

Simple geophysically-imaged shear zones with complex histories: an example from the southern Trans-Hudson Orogen, Manitoba

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The Berry Creek shear zone (BCSZ) transects the southern portion of the Palaeoproterozoic Trans-Hudson Orogen in Manitoba for more than 150 km. It lies below the northern limit of Ordovician limestone cover for much of its length, and its trace was originally geophysically defined on the basis of truncations of aeromagnetic patterns, confirmed in the third dimension by truncation of reflectors in seismic profiles.

The BCSZ was investigated at six locations where it is exposed in windows through the limestone cover. Fabrics and minor structures vary from ductile to brittle along the zone, owing to different ages of deformation, and different tectonothermal conditions during a protracted history.

P–T estimates from across the northeast segment of the BCSZ indicate identical metamorphic conditions on both sides, suggesting little to no offset after the thermal peak of metamorphism. Conversely, across its western segment, metamorphic grade changes southward from greenschist to amphibolite facies. This pattern may have resulted from scissor-like faulting along the BCSZ, with the rotation axis pinned in the northeast. Alternatively, the age of deformation is different at each location. The solution to this problem requires geochronological investigation.

The structure has previously been referred to as a fault or a shear zone, depending on personal preference and the local data set. We interpret the sharp, vertical truncations of geophysical features as most likely resulting from late brittle–ductile and brittle features, such as cataclastic zones. Brittle deformation appears to have reactivated and overprinted earlier ductile shear zone fabrics. The earliest manifestation (ductile) of the BCSZ pre-dates the Tramping Lake granite (1837 ± 8/–6 Ma) and the thermal peak of amphibolite grade metamorphism (1820–1805 Ma). A later ductile manifestation of the BCSZ truncated the pluton. The youngest (brittle) deformation in the zone occurred at sub-greenschist metamorphic conditions during uplift (probably after ~1770 Ma). The BCSZ, as imaged geophysically, therefore represents an anastomosing shear zone/fault system that underwent multiple reactivations during a period in excess of 70 Ma. Different early ductile segments that are presently aligned were probably originally unrelated, but collectively formed a plane of anisotropy that was reactivated during late brittle deformation. The coincidence between the trace of the BCSZ and the northern limit of the Paleozoic cover may not be fortuitous.