EFFECT OF TUBE-BASED X-RAY MICROTOMOGRAPHY IMAGING ON THE AMINO ACID CONTENT OF THE MURCHISON CM2 CHONDRITE. H. L. McLain[1,2], D. P. Glavin[1], J. C. Aponte[1,2], J. P. Dworkin[1], J. M. Friedrich[3,4], D. S. Ebel[3], M. Hill[3], and H. Towbin[3]. [1]NASA Goddard Space Flight Center, Greenbelt, MD 20771, e-mail: daniel.p.glavin@nasa.gov. [2]Catholic University of America, Washington DC 20064. [3]American Museum of Natural History, New York, NY 10024. [4]Fordham University, Bronx, NY 10458.

Introduction: X-ray and synchrotron x-ray microcomputed tomography (μCT) are increasingly being used for three dimensional reconnaissance imaging of chondrites and returned extraterrestrial material prior to detailed chemical and mineralogical analyses [1,2]. Although μCT imaging is generally considered to be a non-destructive technique since silicate and metallic minerals in chondrites are not affected by x-ray exposures at the intensities and wavelengths typically used, there are concerns that the use of μCT could be detrimental to the organic molecules in carbonaceous chondrites. A recent study of Murchison CM2 samples exposed to a total of ~ 1 kGy monochromatic 45 keV synchrotron radiation found that there were no detectable changes in the amino acid abundances [3]. In this work, three separate μCT examinations of the Murchison meteorite using the GE Phoenix v|tome|x s 240 nano-focus high resolution bremstrahlung x-ray tube instrument at the American Museum of Natural History (AMNH) were conducted and the amino acid abundances and enantiomeric compositions were quantified. Lower energy bremsstrahlung x-rays could interact more with amino acids in meteorites.

Materials and Methods: Four separate aliquots (~ 0.5 g each) of homogenized Murchison meteorite powder were transferred to individual borosilicate glass screw capped vials and sealed in air for the x-ray imaging experiments.

The vials were sent to ANMH and three were exposed to x-rays generated with a tube potential of 180 keV and 120 μA current. The x-ray 1 and 2 samples were exposed to the beam for a similar duration (~43 min). Between these, we changed the experimental conditions to study the effects of adding a copper filter (x-ray 2) and increasing the exposure duration (x-ray 3) well beyond what is typically used for x-ray microtomography imaging experiments (459 min.).

Following the x-ray imaging experiments at ANMH, all four vials were returned to NASA GSFC and a portion of each sample was extracted at 100ºC for 24 h. After hot-water treatment, half of the water extract was desalted by cation exchange chromatography and the NH_4OH eluate derivatized by *o*-phthaldialdehyde/N-acetyl-L-cysteine (OPA/ NAC) and analyzed for amino acids by ultrahigh performance liquid chromatography with UV fluorescence and time of flight mass spectrometry detection (LC-FD/ToF-MS) as described previously [4]. The other half of the water supernatant was acidified with 100 μl 6M HCl, concentrated by drying under vacuum and then analyzed by OPA/NAC derivatization and LC-FD/ToF-MS.

Results and Discussion: The abundances of D,L-aspartic and glutamic acids, D,L-serine, D,L-threonine, glycine, D,L-alanine, β-alanine, D,L-α-, D,L-β-, and γ-amino-*n*-butyric acid, α-aminoisobutyric acid, D,L-valine, D,L-isovaline and ε-amino-*n*-caproic acid in the hot-water extracts were determined and the total amino acid abundances in the x-ray irradiated samples relative to the control. We observed no change in the total amino acid concentrations or D/L ratios (Table 1) in the Murchison extracts after x-ray irradiation within analytical errors. These results are consistent with our previous study [1].

Table 2. Amino acid enantiomeric ratios (D/L) measured in the hot-water extracts of the control and x-ray exposed Murchison meteorite samples.

Amino Acid	Control (D/L)	X-ray 1 (D/L)	X-ray 2 (D/L)	X-ray 3 (D/L)
Asp	0.56 ± 0.15	0.56 ± 0.09	0.54 ± 0.11	0.60 ± 0.15
Glu	0.69 ± 0.17	0.69 ± 0.15	0.61 ± 0.10	0.75 ± 0.08
Ala	1.03 ± 0.11	1.02 ± 0.13	0.99 ± 0.06	1.07 ± 0.08
Iva	0.85 ± 0.06	0.86 ± 0.07	0.85 ± 0.05	0.93 ± 0.07

Conclusions: Tube-based x-ray micro-tomography imaging tested under a variety of experimental conditions has no measurable effect on the amino acid content of the CM chondrite Murchison. These data provide some confidence in the use of μCT and similar non-invasive methods for amino acid 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] Friedrich J. M. et al.(2016) *Meteorit. Planet. Sci.* 51: 429-437. [4] Glavin D. P. et al. (2010) *Meteorit. Planet. Sci.* 45: 1948-1942. [5] Cody G. D. and Alexander C. M. O'D. (2005) *Geochim. Cosmochim. Acta* 69: 1085-1097.