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Relationship between oxygen isotope zoning and crystal growth in melilite crystals from fluffy type A CAI

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The oxygen isotopic microdistributions within melilite measured using in situ secondary ion mass spectrometry correspond to the chemical zoning profiles in single melilite crystals of a fluffy Type A Ca-Al-rich inclusion (CAI) of reduced CV3 Vigarano meteorite. The melilite crystals show chemical reverse zoning within an individual single-crystal from the akermanite-rich core to the akermanite-poor rim. The composition changes continuously with the crystal growth. The zoning structures suggest that the melilite grew in a hot nebular gas by condensation with decreasing pressure. The oxygen isotopic composition of melilite also changes continuously from 16O-poor to 16O-rich with the crystal growth. These observations suggest that the melilite condensation proceeded with change consistent with an astrophysical setting around the inner edge of a protoplanetary disk where both 16O-rich solar coronal gas and 16O-poor dense protoplanetary disk gas could coexist. Fluffy Type A CAIs could have been formed around the inner edge of the protoplanetary disk surrounding the early sun.

Keywords: FTA, SIMS, oxygen isotope, CAI