Mn-Cr SYSTEMATICS OF SECONDARY FAYALITE IN THE Y-86009 CV3 CARBONACEOUS CHONDRITE

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Introduction: Secondary fayalite ($Fa_{>80}$) is one of the features characterizing Bali-like oxidized subgroup of CV3 chondrites ($CV3_{OxB}$) [1]. However, Vigarano meteorite, classified to reduced subgroup, contains some $CV3_{OxB}$ clasts containing fayalite [2]. Mineralogy and Mn-Cr formation age of the fayalite in the $CV3_{OxB}$ clasts in Vigarano are consistent with those in $CV3_{OxB}$ chondrites [3, 4, 5], implying that all $CV3_{OxB}$ chondrites and clasts derived from a single $CV3_{OxB}$ asteroid. To check this scenario, we made a detailed characterization of fayalite in the $CV3_{OxB}$ Y-86009 meteorite, and determined formation age based on Mn-Cr system using a SIMS IMS 6f at Kyushu University. Additional age determination using a NanoSIMS at NASA JSC is now in progress.

Results and discussion: The SEM observation indicates that Y-86009 is a breccia consisting of many clasts; a clast is composed of a chondrule and a surrounding fine-grained material. The clasts are embedded in the host matrix or have direct contact with adjacent clasts, which can be recognized by boundaries in BSE image.

Fayalite grains (Fa_{85-100}) are observed in the host matrix and in several clasts. They are 5-50 μm in size and coexist with troilite and/or magnetite, suggesting that the host Y-86009 and the clasts are $CV3_{OxB}$ materials [1]. However, the host matrix contains larger numbers of secondary minerals (e.g. fayalite, magnetite, etc.) than the fine-grained materials of the clasts, indicating that the host Y-86009 and the clasts are slightly different in lithology.

The fayalite in the clasts exists in chondrule interiors and peripheries, and in fine-grained materials. It occurs as isolated grains, or as constituents of laths (up to 20 x 100 μm) that extended from the magnetite-sulfide nodules in the chondrule surfaces. The laths terminate near the clast boundaries, implying the preferential occurrence of the fayalite in the clasts.

Mn-Cr isotope analysis was performed on four fayalite grains (20-50 μm, Fa_{98-100} and high MnO content of 0.8 wt %) in one of the clasts. They do not show iron-magnesium zoning, indicating that the fayalite grains have not been altered after their formation. The Mn-Cr data for them define an initial $^{53}Mn/^{55}Mn$ ratio of $(2.9 \pm 0.4) \times 10^{-6}$. This ratio indicates that the fayalite in the clast in the $CV3_{OxB}$ Y-86009 formed 4 ± 2 Ma before Angrite parent body. An absolute age was also determined to be 4562 ± 2 Ma.

The SEM observations imply that the $CV3_{OxB}$ clasts containing fayalite had not formed in the present structure of the Y-86009. The obtained fayalite formation age is identical within errors to that of $CV3_{OxB}$ chondrites [3, 4] and Vigarano $CV3_{OxB}$ clasts [5], suggesting that they formed in the same period. Therefore, the $CV3_{OxB}$ clast in the Y-86009 could have originated from the single $CV3_{OxB}$ asteroid where all $CV3_{OxB}$ materials formed. Had other $CV3_{OxB}$ clasts in the Y-86009 and the host $CV3_{OxB}$ Y-86009 originated from the same asteroid? Additional age determination of the fayalite in them will verify it.

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