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Small Scale Abundance Variations in TMC-1

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The preprotostellar core TMC-1 is carbon-rich and exhibits large chemical abundance gradients. Various scenarios have been invoked to explain the gradients, such as differences in density, C/O ratio, or chemical evolutionary state. We present results of our study of complex hydrocarbons and prebiotic molecules in TMC-1, including new abundances and evidence for small scale abundance variations, using NASA's Deep Space Network (DSN) 70-meter antenna. We use TMC-1's low temperature environment ($\approx$ 10 K) to observe species via their lowest energy rotational transitions, which occur at centimeter wavelengths for heavy molecules. But without a mechanism for replenishment, gas phase species would be quickly frozen onto grains. Recently, Markwick et al. (2000) constructed a dynamical-chemical model, involving grain mantle removal induced by Alfven wave propagation, which reproduces the large scale abundance gradients along the TMC-1 ridge. Mechanisms for grain mantle removal and production of rich organic species make TMC-1 an ideal target for complex molecule searches. We report abundances for carbon chains, such as C_7H (upper limit) versus C_8H, and upper limits for the linear chain H_2C_5, its related cyclic species c-C_5H_2, and the important prebiotic molecules pyrrole (c-C_4H_5N) and glycine (NH_2CH_2COOH). We also present evidence for small scale variations within TMC-1 from the spatial and velocity structure of dense gas tracers. We determined that emission from multiple CCS clumps (Peng et al. 1998) are present within our 50 arcsec beam. The CCS and HC_7N spectra show evidence for at least 3 velocity components. Assuming the velocity components represent emission from distinct clumps, we calculate large abundance variations ([HC_7N]/[CCS]=0.5–6.3) at 3 velocities within our beam.

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