MINERALOGICAL AND ELEMENTAL COMPOSITION OF CARBONACEOUS CHONDRITES BY MICRO-RAMAN SPECTROSCOPY AND SEM/EDS. A.G. Dall'Asén[1], A.R. Stokke[1], R. Paul[1], R. Kayastha[1], B.C. Bromley[2], and S.J. Kenyon[3]. [1]Department of Physics and Astronomy, Minnesota State University-Mankato, Mankato, MN 56001, USA. E-mail: analia.dallasen@mnsu.edu. [2]Department of Physics and Astronomy, University of Utah, 115 South 1500 East, Salt Lake City, UT 84112, USA. [3]Smithsonian Astrophysical Observatory, 60 Garden St, Cambridge, MA 02138, USA.

Introduction: Meteorites provide precious clues about the formation of planets in the solar system. In particular, carbonaceous chondritic meteorites, considered the most primitive surviving materials from the early Solar System, can contribute to understand how planetisimals (the precursors to planets, of 1-100 km in radius) formed from dust (micron-size grains) [1]. These relics are mainly composed of chondrules (micro/millimeter-sized inclusions) surrounded by a matrix of microparticles [2].

Here we present a comparative study of the mineralogical and elemental composition of the chondrules and surrounding matrix of two carbonaceous chondritic meteorites, Moss (CO) and Murray (CM), using low- and high-resolution micro-Raman spectroscopy and SEM/EDS (Scanning Electron Microscopy/Energy Dispersive X-ray Spectroscopy). We examine how these properties vary in different regions of the chondrules and matrix [3], and between these two samples, looking for signatures of the physical processes that drove their formation.

Samples: Two carbonaceous chondritic fragments were studied: Moss (CO3.6, 1.3 g, fell in Ostfold, Sweden, in 2006) and Murray (CM2, 8 g, fell in Kentucky, USA, in 1950). No sample preparation was required for either Raman or SEM/EDS measurements. Figure 1 shows a photograph of both samples with the measured chondrules (marked with a yellow circle).

Experimental Methods: Low- and high-resolution Raman spectroscopy measurements for this study were performed at room temperature using a custom-built micro-Raman spectroscopy system with a 532-nm excitation source, a laser spot of ~3 μm and power of ~5 mW on the sample. Raman spectra were taken from several spots of selected chondrules and surrounding matrix using a 1-s integration time and different number of accumulations (from 5 to 50) to obtain higher signal-to-noise ratios.

The morphological structure and quantitative elemental composition of the samples were performed by a SEM/EDS system (JEOL JSM 6510LV, Thermo-Noran) using a secondary-electron detector.

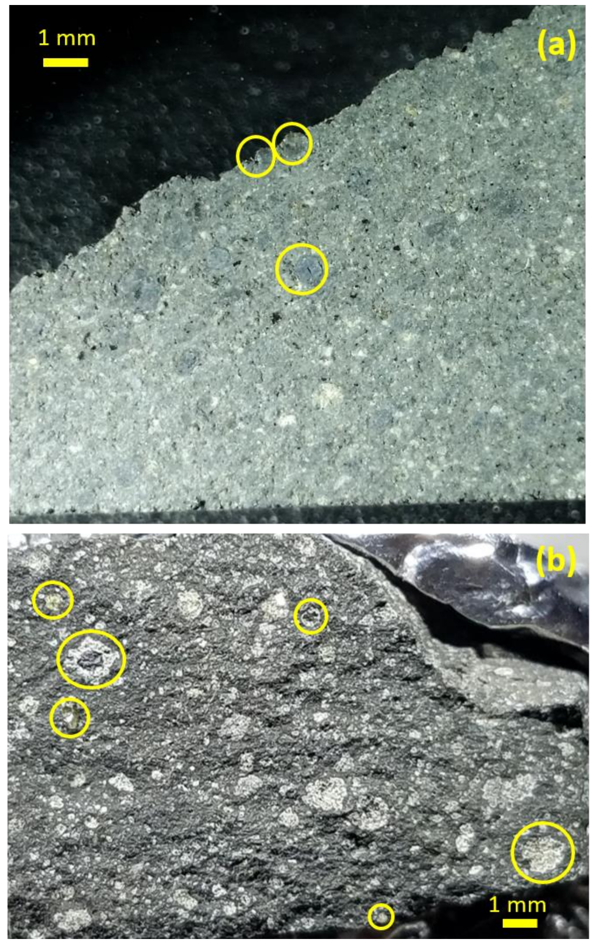

Figure 1. Photograph of the studied meteoritic fragments: (a) Moss; (b) Murray. The yellow circles mark the selected chondrules.

Results and Discussion: From the Raman spectroscopy results, more minerals were found in Moss than in Murray. All the Moss chondrules mainly contained graphitic carbon, olivine (high forsterite content) and pyroxene (high enstatite content), while the surrounding matrix not only contained these minerals but also hematite and magnetite. In the case of Murray, only olivine was mainly found in the chondrules, and graphitic carbon in the matrix. A few more minerals were found in both meteoritic samples but they could not be identified yet. From the SEM images, better defined chondrules were obtained from Moss than from Murray. For both samples, the EDS results showed that all chondrules have higher relative composition of magnesium and silicon, while the matrix has higher relative composition of iron, which was also found in other meteoritic samples, such as NWA 3118 (CV3) [3]. A very distinct feature was found in the Moss chondrules that was not obtained in the Murray sample: well-defined rims with higher relative content of iron and sulfur. In addition, other elements were found in both fragments: oxygen, aluminum, calcium, sodium, carbon, chromium and nickel. Figure 2 shows representative SEM/EDS images of a Moss chondrule with the main observed elements and a well-defined rim surrounding the chondrule.

Some of these mineralogical and elemental components found in these chondritic meteorites were also reported in other works [4-9].

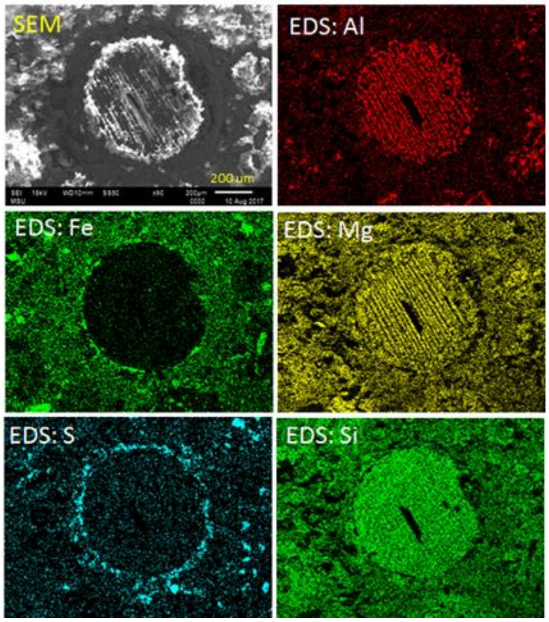

Figure 2. Representative SEM/EDS images obtained from a chondrule and surrounding matrix of the meteoritic sample Moss showing the topography and main elemental composition of the sample, respectively. A well-defined rim was observed.

With these results we expect to understand the conditions that are required for these minerals to form, and thus obtain clues about how the local environment was when planetesimals were created.

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