Development of precise in-situ dating technique for phosphates in chondrites using LA-ICP-MS

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Phosphates in extraterrestrial materials such as Moon, Mars, chondrites and achondrites have high concentration of U and Th (<10 μg/g) and therefore, time-resolved history for planetesimal formation has been constrained based on U-Pb systematics using phosphates in chondrites [1][2]. To establish a reliable chronological scenario, in-situ dating with high spatial resolution is important because these target materials could possibly experience the gain or loss of Pb through the hydrothermal metamorphism in the meteorite parent bodies or derived from the impacts among meteorites [3]. To clarify the time interval for the formation of the chondritic parent bodies, required time resolution is a few million years at least [1]. To achieve this, the combination of MC-ICP-MS equipped with multiple-ion counting system and multiple-spot UV femtosecond laser ablation system [4] was developed. In addition, to establish more robust method for evaluating the system closure of phosphates, we tested the three isotope diagram for Pb. The reability of this method depends on the measuremen of Pb isotope ratio and $^{232}Th/^{238}U$ ratio instead of $^{206}Pb/^{238}U$ ratio which is required in conventional concordia diagram. The precision of the Th/U ratio measurements could be higher than those for the Pb/U ratio measurements because of the similar volatality and ionization potential between Th and U, and thus, this three isotope diagram could provide piercing information concerning the concordance (system closure) of the target minerals.

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