Where Do Meteoritic Glycine and Methylamine Come From?

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Many carbonaceous chondrites, particularly the CI, CM, and CR groups that did not experience extensive parent body thermal alteration contain a rich suite of organic compounds [1]. The study of these organic compounds can reveal the environments within the protosolar nebula where prebiotic organic chemistry occurred and the effects of subsequent processing on asteroidal parent bodies [2].

Glycine and methylamine are simple structurally analogous compounds that have been detected in multiple extraterrestrial samples, including carbonaceous chondrites [3]. Several synthetic routes for glycine and methylamine may be possible from a common set of precursors (e.g., CO, CO_2, and HCN) which are present in meteorites [4]. Analyses of $\delta^{13}C$ values found for meteoritic glycine, methylamine, and those of their precursor molecules have suggested potential synthetic relationships between these molecules [5]. However, the prevalence of the synthetic mechanisms, and thus the presence of glycine and methylamine in meteorites, will depend on the (a) original molecular abundance of the precursor molecules, and (b) the levels of alteration (aqueous and thermal) that occurred inside the parent body. Without a full assesment of the level of fractionation that occurred through aqueous and thermal processing and without knowing the original isotopic values of glycine, methylamine, and their precursor molecules, it remains challenging to evaluate the synthetic routes leading to the origins of meteoritic glycine and methylamine [2]. We will discuss these limitations and will use the available data currently present in the literature toevaluate some of the diverse synthetic pathways that may have led to the occurrence of glycine and methylamine in carbonaceous chondrites.

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