CLOUD-TO-CLOUD VARIATIONS IN H_2CO-TO-H_2 RATIOS

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The ratio H_2CO/H_2 has been determined for Heiles Cloud 2 (HC2) (Sherwood and Wilson, 1980, and references therein). Rather surprisingly, the ratio was much larger than that found by Kutner (1973) in a cloud KC only 3 degrees away. In both ratios the H_2 density was determined from a relation between star counts and dust column density (see Sherwood and Wilson, 1980). Two other clouds have been studied in a similar manner: Khavtassi 3 (K3) (Myers, 1975) and ρ Oph (Myers et al., 1978). The ratio H_2CO/H_2 varies among the four clouds as does the minimum visual extinction apparently required before H_2CO can form. The data are summarized in the Table. In all cases linear fits were used to determine H_2CO/H_2.

		HC2	KC	K3	ρ Oph
Minimum A_V	(mag)	1.4	0	1.9	0.9
$\log(H_2CO/H_2)$		-7.7	-8.4	-7.3	-8.5
Total extinction A_V	(mag)	$\geq$8	$\leq$5	4	12.5

The values of total extinction in the four clouds are from Sherwood and Wilson (1980), Batrla (1979), Myers (1975) and Grasdalen et al. (1973) respectively.

There are three points to notice:

1) The production of H_2CO with respect to H_2 appears to increase as the minimum extinction required to produce H_2CO also increases.

2) With the exception of KC, there is an inverse correlation between the minimum extinction needed to produce H_2CO and the total extinction in the cloud. This may mean that in low density dust clouds (N_D cm^{-2} $\propto$ A_V) the excitation temperature of H_2CO rises to the background temperature 2.7K and only in the cooler central regions of such clouds does one observe H_2CO. Consequently the zero point for A_V would tend to be larger.

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3) The depletion of carbon onto grains is likely to increase as the grain density, i.e. A_V, increases. With the exception of KC, the amount of H_2CO in relation to H_2 (which is directly proportional to A_V) decreases as the total number of grains increases. It should be pointed out that the ratio becomes even smaller if A_V has been underestimated.

Kutner's cloud presents a problem. There are definitely more stars visible toward KC than can be attributed to the foreground if KC is optically thick and 135 pc away (Elias,1978). If KC is optically thin one might confirm the $A_V = 5^m$ by finding stars with known colour excess and distance. Inspection of Blanco et al. (1968), Neckel (1967) and Elias (1978) failed to reveal any, although optical selection effects or low IR sensitivity may have critically influenced the results. On the other hand, both Sume et al. (1975) and Elias (1978) report several groups of T-Tauri and Hα emission-line objects indicative of star formation in HC2 and KC. If these numbers were removed from the star counts, KC would have a larger visual extinction and would appear to be a dense cloud, albeit well fragmented by the action of star formation.

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REFERENCES

Batrla, W.: 1979, Ph.D. Thesis, University of Erlangen-Nürnberg.
Blanco, V.M., Demers, S., Douglass, G.G., and FitzGerald, M.P.: 1968, Publ. U.S. Naval Obs., 2nd Series XXI.
Elias, J.H.: 1978, Astrophys. J. 224, 857.
Grasdalen, G.L., Strom, K.M., and Strom, S.E.: 1973, Astrophys. J.(Letters) 184, L53.
Kutner, M.L.: 1973, Molecules in the Galactic Environment, ed. M.A. Gordon and L.E. Snyder, J. Wiley, New York, p. 199.
Myers, P.C.: 1975, Astrophys. J. 198, 331.
Myers, P.C., Ho, P.T.P., Schneps, M.H., Chin, G., Pankonin, V, and Winnberg, A.: 1978, Astrophys. J. 220, 864.
Neckel, T.: 1967, Landessternwarte Heidelberg-Königsstuhl 19,
Sherwood, W.A., and Wilson, T.L.: 1980, Astron. Astrophys., to be submitted.
Sume, A., Downes, D., and Wilson, T.L.: 1975, Astron. Astrophys. 39, 435.