

Highly Depleted Ethane and Slightly Depleted Methanol in Comet 21P/Giacobini-Zinner: Application of Empirical g-factors for CH₃OH near 50 K

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We report high resolution ($\lambda/\Delta\lambda \sim 24,000$) observations of Comet 21P/Giacobini-Zinner (21P) between $\sim 2.85 - 3.54 \mu\text{m}$, obtained with NIRSPEC at Keck 2 on UT 2005 June 03 ($R_h = 1.12 \text{ AU}$, $\Delta = 1.45 \text{ AU}$). These simultaneously sampled multiple emissions from the ν_7 band of C₂H₆ and the ν_2 and ν_3 bands of CH₃OH, together with several hot bands of H₂O, permitting a direct measure of parent volatile abundances in 21P. Our spectra reveal highly depleted C₂H₆ (0.13-0.14 percent relative to H₂O) and CH₃OH/C₂H₆ ~ 10 , consistent with previously published abundances from observations in the IR [1,2] and millimeter/sub-mm (reporting CH₃OH/H₂O [3]) during its previous apparition in 1998.

We observed similarly high CH₃OH/C₂H₆, and also similar rotational temperature to that measured for 21P, in Comet 8P/Tuttle [4,5]. We used our (higher signal-to-noise) NIRSPEC observations of 8P to produce effective (empirical) CH₃OH g-factors for several lines in the ν_2 band. These will be presented together with interpretation of our results, including constraints on the spin temperature of water. We acknowledge support from the NASA Planetary Atmospheres, Planetary Astronomy, and Astrobiology Programs and from the NSF Astronomy and Astrophysics Research Grants Program.

References: [1] Weaver et al. 1999 Icarus 142:482; [2] Mumma et al. 2000 ApJ 531:L155; [3] Biver et al. 2002 EMP 90:323; [4] Bonev et al. 2008 ApJ 680:L61; [5] Boehnhardt et al. 2008 ApJ 683:L71