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Where is the ice in comets? Twenty years after.

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Recent space missions to comets Borelly, Wild 2, and Tempel 1 gave us a lot of new facts about the cometary nucleus requiring a serious revision of the cometary nucleus models. In contrast to the prevailing concept of a dusty ice body, images taken by the earlier fly-by space missions revealed very dark and "dry" nuclei of refractory material and no trace of water ice. Observations with the scanning infrared spectrometer during the recent fly-by of the Deep Impact mission revealed patches with small amounts of water ice (3 to 6%) on the surface of comet Tempel 1. Areas of nucleus activity could not be identified based on available observations. Hereafter we attack the problem where the ice in comets is. The simultaneous existence of a hot surface ($T>280$ K) and high gas activities can be naturally explained by an assumption that the ice is within the refractory matrix of the nucleus covered by a thin layer (between tens of microns and a few centimetres) of depleted solid matrix and nonvolatile grains. The ice near the surface is heated partly by thermal conduction and sublimates. Only a small amount of the actually present ice may peek through the dusty mantle. Under certain conditions the water vapour drags away the dust above it and exposes some of the fresh dust/ice material. The dust particles are accelerated away from the surface. These physical processes during the sublimation from and inside porous media are investigated in detail in frame of a new consistent model of the near-surface region of a cometary nucleus that was presented in a set of our papers (Icarus v140, v153, v156, v159, v168; Solar System Research v38, v40). The basic features of the model are: volume light absorption and kinetic treatment of gas transport in a porous media; a conjugate consideration of nucleus and surrounding dusty coma. The various scenarios of near-surface layers and their evolution are discussed.