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「あかり」衛星による彗星二酸化炭素の近赤外線分光観測
Near-infrared spectroscopic survey for carbon dioxide in comets with AKARI

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Comets are considered to be the most pristine objects and to provide us precious clues to the solar system formation. In particular, chemical abundances of the icy materials in comets have been used to infer the conditions in the early solar nebula. Most abundant molecular species in cometary ices are water (H_2O), carbon dioxide (CO_2), and carbon monoxide (CO). However, cometary CO_2 cannot be observed from the ground due to the severe absorption by the telluric atmosphere, although CO_2 has the fundamental band at 4.26 micron in the near-infrared wavelength region. Space observatories or spacecraft are indispensable for observations of CO_2 in comets. Parent CO_2 from the comet nucleus was detected in the coma of comet 1P/Halley by the Russian Vega space probe for the first time. Since then, it has been directly observed in only three other comets: Hale-Bopp, 103P/Hartley and 9P/Tempel with Infrared Space Observatory (ISO) and Deep Impact flyby spacecraft.

We present the observational results of H_2O, CO_2, and CO for 18 comets observed with the Infrared Camera (IRC) onboard the Japanese infrared satellite *AKARI*. The IRC has the capability to take spectra from 2.5 to 5 micron, and simultaneous observations of these three major molecules (H_2O, CO_2, and CO at 2.7, 4.3, and 4.7 micron, respectively) could be performed with *AKARI*/IRC. We detect CO_2 in 17 out of 18 comets except for comet 29P/Schwassmann-Wachmann 1 around 6 AU from the Sun, while we detected a reliable CO emission band only in 3 comets, including comet 29P. Our dataset provides the largest homogeneous database of CO_2/H_2O production rate ratios in comets obtained so far.

The CO_2/H_2O production rate ratios (mixing ratios) are considered to reflect the composition of cometary ice when a comet was observed at the heliocentric distance within ~ 2.5 AU since water ice fully sublimates there. Our results show that the CO_2 mixing ratios in comets are in the range from several to ~30% among the comets observed within 2.5 AU from the Sun (13 out of the 17 comets). The range of CO_2/H_2O ratio for the comets is comparable to that of high-mass protostellar ices, and is lower than the mixing ratio of CO_2 in low-mass protostar envelopes. CO_2 in cometary ice is more depleted with respect to water and more diverse than low-mass protostellar ices. The ices incorporated into comets should have been altered in the early solar nebula if the cometary ice composition has not been altered significantly after the formation of cometary nuclei.

Keywords: comets, ice, carbon dioxide, AKARI