Enceladus: Biosignatures

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Saturn's moon Enceladus is a new world for Astrobiology. Through the study of Enceladus' plumes new insights into its habitability will be gained. The four core parameters for life include: water, carbon, nitrogen, and energy; all were found in the plume. Carbon and nitrogen in the plume exist in forms easily usable by biological systems (CH_4, HCN, NH_3, H_2 , CO_2, and organics up to C_6). The first step to search for evidence of life is to define potential biosignatures for Enceladus.

If life exists on Enceladus it will most likely possess peptides containing prebiotic amino acids. The use of amino acids as a biosignature is attractive for three reasons: (1) They possess chirality and living systems primarily uses one stereoisomer; (2) the frequency distribution of amino acids in living systems is different from prebiotic chemistry; and 3) they can be detected by instruments that can fly on future missions. The frequency and abundance of amino acids in prebiotic chemistry and in meteorites is correlated with their Gibbs free energy with the simple amino acids (e.g., glycine and alanine) being the most abundant, whereas, the relative abundance of amino acids in biological systems promotes the synthesis of complex amino acids over simple ones. As a result, the relative ratios of the simple amino acids to complex amino acids along with their chirality in a sample can, in principle be used as a guide to distinguish between abiotic and biological sources. We hypothesize that the combination of homochirality and amino acid frequency distribution can be a biosignature for Enceladus.