3D STRUCTURE OF CARBONACEOUS CHONDRITES.

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Introduction: A number of important conditions of the solar nebula prevailing during the formation of chondrite components can only be learned from petrographic data. Component modal abundances for accurate mass balance calculations, chondrule size distributions to determine sorting processes, component spatial distributions for parent body agglomeration processes, distribution of metal and sulphide between chondrules and matrix to study their origin and formation, orientation of chondrules to study the place of impregnation of their palaeomagnetic field and many more are examples of cosmochemical questions where petrographic data are mandatory.

So far petrographic studies were mostly restricted to 2D slices. Such measurements often provide inaccurate results, or are entierly unsuitable for a given problem. Micro computer-aided tomography (µ-CT) is an emerging technique that has the potential to solve these shortcomings and provide accurate 3D petrographic measurements. In recent years, much progress was made in scanning and quantifying rocks and meteorites [1-6]. First, the quality of the scans became much more accurate, with resolutions down to <1µm. Second, powerful computer hard-and software now allows to reduce the tens of GB of data a single scan produces. We developed a plugin for ImageJ especially designed to quantify meteorite µ-CT data. We are continuously adding new tools to this plugin to make it a standard software package for reducing meteorite µ-CT data.

Technique: We used the Metris X-Tek HMX ST 225 CT at the Natural History Museum, London for scanning. Density is the prime information stored in the voxels (3D equivalent of pixels) of a tomographic scan. Segmenting chondrules from matrix is in particular difficult as both have similar densities and, hence, overlap greatly in grey values. ImageJ is a widely used, public domain image analyses tool. We developed a plugin – called *PhaseQuant* – that, among other features, employs statistical methods to automatically segment and quantify components whose grey values overlap, such as chondrules and matrix.

Results: We scanned a range of carbonaceous chondrites (Allende, Renazzo, Al Rais, etc.) and are producing a set of standard 3D images and videos of the samples. We currently apply *PhaseQuant* to quantify the data sets to determine component 3D modal abundances, size as well as their spatial distributions. In addition, sulphide and metal abundances between chondrules and matrix are studied. The results will be presented at the meeting.

References: [1] Ebel DS & Rivers ML 2007. Meteoritics & Planetary Science 42:1627–1646.[2] Ebel DS et al. 2008. Meteoritics & Planetary Science 43:1725-1740. [3] Friedrich JM et al. 2008a. Planetary and Space Science 56:895–900. [4] Friedrich, J.M., 2008b. Computers and Geosciences 34:1926–1935. [5] Friedrich JM et al. 2008c. Earth and Planetary Science Letters 275:172–180. [6] Hezel et al. 2010. Earth & Planetary Science Letters 296:423-433.