Photodissociation regions associated with massive dense dust clumps

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We study ten molecular transitions obtained from an unbiased 3 mm molecular line survey using the IRAM 30 telescope toward 409 compact dust clumps identified by the APEX Telescope Large Area Survey of the Galaxy (ATLASGAL) to understand photodissociation regions (PDRs) associated with the clumps. The main goal of this study is to investigate whether the abundances of the selected transitions show any variations resulted from the chemical reactions in the PDRs under different clump environments. The selected PDR tracers are HCO, HOC^+, C_2H, c-C_3H_2, CN, $H^{13}CN$, $HC^{15}N$, and $HN^{13}C$. $H^{13}CO^+$ and $C^{18}O$ are used as dense gas tracers. To distinguish the presence and strength of ultra-violet radiation, we compare the determined molecular properties of three groups (i.e., HII, infrared bright non-HII, and dark non-HII regions) of the clumps.

From the survey, we found that HCO shows detection rates of 32% toward the clumps. The detections are mostly associated with HII region sources, 67% of which have HCO emission. The comparison of C_2H and c-C_3H_2 integrated fluxes shows increasing integrated flux ratios of the two molecular lines from IR dark non-HII toward HII region sources. Also, column density ratios of HCO/ $H^{13}CO^+$ drop as H_2 column densities increase. Such the trend seems to be associated with the enhancement of HCO abundance in PDRs.

Our current data do not provide high angular resolution to resolve a PDR and molecular gas region, and crucial molecular transitions to understand chemical reactions resulting abundances of PDR tracers in dust clumps. To confirm such high abundance of HCO and small hydrocarbons toward HII regions, we, therefore, need follow-up observation covering important molecules (i.e., H_2CO, CH_3OH, C^+ and C/H recombination lines) for

formation and destruction of HCO and small hydrocarbons, with high angular resolution (like using NOEMA).