Goldschmidt 2022 Abstract
https://doi.org/10.46427/gold2022.13206

Thermal History of Amoeboid Olivine Aggregates from the Kainsaz CO3.2 Chondrite

JANGMI HAN[1], CHANGKUN PARK[2] AND ADRIAN BREARLEY[3]

[1]University of Houston
[2]Korea Polar Research Institute
[3]University of New Mexico
Presenting Author: jhan28@central.uh.edu

Amoeboid olivine aggregates (AOAs) from the Kainsaz CO3.2 chondrite were analyzed using transmission electron microscopy in order to provide better constraints on fluid-driven thermal metamorphism on the parent body. The Kainsaz AOAs are dominated by strongly zoned, fine-grained olivine grains (Fa_{2-31}) with heterogeneous Fe enrichments along the grain boundaries, which are interpreted as the result of Fe^{2+}-Mg^{2+} interdiffusion with the matrix during thermal metamorphism [1]. However, our diffusion calculations show that such AOA olivine zoning and compositions cannot be produced by a simple diffusional exchange during metamorphic heating, unlike chondrule olivine zoning and compositions [2]. The two-stage scenario is proposed for the Kainsaz AOAs, involving an initial equilibration at $Fa_{\sim 4-8}$ during peak metamorphic heating, when Fe diffused into the center of forsteritic olivine grains, followed by steep Fe enrichments up to $Fa_{\sim 20-27}$ along the edge of olivine grains in the presence of limited fluids. In addition, fine-grained ferroan olivine overgrowths occur heterogeneously in crystallographic continuity with olivines on the AOA exteriors. The overgrowths (Fa_{33-36}) are compositionally distinct from the underlying AOA olivines and are not fully equilibrated with the matrix olivines ($Fa_{\sim 20-55}$). The ferroan olivine overgrowths likely formed by precipitation from fluids in an epitaxial relationship with forsteritic olivine on the edges of AOAs [3]. Collectively, these observations provide evidence for the mobilization of Fe, Mg, and Si in the presence of fluids along olivine grain boundaries and into olivine grains during thermal metamorphism. We conclude that in Kainsaz AOAs, the strong zonation development in individual olivine grains and the formation of ferroan olivine overgrowths were a fluid-driven process that occurred at relatively low temperatures (<500°C), during the cooling history of the CO3 chondrite parent body, following the peak of thermal metamorphism [4].

[1] Chizmadia et al. (2002) MAPS **37**, 1781–1796. [2] Jones and Rubie (1991) EPSL **106,** 73–86. [3] Krot et al. (2000) MAPS **35**, 1365–1386. [4] Han et al. (2022) GCA **322**, 109–128.