Amino acids from ultraviolet irradiation of interstellar ice analogues

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The interstellar dust particles are assumed to be composed of silicate grains, surrounded by ices including carbon containing molecules. H_20, CO_2, CO, CH_3OH, and NH_3 were deposited at 12 K and a pressure of 10^{-7} mbar and irradiated with a electromagnetic radiation representative of the interstellar medium. The ice layer that developed on the solid surface was analysed by enantioselective gas chromatography and mass spectrometry GC-MS. In order to exclude contamination, parallel experiments were performed with ^{13}C-containing educts. After the analytical steps of extraction, hydrolysis, and derivatization, 16 amino acids were identified in the simulated ice mantle of interstellar dust particles [1]. The results were confirmed by the ^{13}C-experiments, which definitely excluded contamination. The chiral amino acids were identified as being totally racemic. The results strongly suggest that amino acids are readily formed in interstellar space. The delivery of such precursor molecules through out the bombardment of Earth with meteoritic or cometary material during the early history of Earth might have contributed to prebiotic chemistry leading to molecules of crucial relevance for processes in chemical evolution.

References

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Global benthic fluxes: Importance of enhanced solute transport in marine sediments

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The activity of benthic infauna or wave induced pressure gradients enhance the transport of pore water constituents in marine sediments. These enhanced transport processes increase the benthic exchange fluxes of solutes across the sediment water interface, in particular, those of oxidants such as oxygen and sulfate, and nutrients, such as phosphate, nitrate and silicic acid.

Here, the contribution to overall solute transport of processes other than molecular diffusion is quantified by comparing O_2 exchange fluxes measured with benthic chambers and O_2 microelectrode profiles. The latter are used to estimate the exchange fluxes due to molecular diffusion only, while benthic chamber measurements are considered to include the effect of bioirrigation or advective flow. Differences between molecular and total fluxes are interpreted using a simple model based on 0^{th} order oxygen consumption kinetics, in order to determine transport parameters.

The mixing parameters obtained are consistent with independent estimates of enhanced transport intensities reported for individual sampling sites. Enhanced transport tends to be significant in continental margin environments, but generally negligible at water depths exceeding 200m. To evaluate the effect of enhanced solute transport on a global scale, total exchange fluxes across the sediment-water interface were calculated with and without including enhanced mixing on a 1-by-1 degree grid for the world's ocean. Approximately 20% of the total global O_2 uptake at the seafloor is due to enhanced transport, while for phosphate enhanced transport is responsible for about 35-40% of the total efflux from sediments. Thus, globally, enhanced solute transport has a major impact on the exchanges between sediments and overlying water of dissolved reactive species.