Polycyclic Deformation and Cementation in the Exhumed Norumbega Fault Zone, Maine-New Hampshire

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Fieldwork, optical and SEM imaging, and microprobe analysis show multiple ductile and brittle reactivations of high-grade fault rocks from the Norumbega fault zone in Maine and New Hampshire. Mineral replacement reactions occurred at several stages of deformation, and most lead to stronger mineral assemblages and random fabric textures. Ductile deformation under amphibolite facies conditions created a conspicuous foliation in amphibolite and biotite granular schists. Pegmatites that crosscut these rocks document a high-grade fracturing event into which pegmatitic fluids were intruded. Ductile fabric in the pegmatites shares the same orientation with the host schists, thus ductile deformation continued with the same kinematics after brittle pegmatite emplacement. Later localization of strain formed a ~100 meter wide ultramylonite band that cuts these schist and pegmatite protoliths. Fractures in the feldspar-rich layers within biotite-rich host rocks project as c' cleavages in phyllosilicate-rich layers and document a later brittle event. Syntectonic feldspar crystallization is indicated by biotite inclusions within feldspar porphyroblasts in the schists, and extensive embayment of actinolite and biotite grains by feldspars and quartz in the ultramylonite. This growth disrupted the contiguity of the weaker sheet silicates and resulted in a rock with a stronger texture and mineral assemblage. This second episode of deformation must have opened conduits through which associated alkaline fluid infiltrated into the fault zone enabling the feldspar replacements. Thus, the generation of ultramylonite involved brittle and perhaps seismic deformation even though evidence of pervasive fractures has been destroyed by subsequent replacements. A third brittle deformation involved the localization of pseudotachylite dikes in this strengthened ultramylonite relative to the biotite-bearing schists. This localization further suggests that reaction hardening was a critical control on the localization of seismic, pseudotachylite-producing events.

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