Structure and Metamorphism along a lower crustal tectonic boundary

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Abstract

The Snowbird Tectonic Zone (STZ) is a 2000-km-long geophysically-defined lineament that marks the boundary between the Rae and Hearne crustal provinces of the Canadian Shield. In northern Saskatchewan and southern Nunavut, this zone is characterized by a chain of anastomosing high grade mylonites including the East Athabasca mylonite triangle (EAmt). Within the EAmt, there are three distinct tectonic blocks that differ in structural, metamorphic, and tectonic history. Unraveling the history of this region may hold the key to the development of the western Canadian Shield and may offer insight into the deformation characteristics of the deep crust. Previous geochronology has yielded dates of 2.6, 2.4, 1.9, and 1.8 Ga, but it is unclear which of these correspond to accretion, reactivation, or exhumation events. Cora Lake, in the center of the EAmt, offers an excellent exposure of the boundary between two of the tectonic blocks, the southeast and northwest domains. The purpose of this work is to identify the nature of this boundary and to place time constraints on the deformation observed on both sides of the boundary, as well as within it.

The Cora Lake area was previously mapped as containing Chipman tonalite mylonite, but recent mapping has revealed layers of other rock types including: two-pyroxene gneisses, an orthopyroxene-bearing mylonite, and several outcrops of diatexite. The western part of the region hosts an intense, very fine-grained ultramylonite that cuts the regional mylonites. Recent field observations and thin section analysis have confirmed a dominant sinistral shear sense in the rocks of the southeast domain, as well as oblique strike-slip, left-lateral movement along the ultramylonite shear zone. Microstructural analysis suggests that the regional deformation occurred under granulite facies conditions and ductile deformation of clinopyroxene within the ultramylonite suggests very high temperatures. A later, chlorite grade mylonite zone is also present across the middle of the region, and overprints the ultramylonite shear zone in some areas. Compositional maps from a sample from the ultramylonite zone showed a gradation of calcium concentration in syntectonic plagioclase coronas around garnet. This suggests that deformation along the Cora Lake ultramylonite zone was occurring during decompression of the rocks. However, because the ultramylonite zone has a nearly horizontal lineation, the actual exhumation must be accommodated by some other structure.

Work on timing constraints is still in progress, but initial ages obtained from electron microprobe monazite analysis show both 2.6 and 1.9 Ga signatures. Some monazite grains were found have high thorium cores and low thorium rims, interpreted to reflect Th-depletion during partial melting. Dating of monazite grains in diatexite bodies from both the north and south sides of the shear zone will be used to constrain the timing of various deformation events. Crystallization and possible metamorphic ages may also be obtained from large zircon crystals present in some of the rocks. From the data gathered so far, it is clear that the juxtaposition of tectonic blocks that we see today is the result of multiple deformation events along an ultramylonite shear zone. Although the shear zone is not interpreted as an exhumation structure, it is clear that the shear zone was active as both blocks were being exhumed.