The spatial distribution of complex organic molecules in prestellar cores

A. Bacmann\textsuperscript{1,2}, A. Faure\textsuperscript{1,2} & E. García-García\textsuperscript{1,2}

\textsuperscript{1} Univ. Grenoble Alpes, IPAG, F-38000 Grenoble, France
\textsuperscript{2} CNRS, IPAG, F-38000 Grenoble France

Complex organic molecules have long been detected in the hot cores of high- and low-mass star forming regions and have widely been used as hot core tracers, i.e. the presence of a hot core could be inferred from the detection of these species. Theoretically, these molecules were thought to form in the ice mantles on grain surfaces during the warm-up phase of the nascent protostar, from reactions between heavy radicals at temperatures close to 30-40 K, until they were released into the gas phase when the temperatures were high enough to sublimate the contents of the ices (typically around 100 K). The detections of complex organic molecules in prestellar cores at 10 K [1] has cast doubts on this mechanism, as the temperatures are not high enough to warrant heavy radical diffusion on the grain surface. Various new models have now been proposed to account for the abundances of these species in the cold gas, but it is yet unclear whether complex organic molecules form from gas phase reactions which had been ignored up to now, or whether photoenergetic processes (e.g. cosmic rays, UVs) or chemical processes (e.g. chemical desorption/explosions) can provide heavy radicals with enough grain surface mobility.

Despite the new interest that the detection of complex organic molecules in prestellar cores has sparked, observations are still lacking which would help tackle the above-mentioned questions. In particular it is unclear how these species are spatially distributed. We present here mapping observations of one important terrestrial-like organic molecule, methyl formate, and of methanol in the prestellar core L1689B. We model the abundance profile using a radiative transfer code and recently determined collisional coefficients. We find that the extended emission is not consistent with the hypothesis that the molecule originates in a photodesorption region. We discuss the implications of this result in terms of possible formation mechanisms.

Références