Chemical complexity in starless and pre-stellar cores

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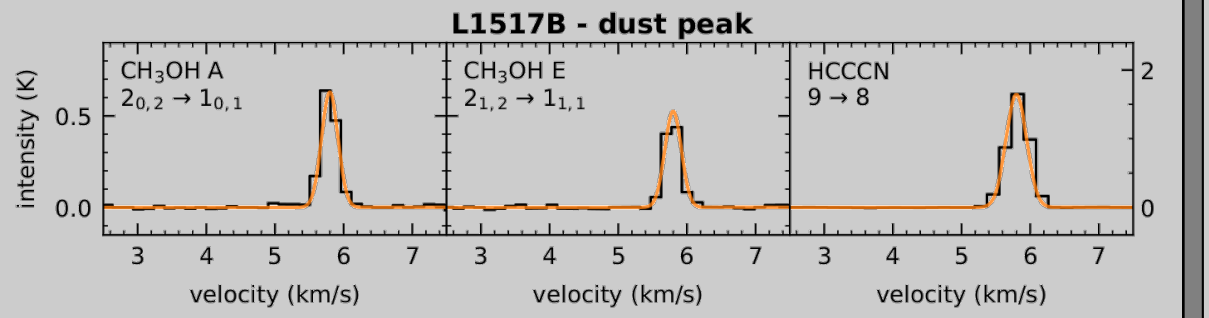

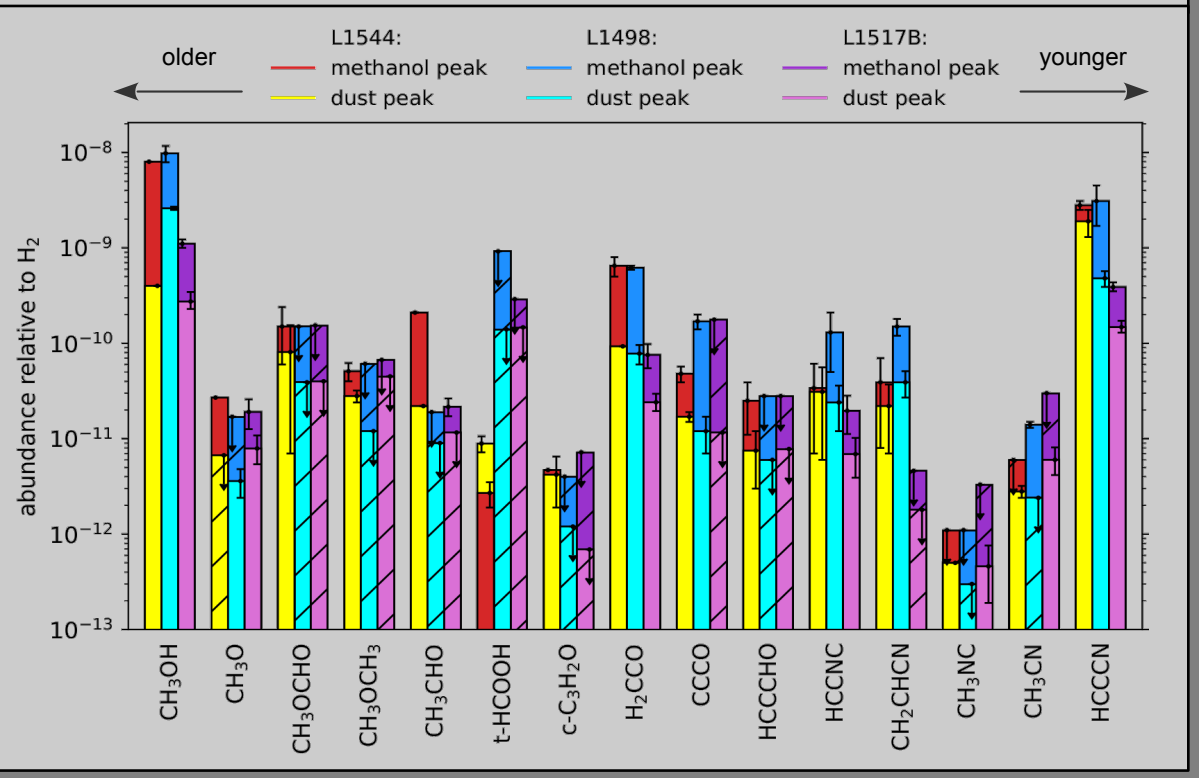

Starless cores are concentrations of cold gas and dust in the interstellar medium, usually grouped in molecular clouds. If they experience infall motions, they are called pre-stellar cores, as they will eventually collapse and form a protostar in its center.

Observations carried out toward these objects have revealed that organic molecules, like CH_3OH, CH_3CHO or HCCCN, are prevalent in them. In 2016, Jiménez-Serra et al. observed the L1544 pre-stellar core and found that complex organic molecules are preferentially produced at an intermediate-density shell rich in methanol (CH_3OH) located at radial distances of several thousands of astronomical units with respect to the core center. Later, in 2021, Jiménez-Serra et al. performed similar observations toward the younger starless core L1498, founding a lower number of complex organics.

In this work, we have observed the starless core L1517B, believed to be even younger than L1498. We took radio spectra in the 3 mm atmospheric window using the 30-meter radio telescope of IRAM at Pico Veleta (Spain), with the aim of determining its level of chemical complexity and to compare it with that of L1544 and L1498. Our radio spectra reveal a lower level of chemical complexity than in the other two cores. We suggest that the differences between these three cores are due to their evolutionary stage, with the N-bearing organics being formed first followed by the O-bearing molecules once the catastrophic depletion of CO into dust grains sets in.

A. Megías, I. Jiménez-Serra, J. Martín-Pintado, A. I. Vasyunin, S. Spezzano, P. Caselli, G. Cosentino, S. Viti; 2023, MNRAS, 519, 1601-1617. https://doi.org/10.1093/mnras/stac3449