[EJ] Evening Poster | P (Space and Planetary Sciences) | P-PS Planetary Sciences

[P-PS06]Formation and evolution of planetary materials in the Solar System

convener:Akira Yamaguchi(National Institute of Polar Research), Wataru Fujiya(Ibaraki University, College of Science), Yoko Kebukawa(横浜国立大学 大学院工学研究院, 共同), Masahiro KAYAMA(Department of Earth and Planetary Material Sciences, Faculty of Science, Tohoku University)

Wed. May 23, 2018 5:15 PM - 6:30 PM Poster Hall (International Exhibition Hall7, Makuhari Messe)

This session will focus on the evolution in the Solar System with interaction and co-evolution in minerals, water, organic matter, and noble gas in meteorites and interplanetary dust particles. New innovative analytical and theoretical techniques in various fields will be discussed. The developing methods are welcome to submit for the future mainstream of meteorite study. In order to explore the planetary materials and their evolution, both meteorite studies and experimental approaches are necessary. In this session, we will discuss these topics from extraterrestrial sample analyses and experimental works. Research works on undifferentiated and differentiated meteorites and parent body processes such as aqueous alteration, thermal metamorphism, shock metamorphism, volcanic activity, and core-mantle-crust differentiation are especially included in this session.

[PPS06-P03]Estimate of Chondrule Cooling Rates from Fe-FeS Cooling Experiments

*Megumi MORI[1], Shogo Tachibana[1,2] (1.Graduate School of Science, Hokkaido University, 2.Graduate School of Science, University of Tokyo)

Keywords:chondrule, cooling rate, metallic iron, iron sulfide, eutectic solidification texture

Chondrules are major constituents of chondrites, but their formation mechanism is still debated [1]. Understanding of the thermal history of chondrules is a key to constraint chondrule-formation events. The peak temperatures should have been above the silicate solidus, and may have been even above or below the silicate liquidus depending on chondrules. Crystallization experiments to reproduce chondrule textures showed that the the cooling rates should have been 100-1000 °C for porphyritic olivine [3, 4] and 500-2300 °C /h for barred olivine [5, 6]. These cooling rates are those above the silicate solidus, and little or no constraint has been given for cooling rates below the silicate solidus except for that below 600°C [7]. In this study, we focus on the eutectic solidification texture of Fe-FeS, which are common opaque phases in chondrules, to constrain the cooling rates of chondrules below ~1000°C.

Powders of Fe metal and FeS with a mixing ratio close to the Fe-FeS eutectic composition was heated at 1400°C in an evacuated silica glass tube with graphite for 3 hours, quenched in water, and ground into 50-400 micron-sized powder. The powder was dispersed in silica wool, and sealed in a silica glass tube with FeS and graphite under vacuum. The sealed tube was heated at 1330°C for 3 hours, and cooled down to room temperature with different cooling rates of 25, 100, 500 K/h. The texture of run products was observed with FE-SEM (JEOL JSM-7000F).

The eutectic solidification texture of Fe-FeS contains Fe metal blobs in a FeS matrix. The typical size of Fe metal blobs is smaller and their number density is higher for samples cooled at higher rates. The distance to the nearest neighbor (*d*) was measured for individual Fe metal grains to quantify the relationship between the texture and the cooling rate. We found that the frequency distribution of *d* (number × d^2) is well well-explained with a log-normal distribution. The parameters of log-normal distributions (m and s^2) are (1.53, 0.31), (1.16, 0.20), and (0.18, 0.14) for the cooling rates of 25, 100, and 500 K/h, respectively, and are clearly different for different cooling rates. This distribution of the nearest neighbor distance could thus be applicable to the estimate of cooling rates of chondrules below the silicate solidus.

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