Chemistry in Star Forming Cores: WCCC vs Hot Corino

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Various complex organic species (COMs) and carbon chains are detected in low-mass protostellar cores. Cores with COMs are called hot corinos, while those with unsaturated carbon chains are called Warm Carbon Chain Chemistry (WCCC) sources. Hot corinos tend to be deficient in carbon chains, and WCCC sources tend to be deficient in COMs, although recent observations found that cores like B335 are reasonably bright both in COMs and carbon chain lines [1][2][3]. Theoretical models show that unsaturated carbon chains are formed via gas-phase reactions of sublimated CH_4, while many COMs are formed from CH_3OH, which in turn form via hydrogenation of CO (e.g. [4][5]). Deficiency of COMs (carbon chains) in WCCC sources (hot corinos) are thus considered to originate in chemistry in prestellar core stage; e.g. the cores evolve to be WCCC sources, if they start gravitational collapse before carbon is completely converted to CO.

In order to investigate the critical condition for the cores to be WCCC sources or hot corinos, we run three-phase chemical reaction network models in star-forming cores, varying the initial temperatures, visual extinction (*A*v), and duration of presetllar phase. Preliminary results show that the duration of the prestellar phase does not significantly affect the abundances of carbon chains and COMs. Both species are reduced, if the initial core is warmer than ~ 20 K. While the low *A*v is expected to enhance carbon chains and reduce COMs, both species become abundant in the model with the initial ambient *A*v of 1 mag; CH_3OH and other COMs are formed via reactions such as CH_3 + OH. It is thus not straightforward to reproduce the deficiency of COMs (carbon chains) in WCCC sources (hot corinos).

References

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