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High-resolution TEM study of jimthompsonite, chesterite, and chain-width disorder in Archean ultramafic rocks from Isua, West Greenland

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Abstract

Jimthompsonite and chesterite occur as intergrowths within anthophyllite up to a few millimeters across in talc-magnesite schist from the ~3800 Ma Isua Supracrustal Belt, West Greenland. Pyribole lamellae span the entire intergrowth width and have their own crystal faces. The schist is strongly foliated and pyribole intergrowths are aligned with this foliation indicating broad synchronicity among metamorphic deformation, recrystallization, and pyribole formation.

Chain-width errors, polytypic disorder, zipper terminations, displacive planar faults, replacement products by sheet silicates, polygon-shaped cavities, cavity-filling materials, and low-angle grain boundaries were revealed by HRTEM. Based on cross-cutting relationships, the order of the formation of these defects was determined. Pyribole intergrowths formed prior to displacive planar faults and cavity-filling materials. Fine sheet silicates replaced pyriboles or filled cracks after the pyribole intergrowth formation. No obvious reaction or replacement products by talc or chlorite were confirmed at the interface between pyriboles and optically recognizable large sheet silicates, suggesting that fine sheet silicates replacing pyriboles formed later than talc and chlorite. Polysomatic and polytypic lamellae may have grown simultaneously because the lamellae cross cut each other and one does not affect the formation of the other.

The possible reaction fronts that separate jimthompsonite or chesterite from anthophyllite were not found in [001] HRTEM images of our samples. Instead, narrow jimthompsonite and chesterite lamellae that break termination rules were commonly found. These textural features can be better understood as a simultaneous growth of jimthompsonite, chesterite, and anthophyllite and not as a retrograde reaction product of anthophyllite.

Keywords: Jimthompsonite, chesterite, anthophyllite, pyribole, chain-width disorder, high-resolution TEM, Isua, West Greenland