (WIS) 91600. We identified carbonates with an optical microscope, and the selected areas were then studied with Raman spectroscopy. The Raman peaks were reduced by simultaneous peak fitting to pure Lorentzian profiles (one calcite, one G and four D bands) and linear baseline correction accomplished using custom software written in the Python programming language.

Results and Discussion: Carbonates were identified by optical examination and confirmed by the distinctive Raman band in the ~1100 cm^{-1} region which corresponds to the symmetric stretch mode of the $(CO_3)^{2-}$ anion [5]. The typical first-order D bands at ~1350 cm^{-1} and G band at ~1580 cm^{-1} were detected in the carbonates in Jbilet, Nogoya and WIS 91600. The broad D and G bands indicate the presence of highly disordered aromatic materials. On the contrary, while carbon peaks are observable in the matrixes of Murchison and Santa Cruz, the carbonate crystals are devoid of organic matter. The overall shapes of the Raman spectra show that these chondrites have experienced low peak metamorphic temperatures (PMT). Jbliet has experienced the lowest PMT among the analyzed CMs (~200°C).

Jbilet, Nogoya and WIS 91600 have experienced a more extensive aqueous alteration as compared to many other CMs [6-8]. The carbonates were likely formed as late-stage alteration replacement products, which could also serve to entrain or adsorb organic materials during their formation. This process can be influenced by the carbonate nucleation rate, which is in turn affected by PT conditions and carbonate concentration in the liquid phase. We will discuss how mineral phase Raman imaging can be used to interpret the nucleation rate of the carbonates, and by studying the organic contents of CMs with different degree of aqueous alteration we will demonstrate the evolution of organics as influenced by aqueous processing.

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