

HYDROXY AMINO ACIDS IN CARBONACEOUS CHONDRITES.

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Introduction: Carbonaceous chondrites contain a variety of organics of potential importance for life. Of these, amino acids have been extensively studied since they: 1) plausibly contributed to the origin of life on Earth, 2) provide insight into parent body chemistry, 3) serve as a vehicle to examine the origin of homochirality, and 4) analytical methods are mature ([1] and references therein).

While aliphatic amino acids have been well studied in meteorites, until recently, -OH bearing amino acids, or hydroxy amino acids (HAAs) have been neglected, except for serine. Nine C3 and C4 HAAs were detected in both the acid hydrolyzed hot water extract of the Murchison (CM2) meteorite and in the acid hydrolyzed post-extraction residue [2]. Interestingly, aliphatic amino acids, such as isovaline, were detected at lower abundances in the post-extraction residue than in the hot water extract, while the reverse is true for some HAAs. Perhaps HAAs have a stronger affinity to minerals than aliphatic amino acids. It is possible that such an affinity could manifest in strong correlations between HAA chemistry and meteorite petrology. Since the isomeric and enantiomeric compositions of meteoritic amino acids have provided implications for parent body processes [1], similar analyses of HAAs should provide additional insight into the early Solar System, and perhaps contributed to the origin of life on Earth.

To this end, we describe here the development of a new gas chromatography–mass spectrometry (GC-MS) method to detect and quantify structural isomers and enantiomers of C3 and C4 HAAs (**Figure 1; Table 1**). Target analytes underwent pre-column derivatization by heptafluorobutyric anhydride and isopropanol (HFBA-IPA derivatization). Subsequently, we are applying this new method in parallel with established liquid chromatography–mass spectrometry methods [3] to analyze the following meteorites, which have differing petrology and mineralogy, for HAAs in the water extracts and the extracted residues of these meteorites: Yamato 791198 (CM2), Asuka 881458 (CM2), LEW 90500 (CM2), LON 94101 (CM2), ALH 83100 (CM1/2), MET 00426 (CR3), MIL 07525 (CR2), GRO 95577 (CR2), and LAP 02342 (CR1). This paper will detail results from our analyses of these meteorites for HAAs using our newly developed method.

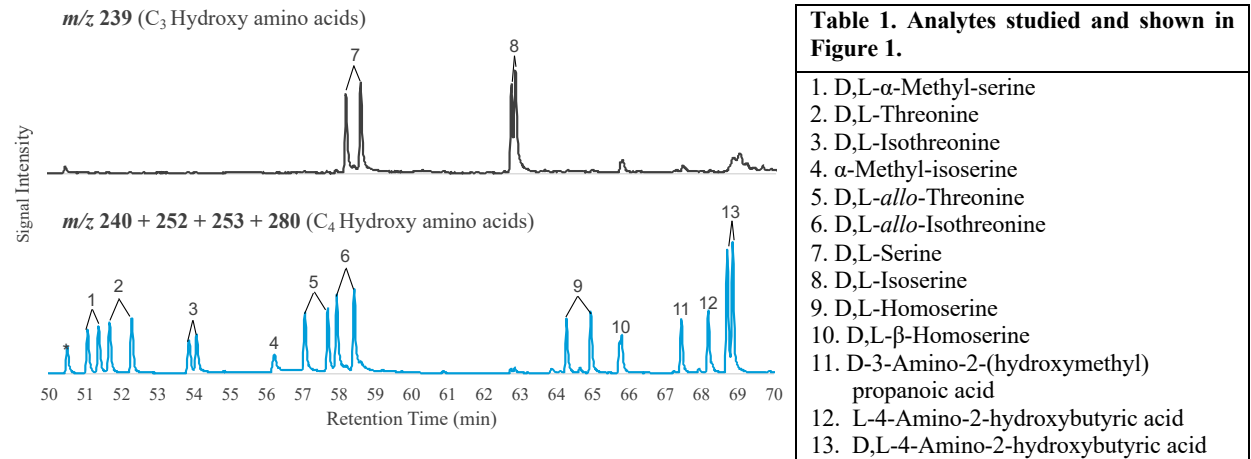


Figure 1. The 50.8–69.4 min regions of the GC-MS extracted ion chromatograms of HFBA-IPA HAA derivatives (C3 HAA: $m/z = 239$; C4 HAA: $m/z = 240 + 252 + 253 + 280$). Peak identities are in Table 1.

References:
[1] Elsila J. E. et al. (2016) *ACS Central Science*, 2:370-379. [2] Koga, T. and Naraoka, H. (2017) *Scientific Reports*, 1–8. [3] Glavin, D. P. et al. (2010) *Meteoritics & Planetary Science* 45: 1948-1972.