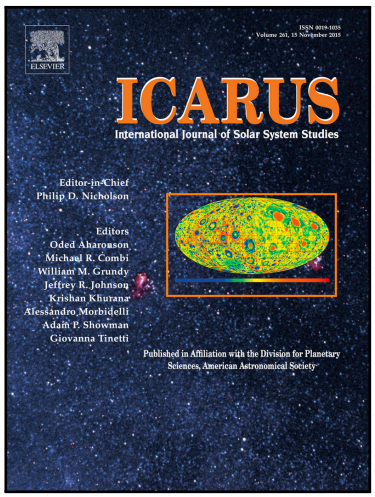

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Ice state evolution during spring in Richardson crater, Mars

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Abstract

The Martian climate is governed by an annual cycle, that results in the condensation of CO_2 ice during winter, up to a meter thick at the pole and thousands of kilometers in extension. Water and dust may be trapped during the condensation and freed during the sublimation. In addition, ice may be translucent or granular depending on the deposition process (snow vs direct condensation), annealing efficiency, and dust sinking process. The determination of ice translucency is of particular interest to confirm or reject the cold jet model (also known as Kieffer model).

This work is focused on the dune field of Richardson Crater (72°S, 180°W)in which strong interactions between the water, dust and CO_2 cycles are observed. We analyzed CRISM hyperspectral images in the near IR using radiative transfer model inversion. We demonstrate that among the states of CO_2 ice, the translucent state is observed most frequently. The monitoring of surface characteristics shows a decrease in the thickness of the ice during the spring consistently with climate models simulations. We estimate a very low dust content of a few ppmv into the CO_2 ice, consistent with the formation scenario of cold jets. The water impurities is around 0.1%v, almost stable during the spring, suggesting a water escape from the surface of subliming CO_2 ice layer. The water ice grain size varies in a range 1 to 50 microns. From these results, we propose the following new mechanism of small water ice grain suspension: as a cold jet occurs, water ice grains of various sizes are lifted from the surface. These jets happen during daytime, when the general upward gas flux from the subliming CO_2 ice layer is strong enough to carry the smaller grains, while the bigger fall back on the CO_2 ice layer. The smaller water grains are carried away and integrated to the general atmospheric circulation.

Keywords: Mars, CO2 ice, radiative transfer, inversion, spectroscopy, seasonal south polar cap