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Future asteroidal sample return missions for understanding the evolution of pristine materials in the solar system

Future asteroidal sample return missions for understanding the evolution of pristine materials in the solar system

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Sample return missions have made significant contributions to the study of the solar system. Analyses of cometary dust particles, obtained from Comet Wild 2 by the Stardust mission, showed that materials in the warm inner disk were transported into the cold outer disk (McKeegan et al. 2 006) probably by the outward gas ?ow in the mid?plane of the disk (Ciesla 2007). However, cometary volatile materials such as ice and organics could not be directly sampled in the mission because of extensive heating during sample capture.

The Hayabusa mission, a sample-return mission from the asteroid Itokawa, is now on the way back to the Earth, and is expected to bring the sample back from the asteroid Itokawa in June 201 0. X-ray fluorescence spectroscopy of Itokwa showed that the surface chemical composition of Itokawa resembles to that of LL- or L-chondrites (Okada et al., 2006), indicating that the retuned samples may consist mainly of inorganic minerals.

There have been returned samples neither containing ice and volatile organics nor keeping the interactions between inorganics, ice and organics intact although recent progress in research of extraterrestrial materials has revealed that the most pristine materials in the solar system are an interacted mixture of minerals, ice, and organic matter.

It is accordingly important to study the interactions between minerals, ice, and organic matter within the pristine materials in the dynamically active protosolar disk to understand the very early evolution of minerals, ice, and organic matter, which would have later evolved to the Earth, ocean, and life, respectively. The sample return missions from primitive bodies such as primitive undifferentiated asteroids and comets are surely required for this purpose. In this talk, we will illustrate the importance of sample-return return missions from undifferentiated asteroids and comets, which preserve pristine minerals, ice, and organics, including a future Japanese asteroidal sample return mission, Hayabusa-2, to the C-type asteroid 1999 JU3.

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