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MOLECULAR CLOUDS IN THE CEPHEUS REGION

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Abstract. We present a broad–band multiwavelength study of selected dark molecular clouds in the Cep–Cas region, L 1219, L 1251 and L 1274, with the main aim to investigate physical and chemical conditions in molecular clouds possibly disturbed by external shocks. Both dynamical (e.g., discrepancies in gas mass estimates) and chemical signposts (e.g., relative abundances of trace molecules in cores in different stages of evolution) of a shock–cloud interaction are considered.

L 1274 is a small ($2R \approx 2$ pc), nearby ($d = 200 \pm 30$ pc) pre–stellar dark cloud. Fully sampled maps of the cloud in ^{12}CO(1–0), ^{13}CO(1–0) and ^{12}CO(2–1), indicated two distinct features: a "main body" and an adjacent filament, "ridge". The main body, consisted of a gas as dense as $n_{\rm H_2} \approx 10^{5-6}$ cm^{-3}, has an excess internal motion i.e., the virial mass is 3 to 17 times larger than the CO– and ^{13}CO–inferred gas mass. More diluted gas is found in the ridge. Based on the derived molecular gas and dust properties, we suggest that L 1274 has undergone almost a head–on collision with e.g., a supernova induced, shock front. The shock either disturbed an existing cloud, or, triggered the formation of it. With some positive peculiar velocity relative to the main body the ridge might be a consequence of such a passage.

Morphology of both L 1219 and L 1251 i.e., their cometary shape, with more evolved star formation in the "head" of a cloud, indicated a cloud–shock collision about 10^6 years ago. We searched for chemical evidence of such encounter. The clouds' cores were mapped in several high gas density tracers and selected positions were observed in rare isotopomers. A qualitative discussion about the "early" and the "late" time molecules strongly indicated that the observed chemical differences in L1251 are probably due to combined effects of the on–going star formation, the gas density differences and a possibility that initial abundances of some elements/ions over the cloud were different. Once formed, even from the earliest stages, the newly formed star i.e., young stellar object (YSO), will have an enormous influence on the surrounding molecular gas. Increased kinetic temperatures of the gas and the dust in vicinity of YSO in the first place release molecules previously frozen onto dust grains e.g., HCO$^+$ and HCN. YSOs should be strong X–ray emitters and would be able to produce ample quantities of H_3^+ ion. This would in the first place boost the ions e.g., HCO$^+$, concentrations, but would also initiate the whole set of charge transfer reactions in the ion–molecule chemistry (e.g., CS–production reactions). High speed shocks in the outflows would have a similar effect on the chemistry.