The role of super volatiles (CO and CO_2) for cometary activity

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Cometary activity is often observed at large heliocentric distances where water sublimation is negligible. More volatile compounds are needed to maintain activity. Both CO_2 and CO are difficult to observe in cometary comae. The relative amounts (H_2O:CO_2:CO) seem to vary strongly from comet to comet but also as a function of heliocentric distance (see A'Hearn et al. 2012 for a compilation and critical assessment). A correlation of higher volatility with orbital evolution of the comets (Jupiter Family, Halley Type, or Long Period comets) could not be established. Variation of super-volatile (CO_2, CO) content may depend on the exact location of cometary formation in between the snowlines of CO_2 and CO of the planetary nebula. Observed CO_2:H_2O ratios of up to 0.25 suggest that the activity of comets even close to the Sun will be strongly influenced by super volatiles. This requires that the sublimation fronts of the super volatiles and water stay close together. Observations of the CO production of, for example, comet Hale Bopp, show that even this sublimation follows essentially the solar heat input. This requires its sublimation front to be very close to the surface of the nucleus (Gortsas et al. 2011). The heat conductivity of the very porous nucleus material is very low in agreement with laboratory experiments (Gundlach and Blum 2012) and recent modeling (Skorov and Blum 2012). Water ice could be released together with dust in solid state. Close to the Sun, the dirty ice particles will have a very short lifetime and their contribution to the overall water vapor production is indistinguishable for remote observations.

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