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Nucleobase Inventory of the Tagish Lake Meteorite: Heterogeneity and Alteration Impacts on Organic Compounds

LIBBY D. TUNNEY[1], GREG F. SLATER[1] AND CHRISTOPHER D.K. HERD[2]

[1]McMaster University
[2]University of Alberta

The origin of life and the possibility of life elsewhere remain some of the biggest questions in the field of astrobiology. Since we only have one example of life, drawing conclusions from modern Earth biology is the most logical way to construct our baseline of the necessities of life. One of the requirements for life as-we-know-it is the ability to store genetic information and synthesize proteins – both of which are controlled by nucleobases that makeup DNA and RNA. Due to our incomplete record of prebiotic chemistry of the early Earth, we can turn to meteorites to inform this gap in knowledge. Here, we investigate the nucleobase content of five Tagish Lake meteorite specimens (designated; TL1, TL4, TL6, TL7, and TL10a) from the University of Alberta Meteorite Collection.

Using an ultrasound assisted extraction method [1], cytosine (2-46 ppb), guanine (1-7 ppb), thymine (15-68 ppb), uracil (17-105 ppb), and hypoxanthine (23-30 ppb) nucleobases were detected across the five Tagish Lake specimens. Standards of adenine and 2,6-diaminopurine were also included in the analysis but were not detected. Tagish Lake was dominated by pyrimidine nucleobases over purine nucleobases, which is in line with other studies [2]. In addition, the Tagish Lake specimens have been documented to be extremely heterogeneous in terms of the intensity of alteration they experienced and the resulting organic compound composition [3]. This is again demonstrated in the wide ranges of nucleobases reported in a given specimen. Studying different types of organic compounds in various Tagish Lake specimens can help unravel the history of the parent body asteroid and inform how these diverse suites of organic compounds are created. Despite Tagish Lake being a relatively pristine meteorite sample, contamination is still an obstacle that needs to be acknowledged and appropriately handled. The preliminary results presented here will be further investigated and supported by additional analyses to confirm extraterrestrial (abiotic) origins.

[1] Timoumi et al. 2024. *Ultrasonics Sonochemistry* 103:106775. [2] Oba et al. 2022. *Nature Communications* 13:2008. [3] Simkus et al. 2019. *Meteoritics & Planetary Science* 54:1283-1302.