Multi-scale analysis of structures and textures and their relationship to mineral growth across the New Quebec orogen, Canada

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The New Quebec orogen (NQO) is a Paleoproterozoic orogenic belt located in the southeastern Churchill Province of Quebec, separating the Superior Craton from the Core Zone. The NQO has been divided into a western foreland referred to as the Kaniapiskau Supergroup, and an eastern hinterland made up of the Rachel-Laporte Zone and the Kuujjuaq Zone, with the latter representing remobilized Archean basement. Deformation events associated with the NQO include two compressional phases related to the initial collision responsible for the general NNW-SSE trend of the area and a late oblique compressional event that resulted in dextral transverse movement along pre-existing thrust faults.

Structural data and petrographic samples were collected across a 40 km transect documenting the foreland-hinterland transition of the northern NQO. In greenschist facies samples original bedding, S_0, is well preserved. S_1 foliation is commonly formed by chlorite, muscovite, biotite, and elongated quartz. A strong S_2 crenulation cleavage (related to D_2) is identified in some samples which folds S_1 minerals and is responsible for new chlorite growth. Several samples display C-S fabrics related to D_3. Chlorite pseudomorphs after biotite are parallel to S_1, indicating biotite growth was syn-kinematic with D_1. Amphibolite facies samples typically contain a biotite-muscovite-quartz matrix with biotite, garnet, and rare staurolite porphyroblasts. In these samples, inclusion trails and rotated porphyroblasts are common with garnet porphyroblasts displaying up to 90° dextral rotation (based on S_i perpendicular to S_e). Garnet growth is interpreted as inter-kinematic with D_1 and D_3 . In general, three deformation events are observed with D_1 forming the dominant NNW-SSE foliation observed across the transect, D_2 forming an E-W crenulation cleavage best observed in the western greenschist facies portion of the transect, and D_3 resulting in evidence of dextral shearing in C-S fabrics in finer-grained greenschist samples and rotated porphyroblasts in the eastern amphibolite samples. Peak metamorphic conditions were syn-kinematic with D_1 in greenschist facies samples, and late syn- to early postkinematic with D_1 in amphibolite facies samples. Evidence of retrograde metamorphism is observed in the presence of chlorite pseudomorphs of biotite, syn-kinematic with D_3. The continent-wide, composite Trans-Hudson orogen is responsible for three phases of deformation experienced by the NQO, as the supercontinent Nuna was being assembled. The foreland experienced peak greenschist facies metamorphism during the initial collision while the hinterland attained peak amphibolite facies metamorphism slightly later. Retrograde greenschist facies metamorphism was experienced by the entire orogen until at least the third phase of deformation.

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