P32a

Discovery of the Second Warm-Carbon-Chain-Chemistry Source, IRAS15398-3359 in Lupus

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We have conducted a survey for carbon-chain molecules toward 16 protostars with the Mopra 22 m and Nobeyama 45 m telescopes, and have detected the high excitation lines from several species such as C_4H ($N = 9 - 8$), $C_4H_2(J = 10_{0,10} - 9_{0,9})$, $CH_3CCH(J = 5 - 4, K = 2)$, and $HC_5N(J = 32 - 31)$, toward the low-mass protostar, IRAS15398-3359 in Lupus. The C_4H line is as bright as 2.4 K with the Nobeyama 45 m telescope. The kinetic temperature is derived to be 12.6 ± 1.5 K from the $K = 1$ and $K = 2$ lines of CH_3CCH. These results indicate that the carbon-chain molecules exist in a region of warm and dense gas near to the protostar. The observed features are similar to those found toward IRAS04368+2557 in L1527, which shows Warm Carbon-Chain Chemistry (WCCC). In WCCC, carbon-chain molecules are produced efficiently by the evaporation of CH_4 from the grain mantles in a warm and dense region near the protostar. Our data clearly indicate that WCCC is no longer ! specific to L1527, but occurs in IRAS15398-3359. In addition, we draw attention to a remarkable contrast between WCCC and hot corino chemistry in low-mass star-forming regions. Carbon-chain molecules are deficient in hot corino sources like NGC1333IRAS4B, whereas complex organic molecules seem to be less abundant in the WCCC source. A possible origin for such source-to-source chemical variations is suggested to arise from the time scale of the starless-core phase. If this is the case, the chemical composition provides an important clue to explore the variation of star-formation processes between sources and/or molecular clouds.