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Title **OPRs Of Ammonia versus $^{14}\text{N}/^{15}\text{N}$ Ratios In CN In 15 Comets**

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Abstract The solar system was formed from interstellar matter 4.6 Gyrs ago and comets are considered as remnants of icy planetesimals formed in the early solar system. One of interesting primordial characters of cometary ice is an ortho-to-para abundance ratio (OPR) of molecules such as H₂O, NH₃, etc. The OPR probably indicates the molecular formation temperatures in the solar nebula or in the pre-solar molecular cloud.

We determined the OPRs of ammonia by using the high dispersion optical spectra of NH₂ in 15 comets: C/1995 O1 (Hale-Bopp), C/1999 S4 (LINEAR), C/2001 A2 (LINEAR), C/2000 WM1 (LINEAR), 153P/Ikeya-Zhang, C/2002 V1 (NEAT), C/2002 X5 (Kudo-Fujikawa), C/2002 Y1 (Juels-Holvorcem), C/2001 Q4 (NEAT), C/2002 T7 (LINEAR), C/2003 K4 (LINEAR), 8P/Tuttle, 88P/Howell, 9P/Tempel 1, and 73P-B and -C/Schwassmann-Wachmann 3. The observations were mainly carried out by the Ultraviolet and Visual Echelle Spectrograph (UVES) mounted on the Very Large Telescope (VLT) in Chile. Other telescopes/instruments were also used in some cases. The OPRs of ammonia are determined from OPRs of NH₂ (0,9,0) ro-vibronic band around 600 nm. Although absorption lines (by the telluric atmosphere) and cometary C₂ emission lines blended affected to NH₂ emission lines in this region, we removed them in our analysis. The determined OPRs of ammonia clustered around ~30K but not in the cases of 73P-B and -C. This situation is very similar to that of $^{14}\text{N}/^{15}\text{N}$ ratios in CN (i.e., 73P-B and -C are quite peculiar relative to other comets). We discuss about the relationship between the OPRs of ammonia and $^{14}\text{N}/^{15}\text{N}$ ratios in CN in these 15 comets. Our results indicate the formation of materials at relatively higher temperatures for 73P-B and -C than other comets.

