The effect of amorphous ice on the structure and activity of comet nuclei

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If comets are formed in an environment of low temperature and pressure, their water ice will be amorphous and will trap within it other volatile species. Upon warming, either during early evolution by radioactive sources, or later on by solar radiation, crystallization of the amorphous ice will release both latent heat and part of the occluded volatiles. These volatiles may refreeze in regions of appropriate temperatures, thus creating a complex stratified structure. Upon further heating, sublimation of these newly formed ices, as well as the crystalline ice with the residual volatiles still trapped within it, will result in a wealth of activity patterns, depending on local illumination and subsurface structure. Since crystallization occurs in spurts, rather than continuously, outbursts of various strengths and durations may arise at large heliocentric distances. The internal pressures generated by volatile species may cause morphological changes in the outer layers of the nucleus. Thus, a wide diversity of phenomena such as have been detected in active comet nuclei in particular during the Rosetta mission may be explained by the presence of amorphous ice at formation.