

Differentiation of silicates from H₂O ice in an icy body induced by ripening

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Planetary differentiation is the process of the separation of the constituents of a planetary object as a consequence of their physical and chemical behavior. Distinct layers are developed in the object, and the denser materials sink to the center while the lighter materials rise to the surface.

One of the probable scenarios of differentiation between silicate-ice in an icy object is the settling of a silicate particle in water after melting of the object. In order for settling to proceed or occur, the size of a particle should be sufficiently large such that the settling velocity of the particle must exceed the background flow velocity induced by thermal convection. The sizes of the particles change because of dissolution and precipitation. This process is called ripening. In this study, I derive the critical particle sizes required for settling and the timescales for growth of the particles to these sizes through ripening. It is observed that settling is possible if the silicate particles coagulate with each other to form a network in water. If the particles do not coagulate, the probability of the occurrence of settling is low because the time duration required for the particle growth to the critical size is large. The coagulation of silicate particles strongly depends on the pH of water.

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