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Accretion of Icy Planetesimals in the Inner Solar System: Effect of Collisional Heating

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Standard scenario of planet formation have been developed on the assumption that the primordial solar nebula is optically thin, so that H_2O ice condenses only outside 2.7 AU from the Sun. The solid material is composed of only rocks at the formation region of terrestrial planets (Hayashi 1981; Hayashi et al. 1985). The inner edge of the H_2O ice condensation is called snow line. The formation regions of terrestrial planets and giant planets are traditionally divided by the location of the snow line. Hayashi's disk model is called the minimum-mass solar nebula (MMSN) model, and often referred as the reference disk model of solar nebula by many followers.

However, it is widely accepted in the astronomical community that the protoplanetary disks are initially opaque owing to the floating small dust particles and become transparent only at the late stage of planetary formation. Recent models of optically thick protoplanetary disk successfully account for most properties in the observed spectral energy distributions (SEDs) (Chiang and Goldreich 1997; Chiang et al. 2001). In optically thick disks, the interior of the nebula is shadowed from direct exposure to sunlight, so that the H_2O ice is prevented from sublimation even at the formation region of terrestrial planets (Chiang and Goldreich 1997; Chiang et al. 2001).

If planetesimals are formed in such opaque protoplanetary disks, they should be mainly composed of H_2O ice. We call such planetesimals *icy planetesimals* hereafter. Icy planetesimals can play important rolls in hydration of meteorites, water supply to terrestrial planets, formation of planetary atmospheres, formation region of giant planets which can accrete gas envelopes, etc.

We have investigated the evolution of icy planetesimals focusing on their accretion and sublimation. However, other physical processes, such as collisional destruction and heating, heating by the short-lived radioactive elements, and modification of inner structure, can affect the evolution of icy planetesimals. Among them, collisional destruction and heating may have strong effects. A large loss of water from icy planetesimals can occur owing to the release of gravitational energy through their accretions. Collisional destruction slows down the accretion of icy planetesimals, and hence enhance the sublimation of icy planetesimals. In the case, accretion of icy planetesimals occurs after collision, mixing of material can modified the inner structure of icy planetesimals. In this study, we aim to survey the effect of collisional heating on the evolution of icy planetesimals.