

Pre-perihelion near-infrared spectroscopy from Keck and IRTF of comet C/2013 R1 (Lovejoy)

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Comet C/2013 R1 (Lovejoy) was discovered at a heliocentric distance of $R_h = 1.94$ au pre-perihelion by Terry Lovejoy on UT 2013 September 7 (Lovejoy et al. 2013). Its orbital elements indicate that the comet probably originated in the Oort cloud. Lovejoy became a bright comet pre-perihelion and observational conditions were favorable making Lovejoy a primary target for Earth-based observers, especially, after the post-perihelion observations of disintegrated comet C/2012 S1 (ISON) were not possible. Comet Lovejoy reached a maximum brightness of ~ 5 th magnitude (in V-band) in the middle of November 2013. Early observations at optical wavelengths revealed that the comet was relatively gas-rich and typical in composition (Opitom et al. 2013). However, to date there are no reports on the composition of organic parent molecules. We report the mixing ratios of organic volatiles in comet Lovejoy determined from high-dispersion spectroscopic observations in the near-infrared (L- and M-bands). Spectroscopic observations were carried out using the NIRSPEC spectrometer mounted on the 10-m Keck-2 telescope at the W. M. Keck observatory and the CSHELL spectrometer mounted on the 3-m IRTF telescope. We report pre-perihelion (perihelion was on UT 2013 December 22.7 when the comet was at $R_h = 0.81$ au) volatile abundances in comet Lovejoy as determined from high-resolution ($R \sim 25,000$) infrared spectra taken on UT 2013 October 28 ($R_h = 1.29$ au, $\Delta = 0.71$ au) with NIRSPEC and on UT 2013 December 10, 11, and 12 ($R_h = 0.84\text{--}0.82$ au, $\Delta = 0.67\text{--}0.71$ au) with CSHELL. These spectra show emission lines attributed to H₂O, CO, HCN, CH₄, C₂H₂, C₂H₆, H₂CO, CH₃OH, NH₃, NH₂, and OH. We present the mixing ratios of volatiles and discuss the physico-chemical evolution and the origin of the molecules in comet Lovejoy.

Acknowledgements: The NASA Planetary Atmospheres and Planetary Astronomy Programs supported this work. Data were obtained at the W. M. Keck Observatory, which is operated as a scientific partnership among the California Institute of Technology, the University of California, and the National Aeronautics and Space Administration. The Observatory was made possible by the generous financial support of the W. M. Keck Foundation. Data were also obtained at the NASA IRTF which is operated by the University of Hawaii under Cooperative Agreement Number NNX-08AE38A with the National Aeronautics and Space Administration, Science Mission Directorate, Planetary Astronomy Program. The authors also wish to acknowledge the significant cultural role and reverence that the summit of Mauna Kea has always had within the indigenous Hawaiian community. We are most fortunate to have the opportunity to conduct observations from this mountain.

References: Lovejoy, T., Guido, E., Howes, N., et al. 2013, CBET 3649. Opitom, C., Jehin, E., Manfroid, J., and Gillon, M. 2013, CBET 3659.