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THE COSMOGEOCHEMISTRY OF AMINO ACID SYNTHESIS FROM HYDROGEN CYANIDE

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The synthesis of amino acids from hydrogen cyanide (HCN) may provide important insights into the prebiotic chemistry of comets, the primitive Earth and the oceans on Jupiter's moon Europa. A series of hydrogen cyanide (HCN) polymerization reactions were carried out at various temperatures, pH values and HCN concentrations. The reaction solutions were hydrolyzed in 6 N HCl and analyzed for amino acids using high performance liquid chromatography with fluorescence detection. Glycine was found to be the main amino acid product and accounted for 75-98% of the total amino acids produced. Other amino acids detected were alanine, aspartic acid, and possibly diaminosuccinic acid. The synthesis of glycine as a function of time and the effects of the various reaction conditions on the rate and maximum yield of glycine production will be presented.

Two frozen cyanide solutions, which had reacted over a period of 25 years, were also analyzed and their glycine production compared with reactions taking place at higher temperatures in liquid water. The glycine yields of the frozen solutions were similar to those in higher temperature liquid reactions, suggesting that even in cold environments, the acid-labile precursors of glycine could be readily produced from HCN, possibly as a result of eutectic concentration of aqueous HCN.

The distinctive distribution of amino acids produced directly from HCN products will be discussed as a possible means of identifying the origin of amino acids in cosmogeochemical samples.