Gibbs free energy (3HCOOHCH) does not occur near the 13 bar level, the water abundance below the clouds remains unknown.

Here we estimate the water and total oxygen abundances of Saturn’s deep atmosphere by examining their effect on tropospheric chemistry. Using a similar approach as Feagin & Prinn (1988) [6], we find that:

- The observed PH3 abundance constrains the upper limit of the H2O abundance.
- The observed CO abundance constrains the lower limit of the H2O abundance.
- The observation of SiH4 constrains the lower limit of the total abundance.

Our results indicate that water and total oxygen abundances are well below the level such that carbon and phosphorus in PH3 and SiH4, respectively, can react with O feastly, the calculation of the net thermochemical reaction:

\[ \text{CO}_2 + \text{H}_2 \rightarrow \text{CO} + \text{H}_2\text{O} \]

By solving equations 1 and 2 of the observed PH3/H2 ratio is ~30 orders of magnitude higher than that predicted by equilibrium with the CH4/P/H2 ratio, andPH3/H2 formation efficiency at the top of the troposphere is predicted to be 1.9 to 6.5 times the protosolar abundance. We therefore conclude that PH3/H2 formation efficiency at the top of the troposphere is predicted to be 1.9 to 6.5 times the protosolar abundance.

4.2. Carbon Monoxide (CO)

Using a similar approach as Fegley & Prinn (1988) [6], we find that:

- The observed CO abundances are well above the observational upper limit.
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- The observed CO abundances are well above the observational upper limit.

We adopted a nominal enrichment factor of 7.4 times the protosolar element/H abundance for CO on Saturn. We observe a CH4 enrichment of 7.4 ± 2.3 by comparison with the observed P/H abundance at 3.9 times the protosolar abundance. This mass balance relates the CH4 and CO abundances on Saturn.

We consider an alternative kinetic scheme proposed by Yang et al. (1988) [21] where CO destruction is not at odds with the methane enrichments suggested by the observed CH4/H2 abundance on Saturn. We employ a mixing length of 4.0 × 10^7 km, which requires that CO from CH4 reaction (7) is enriched by a factor of 2.3 ± 1.0 times the protosolar abundance. We observe a CH4 enrichment of 7.4 ± 2.3 by comparison with the observed P/H abundance at 3.9 times the protosolar abundance. This mass balance relates the CH4 and CO abundances on Saturn.

We now rewrite equation (12) to show the dependence of the CO abundance on the CH4 and H2O enrichment factors.

\[ \text{CO}_2 + \text{H}_2 \rightarrow \text{CO} + \text{H}_2\text{O} \]

We observe a CH4 enrichment of 7.4 ± 2.3 by comparison with the observed P/H abundance at 3.9 times the protosolar abundance. This mass balance relates the CH4 and CO abundances on Saturn.

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