Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.11361

Amino Acid Analyses of Hayabusa2 Samples via Liquid Chromatography with Fluorescence Detection and High-Resolution Mass Spectrometry

ERIC T. PARKER, DANIEL P. GLAVIN AND JASON DWORKIN

NASA Goddard Space Flight Center

Presenting Author: eric.t.parker@nasa.gov

Extraterrestrial materials (e.g., asteroids and comets) contain primitive solar system compounds. Analyzing asteroid chemistry can help understand chemical evolution that likely contributed to the origin of life [1]. Amino acids are ideal target analytes to search for in asteroids, partly because amino acids are integral components of life whose chemical properties help evaluate molecular origins and syntheses [2]. Here, we report amino acid analyses of asteroid Ryugu sample A0106 and a baked serpentine procedural blank by the Hayabusa2 initial analysis team.

Hot-water extraction (105 °C, 20 hours) was performed on 13.08 mg of Ryugu sample A0106. Acid vapor hydrolysis and pre-column derivatization [3] were executed prior to liquid chromatography-fluorescence detection and high-resolution mass spectrometry analyses.

Eleven amino acids were quantitated and five additional C_5 amino acids were tentatively identified. Abundances ranged from 0.027-3.8 nmol/g, comprised of α-, β-, Î³-, and δ-amino acids. Non-protein amino acids, including β-alanine, D,L-α-amino-*n*-butyric acid, D,L-β-aminoisobutyric acid, and δ-amino-*n*-valeric acid, were detected, many of which are rare on Earth. Most detected chiral amino acids were racemic (D=L). However, select trace protein amino acids were enriched in the L-enantiomer. Overall, the amino acid data indicated minimal terrestrial contamination, and that most species were indigenous to Ryugu.

The lower amino acid abundances and lack of L-excesses in Ryugu were in contrast to CI1 Orgueil [4], indicating different parent body conditions attributable to amino acid syntheses. Ryugu's broad amino acid distribution suggests multiple formation mechanisms were at play. For example, Strecker-cyanohydrin synthesis plausibly formed α-amino acids, while other amino acids were likely the result of alternative processes. Three C_3-C_5 *n*-Ω-amino acids were found at elevated abundances, akin to those for thermally altered CV and CO meteorites [5], which were possibly shielded from thermal degradation at elevated (>300 °C) temperatures via lactam formation [6,7].

[1] Chyba & Sagan (1992) *Nature*, 355. [2] Simkus et al. (2019) *Life*, 9. [3] Glavin et al. (2010) *MAPS*, 45. [4] Burton et al. (2014) *Polar Sci.*, 8. [5] Burton et al. (2012) *MAPS*, 47. [6] Islam et al. (2003) *Bull. Chem. Soc. Jpn.*, 76. [7] Li & Brill (2003) *Int. J. Chem. Kinetics*, 35.