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Amino Acid Contents of Meteorite Mineral Separates

E. L. Berger¹, A. S. Burton², D. Locke³

¹GCS – Jacobs JETS contract – NASA Johnson Space Center, ²NASA Johnson Space Center,

³HX5 – Jacobs JETS contract – NASA Johnson Space Center

* eve.l.berger@nasa.gov

Introduction: Indigenous amino acids have been found indigenous all 8 carbonaceous chondrite groups [1]. However, the abundances, structural, enantiomeric and isotopic compositions of amino acids differ significantly among meteorites of different groups and petrologic types [2, 3]. This suggests that parent-body conditions (thermal or aqueous alteration), mineralogy, and the preservation of amino acids are linked. Previously, elucidating specific relationships between amino acids and mineralogy was not possible because the samples analyzed for amino acids were much larger than the scale at which petrologic heterogeneity is observed (sub mm-scale differences corresponding to sub-mg samples). Recent advances in amino acid measurements [e.g., 4] and application of techniques such as high resolution X-ray diffraction (HR-XRD) and scanning electron microscopy (SEM) with energy dispersive spectroscopy (EDS) for mineralogical characterizations allow us to perform coordinated analyses on the scale at which mineral heterogeneity is observed.

Methods: We link amino acid data to mineralogy by performing ultra-performance liquid chromatography with quadrupole-time of flight mass spectrometry (LC-MS) analyses, followed by SEM or HR-XRD analyses on bulk samples (~20mg) and mineral separates (<2mg) from a variety of spatial locations within our meteorite samples.

Results: The matrix material of the Murchison meteorite is comprised primarily of fine-grained phyllosilicates, whereas our non-matrix fraction consists of mostly mafic silicate minerals. Although both matrix and non-matrix fractions contain amino acids, the amino acid abundances of matrix-containing fractions differ markedly from non-matrix fractions (e.g., figure 1).

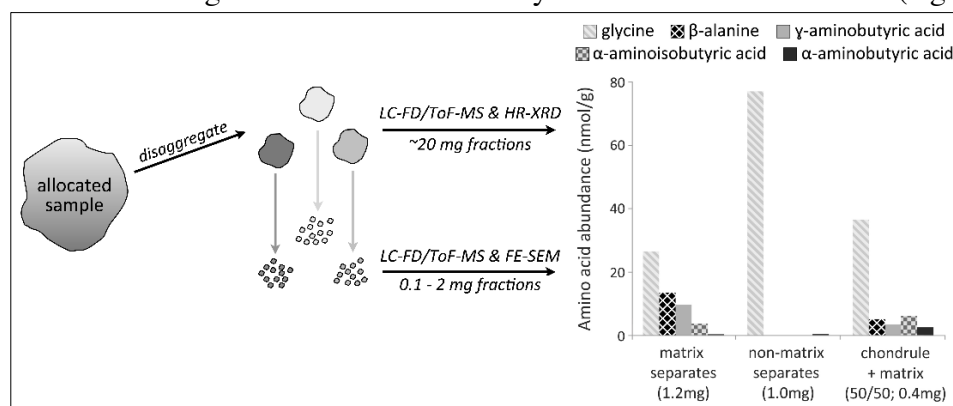


Figure 1. Meteoritic samples are gently disaggregated into ~50mg fractions, which are further sub- divided: one larger fraction (~20mg) for HR-XRD and a dozen mineral separates (e.g., matrix material, non-matrix grains, opaques, etc. of 0.1 to 2 mg) for amino acid analysis by LC-MS and mineralogy characterization by FE-SEM analyses. Results shown are from analyses on mineral separates from the CM2 carbonaceous chondrite, Murchison.

References: [1] Elsila JE et al. (2016) *ACS Central Science*. [2] Elsila JE et al. (2012) *Meteoritics & Planetary Science* 47:1517-1536. [3] Glavin DP et al. (2010) *Meteoritics & Planetary Science* 45: 1948-1972. [4] Callahan MP et al. (2014) *Journal of Chromatography A* 1332: 30-34.