Japan Geoscience Union Meeting 2011
(May 22-27 2011 at Makuhari, Chiba, Japan)

PPS025-16 会場:101 時間:5 月 23 日 18:15-18:30

原始惑星系円盤条件でのマグネシウムケイ酸塩凝縮実験
Condensation experiments of magnesium silicates under protoplanetary disk conditions

橘 省吾[1*], 片岡 香織[1], 瀧川 晶[1], 永原 裕子[1], 小澤 一仁[1]
Shogo Tachibana[1*], Kaori Kataoka[1], Aki Takigawa[1], Hiroko Nagahara[1], Kazuhito Ozawa[1]

[1] 東京大学理学系研究科地球惑星科学専攻
[1]Dept. Earth Planet. Sci., Univ. Tokyo

Magnesium silicates are one of the most abundant materials condensing in the system of solar abundance. Condensation from vapor is the fundamental process for formation of Mg-silicates, and there have been many experimental studies to simulate Mg-silicate formation. However, quantitative discussion on condensation kinetics, especially on the condensation coefficient that reflect the efficiency of condensation of gas species colliding with the surface of condensate, has not yet been made due to experimental difficulties.

In this study, we conducted condensation experiments of magnesium silicates at low pressures in the H2-H2O atmosphere to simulate condensation of magnesium silicates under controlled conditions of pressure, temperature, and gas chemistry close to protoplanetary disk conditions and to discuss condensation kinetics of magnesium silicates quantitatively.
Several important findings were made in this study:

(1) Crystalline forsterite condensed on the substrate of forsterite under controlled conditions (1340 K; total pressure of 1 Pa; Si/H2O/H ratios of ~0.07/~70/1 relative to the solar ratios; supersaturation ratio of ~7), which are much more similar to protoplanetary disk conditions and better controlled than those in previous studies.

(2) The condensation coefficient of forsterite under the above condition was estimated to be <0.2 (or possibly <0.01).

(3) Forsterite (possibly olivine) condensed on the surface of metallic iron under the same condition, but not on molybdenum and corundum. Metallic iron also condened on the substrate of forsterite with a similar supersaturation ratio.

(4) The evaporation rate of forsterite was suppressed under H2O-rich conditions.

These findings, for instance, suggest that forsterite and metallic iron can nucleate and grow mutually in protoplanetary disks but with different efficiencies, and they will make huge contribution to discussion on dust evolution and chemical fractionation in protoplanetary disks and on physical properties (especially thermal structure) of disks as fundamental kinetic data for condensation of magnesium silicates.

キーワード: 原始惑星系円盤, ダスト, 凝縮, ケイ酸塩, 速度論, 不均質核形成
Keywords: protoplanetary disk, dust, condensation, silicate, kinetics, heterogeneous nucleation