The zoned melilite in Fluffy Type A CAI from Vigarano meteorite

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Coarse-grained Ca-Al-rich-inclusions (CAIs) in carbonaceous chondrites are classified into three groups, Type A, Type B and Type C. Type A is further classified into fluffy type A (FTA) and compact type A (CTA) (MacPherson et al., 1988). It is widely accepted that CTAs were formed by crystallization from a melt (e.g., Simon et al., 1999). On the other hand, FTAs condensed as solids from the hot solar nebular gas, based on their irregular-outlines and the existence of reversely-zoned melilite crystals (MacPherson and Grossman, 1984). Harazono and Yurimoto (2003) discovered that oxygen isotopic compositions of melilite grains in a FTA CAI from the Vigarano meteorite are depleted in O-16 for the most parts, but enriched in O-16 only for portins of gehlenitic composition (akermanite composition less than 5). Such oxygen isotopic heterogeneity was observed not only in inter-grains but also in intra-grain. This observation shows that melilite was not formed in an oxygen isotopic reservoir. However, relationships between reversely zoning of melilite and the oxygen isotopic distribution have not been studied. In this study, we study compositional zoning of melilite crystals in V2-01 FTA CAI from Vigarano meteorite.

A polished thin section of the V2-01 FTA CAI from Vigarano meteorite (Harazono and Yurimoto, 2003) was used in this study. Compositional zoning of melilite crystals was determined by X-ray mapping with about 1 micron spatial resolution using FE-SEM-EDS in Hokkaido University. We observed that the CAI was deformed and fragmentized mechanically by compaction probably during accretion onto the parent body. The degree of deformation and fragmentation was estimated by tracing of a Wark-Lovering rim existing at the edge of the FTA. The fragmentation was also estimated by a grain shape of melilite with compositional zoning. In this study, we focused on melilite grains having original growth shape escaped from fragmentation.

Most melilite are reversely zoned and the chemical composition gradually changes towards rim. The ranges of akermanite composition are from 25 to 0 from core to rim. But discontinuous chemical zoning (step zoning) has often observed in some melilite grains. Ti-Al-rich diopside (about 10 micron) is enclosed in akermanite-rich melilite portions of 25 of akermanitic composition. In addition, Ti-Al-rich diopside is also observed as tiny (about 1 micron) blebs in both akermanite-rich and akermanite-poor melilite parts. The blebs suggest that the Ti-Al-rich diopside was formed by exsolution from the host melilite crystal. Akermanite-rich veins appear in grain boundary of some melilite crystals. The center of this vein is akermanite-rich and the rims of both sides are akermanite-poor.

In the next step, we will measure oxygen isotopic distribution of the melilite in order to discuss relationships between observed reversely zoning of melilite and the oxygen isotopic distribution.