EFFECT OF A ROUTINE SYNCHROTRON X-RAY MICROTOMOGRAPHY SCAN ON THE AMINO ACID CONTENT OF THE MURCHISON CM CHONDRITE.

J. M. Friedrich[1,2], D. P. Glavin[3], M. L. Rivers[4], and J. P. Dworkin[3]. [1]Dept. of Chemistry, Fordham U., Bronx, NY, USA. e-mail: friedrich@fordham.edu. [2]Dept. of Earth and Planetary Sciences, American Museum of Natural History, New York, NY, USA. [3]Solar System Exploration Division, NASA Goddard Space Flight Center, Greenbelt, MD, USA. [4]Center for Advanced Radiation Sources, University of Chicago, Argonne, IL, USA.

Introduction: X-ray microtomography (µCT) and synchrotron µCT are becoming popular tools for the reconnaissance imaging of chondritic and returned extraterrestrial material [e.g. 1-4]. However, there are concerns that the use of µCT may be detrimental to organic components of a chondrite. We conducted an experiment to examine if exposure to synchrotron radiation during a µCT scan causes detectable changes in the soluble organic compound (amino acid) content of a carbonaceous chondrite.

Methods: We used the µCT apparatus at beamline 13-BMD at the Advanced Photon Source of Argonne National Laboratory. 13-BMD uses monochromatic x-rays for imaging samples. This has the benefit of managing the photon energy deposited during the experiment. We chose a homogenized sieved Murchison (CM2, USNM 5453) carbonaceous chondrite powder because we have characterized the amino acid content and found it to be homogeneous [5]. We irradiated two samples of the Murchison meteorite under conditions slightly harsher (increased beam exposure time) than those typically used for x-ray microtomography imaging experiments [1]. We used monochromatic x-rays of 46.6 keV and 48.6 keV. After irradiation, we examined the amino acid abundances and enantiomeric ratios in the samples and compared them to a non-irradiated Murchison sample using the established methods outlined in [5].

Results and Discussion:

Ionizing radiation dose. It is challenging to calculate the actual absorbed radiation dose experienced by the amino acids. The x-rays deposit energies by a variety of mechanisms including inelastic scattering, photoelectron emission and absorption, Auger electrons, and x-ray fluorescence. These secondary particles will have a mean free path much larger than the size of an amino acid. So, x-rays stopped by a host or neighboring mineral will generate photoelectrons that damage the amino acid. So, it is not just the x-rays absorbed by the amino acids that matter, but the total x-rays absorbed by the system. We found the total dosage experienced by our two samples to be 1.1 kGy and 1.3 kGy. Total energy exposures are on the order of 0.6 J.

Amino acid data. We found that the amino acid abundances and enantiomeric ratios of the target compounds extracted from the irradiated Murchison samples were within analytical errors of the measurements made on the control Murchison sample.

Conclusions: We conclude that a routine synchrotron x-ray microtomography experiment has no effect on the amino acid content of a carbonaceous chondrite. These data provide confidence in the use of µCT and similar non-invasive methods for analysis of returned samples from OSIRIS-REx and Hayabusa2.

References: [1] Ebel D. S. and Rivers M. L. 2007. *Meteorit. Planet. Sci.* 42:1627-1646. [2] Tsuchiyama et al. 2011. *Science* 333:1125-1128. [3] Jenniskens et al. 2014. *Meteorit. Planet. Sci.* 49:1388-1425. [4] Friedrich et al. 2014. *Earth Planet. Sci. Lett.* 394:13-19. [5] Glavin, D. P. et al. 2010. *Meteorit. Planet. Sci.* 45:1948-1972.