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CAIs high-temperature rims as traces of nebular processes: evidence from the NWA 12800 meteorite.

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Calcium-aluminum-rich inclusions (CAIs) are among the first solids to have formed in the Solar System recording the most primordial processes in protoplanetary disk, including condensation, melting, and evaporation [1]. High-temperature rims found in some CAIs, commonly referred to as Wark-Lovering (WL) rims, are believed to form through high-temperature, flash-heating events and interactions with the nebular environment [2]. While the general mineral sequence of WL rims is well documented, pristine CAIs that have avoided parent body processes, such as aqueous alteration or metasomatism, are rare. Additionally, variations in rim structure and composition remain poorly constrained, limiting our understanding of their formation conditions. Thus, WL rims serve as probes to investigate primordial nebular conditions. In this work, we investigate the mineralogy and petrography of two pristine CAIs from the NWA 12800 CV3 carbonaceous chondrite using scanning electron microscopy. Both inclusions contain a diopside ± spinel core surrounded by high-temperature rims composed of melilite ± anorthite, spinel + perovskite, ± olivine, and diopside. We compare these inclusions and discuss their distinct formation processes. Although both CAIs display rims consistent with classic WL rims, their crystallization sequences deviate from the strict WL definition while still reflecting condensation, melting, evaporation, and recrystallization processes, analogous to those involved in WL rim formation. As rim diversity in CAIs is essential to understanding protoplanetary disk processes, further characterization of CAIs with differing rim characteristics is needed. This work contributes to this effort by providing new insights into CAIs formation and evolution.

[1] MacPherson, Simon & Davis (2005), *Chondrites and the Protoplanetary Disk*, *Astronomical Society of the Pacific Conference Series* 341, 225.

[2] Wark & Boynton (2001), *Meteoritics & Planetary Science* 36, 1135-1166.