ON THE OCCURRENCE OF A DIOPSIDE-RICH CAI IN THE CV3 CHONDRITE NORTHWEST AFRICA 4669
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Introduction: In general, diopside is not an especially abundant phase in CAIs in CV chondrites where it most commonly occurs within the Wark-Lovering rim sequences on inclusions [1]. However, aluminous diopside has been mainly described from fine-grained, spinel-rich inclusions from the oxidized CV chondrites Allende, Kaba, Mokoia (e.g., [2-4]) and from the reduced CVs Efremovka and Leoville (e.g., [5]).

Here I report on the mineralogy of an unusual CAI from the recently described CV3 chondrite NWA 4669. A detailed study by analytical SEM and EMPA revealed that the entire inclusion consists mainly of Al-diopside and (Mg, Al)-spinel.

Results: The inclusion is an irregularly shaped fine-grained aggregate that stretches out over 4 mm with expanses of intervening matrix of the host meteorite. The overall texture can be described as consisting of multiple, closely-packed microaggregates (< 50 to > 100 µm in size), each of which contains spinal “cores” surrounded by a thick layer of Al-diopside (comprising > 50 vol. %). The spinels typically are surrounded by an in places > 10 µm wide zone exhibiting a mottled appearance in backscattered electron images. This zone which occurs throughout the whole inclusion is interpreted as chemical reaction zone at the contact between spinel and diopside.

Compositionally, the spinels are close to pure MgAl₂O₄ with contents of 0.1-0.3 wt % TiO₂, 0.4-0.8 wt % FeO, 0.4-0.7 wt % Cr₂O₃ and 0.1-0.3 wt % V₂O₃. Al-diopside commonly have Al₂O₃ contents that range from ~2-5 wt %, a few analyses gave contents up to ~9-10 wt %. TiO₂ contents of Al-diopside are low (0.1-0.5 wt%) as are the contents of other minor elements with 0.2-0.6 wt % FeO, < 0.1 wt % Cr₂O₃, <0.1 wt % MnO, < 0.1 wt % V₂O₃. The reaction zone around the spinel nodules is a heterogeneous mixture of a fine-grained intergrowth with individual grain sizes below the analytical resolution of the electron microprobe. Therefore, EMP analyses show some compositional variation in the range of 29-32 wt % SiO₂, 33-36 wt % Al₂O₃, 14-16 wt % CaO, 0.4-0.8 wt % FeO, and 0.1-0.3 wt % TiO₂.

Conclusions: The fine-grained and irregularly shaped inclusion exhibits a non-igneous texture. Therefore, it is very likely that it formed from minerals that condensed in the solar nebula. The modal composition (mainly Al-diopside + spinel), the absence of other major phases and the presence of an apparent reaction zone between spinel and diopside suggest that the inclusion was altered by a gas-solid reaction in the final stage of its formation. The (Mg,Al)-spinel appears to be a relict from a precursor mineral association whereas the abundant Al-diopside was formed by the final gas-solid nebular reaction.