Petrography of a Type A CAI evolved by multiple heating.

*Shun Yoneyama[1], Shoichi Itoh[2]

1.Kyoto University, 2.Graduate school of Science, Kyoto University

Calcium-aluminum-rich inclusions (CAIs) are the oldest solid materials in the early solar system formed at 4567Ma based on the U-corrected Pb-Pb absolute age (e.g., [1]). Coarse-grained CAIs are divided into three groups, type A, type B and type C by the petrography and the bulk chemical composition [2]. Although all type of CAIs has partially melted more than once (e.g., [3, 4, 5]), the petrography and isotopography considering the fractional crystallization with partial melting processes are limited for in-situ chronology (e.g., Al-Mg system). In this study, we try to estimate the crystallization history with petrography and trace elements mapping of wide area by LA-ICP-MS corresponding to the multiple heating process. The major elements mapping were conducted using FE-SEM-EDS at Kyoto University (JSM-7001F and X-max 150). The trace elements mapping were conducted using LA-ICP-MS at Kyoto University (NWR193 Laser Ablation system and iCAP Q ICP-MS).
A large (8 mm ×6 mm) perfect rounded shaped CAI, named KU-N-01, that consists of about 80% melilite, and could be belong to compact type A CAIs. However, KU-N-01 has a bulk chemical compositions between type A and type B on the Stolper's diagram [6], since the KU-N-01 CAI has spinel-fassaite-rich area that is corresponding to the texture of type B CAIs, even in the core consists of $Åk_{20-30}$ melilite enclosed by veined $Åk_{30-40}$ melilite.
The trace elements, including rare earth elements (REEs), mappings are obtained by LA-ICP-MS. This mapping applied to the clear partial melting texture at the layered mantle-rim strucure, which consists of fassaite, melilite with zoning of $Åk_{20}$ to $Åk_{70}$, $Åk_{15-20}$ melilite and gehlenetic mantle surrounding Wark-Lovering rim (W-L rim). As results, the REEs excepting Eu (La, Ce, Nd, Sm, Yb, Lu) are enriched in fassiate, whereas Eu are depleted. In contrast the REEs excepting Eu are depleted in the zoning melilite, whereas Eu are enriched. In $Åk_{15-20}$ melilite, all REEs are enriched. In the area of gehlenetic mantle with reversely zoned melilite and W-L rim at the most outside, the REEs excepting Eu are enriched in W-L rim and have higher concentration of REEs than the others.
These results suggest that the area of fassaite and melilite with zoning of $Åk_{20}$ to $Åk_{70}$ are crystallized from the pocket of partially melted, however $Åk_{15-20}$ melilites are relict, since the REEs are enriched in the melt rather than that of other crystals without Eu. The gehlenetic mantle and W-L rim were formed by condensation, because gehlenetic mantle with reversely zoned melilite is formed by condensation [7] and rim has Group II REEs pattern [8]. In this talk, through the survey with REEs broad area mapping, we will discuss about new perspective to estimate the partial melting history in CAI formation process.
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