# Carbon-rich icy moons and dwarf planets

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**Résumé**

Density and moment of inertia of icy moons and dwarf planets suggest the presence of a low-density carbonaceous component in their rocky cores. This hypothesis was tested using inner density structure and thermal models. Rocky core densities in dwarf planets and icy moons are found to consist of a mixture of chondritic silicate-sulfide rocks and carbonaceous matter. Carbonaceous matter was originally mixed with ice in a rock-free precursor. In a homogeneous accretion scenario where these components are mixed in solar proportions, ices then differentiated from the carbon-rich refractory core, while hydration of silicates could take place. Thermal models taking into account the presence of carbonaceous matter suggest that originally hydrated silicates are only partially dehydrated in the refractory cores of most moons. Viable scenarios point to a difference in formation or evolution between Ganymede and Titan in spite of their similar size and mass. Fully dehydrated mineralogies, inferred in Europa and possibly the densest dwarf planet Eris, require heterogeneous accretion near the water snow line of the solar or circumplanetary nebula. Progressive gas release from slowly warming carbonaceous matter-rich cores may sustain up to present-day the replenishment of ice-oceanic layers in organics and volatiles. It accounts for the observation of nitrogen, light hydrocarbons and complex organic molecules at the surface, in the atmospheres, or in plumes emanating from moons and dwarf planets. The formation of large carbon-rich bodies in the outer solar system suggests that carbon-rich planets could form at the outskirts of extrasolar systems.
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**Mots-Clés:** lunes, planètes naines, matière carbonée, composition

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