AMINO ACIDS AND THEIR POLYMERS IN THE LOWER CLOUDS OF JUPITER? -- PRELIMINARY FINDINGS

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According to thermochemical models, the atmosphere of Jupiter at 270-300°K and the several bar pressure level is predicted to have clouds of aqueous NH_3 solution. Voyager detected lightning in Jupiter's clouds. Lightning implies a highly electrically charged environment, and the mixture of CH_4, NH_3, and H_2O (plus H_2 and He) in the atmosphere of Jupiter is therefore subjected to both coronal discharge and lightning, producing organic heteropolymers called tholins. (Other classes of tholin, produced by UV, are also expected.) A typical "spark tholin" produced in the laboratory is a reddish brown heteropolymer produced when mixtures of CH_4, NH_3 and H_2O are subjected to a high frequency electrical discharge (Sagan and Khare, 1979). The physical and chemical properties of spark tholin have been studied. Pyrolytic GC/MS, HPLC, IR and other techniques have revealed that it is a complex nitrogenous heteropolymer with moieties of distinct biological interest (Khare et al., 1981).

We report here preliminary results relevant to the chemical fate of spark tholin when it descends to the H_2O-NH_3 cloud of a Jovian planet. In one study, a spark tholin was treated with 28% (7.4 M, pH 12.5) NH_4OH for about 30 hours at room temperature. Hydrolysis of the vacuum-dried residue in 6N HCl at 100°C for 24 hours, and analysis by cation exchange chromatography, produced a total of 55 ninhydrin-positive peaks. Using standard protocols, many amino acids, including glycine, lysine, alanine, aspartic acid, phenylalanine, serine, leucine, norleucine, and valine -- in quantities of 16.2, 2.25, 1.64, 1.27, 0.390, 0.295, 0.218, 0.0664, 0.0311 mg per gram of spark tholin, respectively -- were identified. The other 46 peaks that appeared in the chromatogram were speculated to be non-protein amino acids and amines. Our previous work confirmed (by GC/MS) a racemic mixture of protein and non-protein amino acids from Titan tholin (Khare et al., 1986), with serine below the detection limit. The presence of nonbiological amino acids together with the fact that serine ranks sixth in abundance among the nine identified amino acids indicates that the

identified amino acids reported here are probably not due to microbial or other contamination, but are actually derived from the spark tholin.

In another study, spark tholin that had been treated with NH_4OH was then dissolved in pH 2 HCl at room temperature and examined for the presence of protein amino acids, non-protein amino acids, and peptides without further hydrolysis. About 10 peaks were found that did not correspond to peaks in a standard amino acid mixture, and may be polyamino acids or peptides, or other compounds that have some absorbance at 570 and 440 nm wavelength. After collection, acid hydrolysis, and amino acid analysis of these peaks, we found that several were composed of up to a dozen amino acids. NH_4OH without spark tholin taken through the same protocol proved that no impurity was introduced in the experimental procedure. Work on determining the sequence of these polyamino acids or peptides is in progress. Application of these results to the H_2O-NH_3 solution in the lower clouds of the Jovian planets is preliminary because the NH_3 concentrations there are probably somewhat lower, and maximum pH occurs near 273°K. From Weidenschilling and Lewis (1973), we estimate a pH of 11.1 for Jupiter to 11.9 for Uranus. Further work in progress investigates these thermodynamic regimes and will study in detail the possible formation of short peptides by a cold ammoniacal hydrolysis mechanism.

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