MOLECULAR ABUNDANCES IN THE SGR A MOLECULAR CLOUD

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ABSTRACT. We have obtained column densities for HCO^+, HCO, HCS^+, C_3H_2, HC_5N, SiO, OCS, HCOOH, CH_3CH_2OH, and CH_3CCH toward Sgr A. The fractional abundance of SiO relative to molecular hydrogen in Sgr A is comparable to that for the Orion plateau, ~ 10^{-7} - 10^{-8}, which may be a typical value for hot clouds. The abundances of HCO, CH_3CH_2OH and CH_3CCH all appear to be enhanced relative to other molecular clouds suc as Sgr B2.

The molecular abundances and chemistry of the Sgr A molecular cloud have not been as well characterized as those of Sgr B2, but the strong activities and shocks of the Galactic center could affect the clouds in Sgr A more efficiently because of their greater proximity. This may result in a unique chemistry of the Sgr A clouds, such as has been suggested from observations of HCO_2^+ (Minh et al. 1991a; Paper 1).

Data were obtained in 1988 June with the Swedish-ESO 15 m telescope in Chile. Telescope parameters and observing method were included in Paper 1. Observed molecules, transitions, and rest frequencies are listed in Table 1. We have obtained data for the clouds observed in NH_3 (Gusten et al. 1981) and in HCO_2^+ (Paper 1). Column densities were determined assuming optically thin emission and an apparent background radiation temperature of 10 K (cf. Paper 1 and Minh et al. 1991b).

In Figure 1 we plot the fractional abundances relative to H_2 for th molecules observed toward M-0.13-0.08, and also those for TMC-1 and Sgr B2, and for Orion(KL) from the tabulations of Irvine et al. (1987), and Blake et al. (1987), respectively, for comparison. The fractional abundance of SiO at Sgr A is derived to be ~ 10^{-7} - 10^{-8} relative to molecular hydrogen which is similar to that of the Orion plateau. The high SiO abundance could be explained by high-temperature or shock chemistry (Ziurys et al. 1989). It is also possible, however, that an enhanced abundance of elemental Si comes from the disruption of silicat grains by shocks in the Galactic center region, which can lead naturall to an enhanced SiO abundance.

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TABLE 1. Observed molecules.

Molecule (Trans.)	Rest Frequency (GHz)
$H^{13}CO^+$ (1-0)	86.75429
$HC^{18}O^+$ (1-0)	85.16226
HCO (1_{01}-0_{00} [a])	86.67082
HCS^+ (2-1)	85.34790
C_3H_2 (2_{12}-1_{01})	85.33889
HC_5N (32-31)	85.20135
SiO (2-1)	86.84700
^{29}SiO (2-1)	85.75913
OCS (7-6)	85.13911
HCOOH (4_{14}-3_{13})	86.54613
CH_3CH_2OH (6_{06}-5_{15})	85.26547
CH_3CCH (J=5-4 K=0)	85.45730
(J=6-5 K=0)	102.54798
CH_3OH (3_1-4_0 A^+)	107.01385

[a]For the (3/2-1/2 2-1) trans.

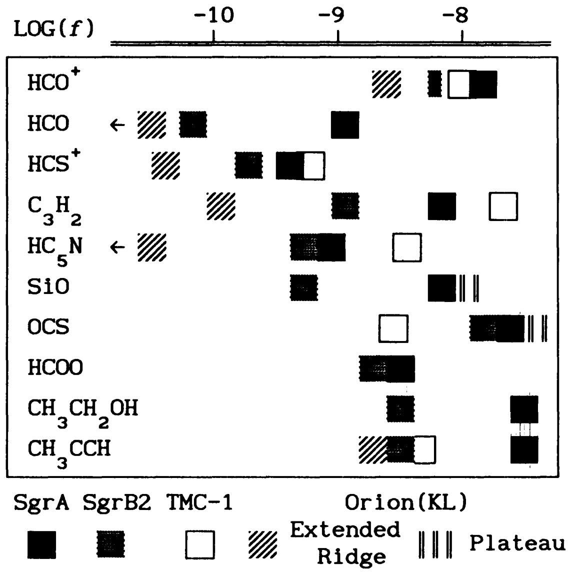

Figure. 1 Abundances relative to molecular hydrogen on a logarithmic scale for Sgr A, Sgr B2, TMC-1 and the Orion extended ridge and the plateau. Data for Sgr B2 and TMC-1 from Irvine et al. (1987), and for Orion(KL) from Blake et al. (1987).

The fractional abundances of several molecules observed here, in particular HCO, CH_3CH_2OH, and CH_3CCH, appear to be enhanced relative to values for other sources (Figure 1). It is interesting that the production of CH_3CH_2OH and CH_3CCH probably involves relatively hydrogenated species such as C_2H_4 or CH_4 (Millar et al. 1991; Millar & Freeman 1984); this might suggest the influence of grain chemistry or high temperature reactions.

We conclude that a rich chemistry exists in Sgr A, which could partly be a result of the energetic processes of the Galactic center region, such as shocks, UV radiation, and also the possible interaction of the neutral and the ionized gas around the nucleus.

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