

Structural Setting of the Bernic Lake Pegmatite Group, Bird River Greenstone Belt, Southeastern Manitoba



P. Kremer and S. Lin Department of Earth Sciences, University of Waterloo

Summary

In the summer of 2005, a two year M.Sc. study was initiated by the University of Waterloo in cooperation with the Manitoba Geological Survey and the Tantalum Mining Corporation of Canada Limited to examine the structural geology of the Bernic Lake formation of the Bird River greenstone belt in southeastern Manitoba. The Bernic Lake formation is host to the Bernic Lake pegmatite group, of which the highly fractionated, complexly-zoned, rare-element enriched LCT type, petalite subtype Tanco pegmatite, currently being mined for tantalum, cesium, and lithium, is most noteworthy.

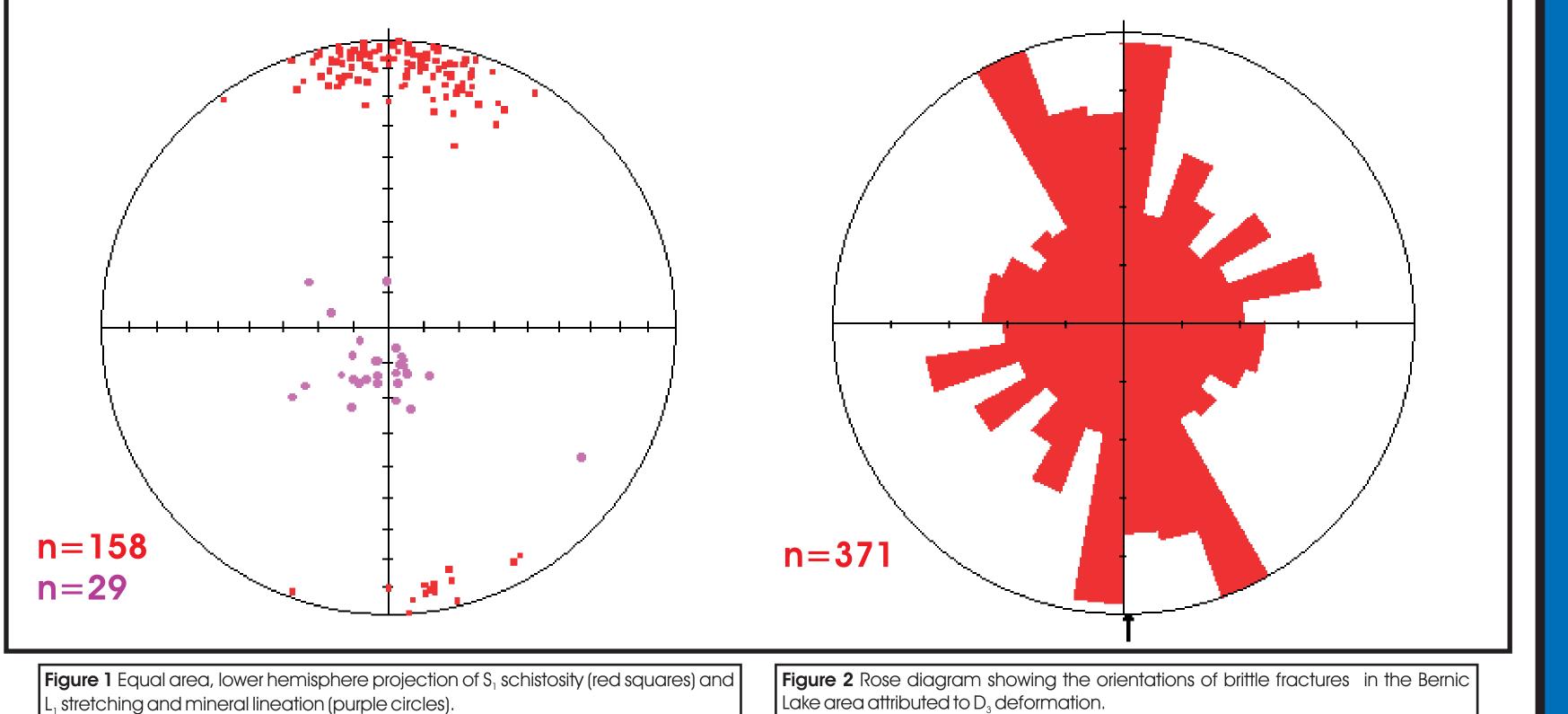
The objectives of the project are:

- 1) To map the Bernic Lake formation with specific emphasis on the stratigraphy and structural geology of the area around Tanco mine ;
- 2) To place structural, lithological, and geochronological constraints on the emplacement of pegmatites that occur in the Bernic Lake pegmatite group within the above framework and determine the genetic relationship (if any) between different pegmatite occurrences;
- 3) Based on the above geological criteria, to identify locations that have the potential to host rare-element enriched pegmatites

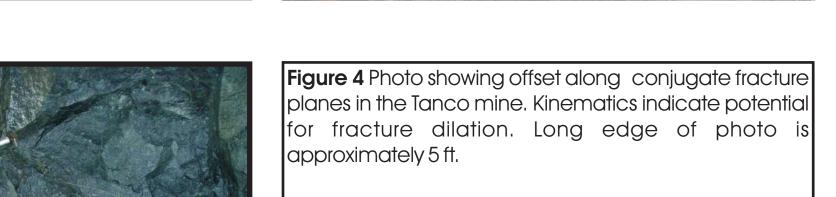
General Geology Cology of the Bernitery Res Protecting Trace mine, Bird River generation below. (VTS SELE) A manufacture of the Bernitery Research (NTS SELE) A manufactur

Structural Geology

Event	Associated Structures
D_1	large-scale isoclinal folding: anticline-syncline pair
	pervasive, layer-parallel biotite-amphibole +/- chlorite schistosity
	downdip stretching and mineral lineation
	S-side-up shearing with minor dextral component
	gentle to open upright folds
	locally developed spaced fracture cleavage
D_3	conjugate brittle fault system
	N-trending faults with sinistral displacement
	ENE-trending faults with dextral displacement
	Table 1. Summary of deformation eventsand structures in the Bernic Lake area.



Pegmatite Structure



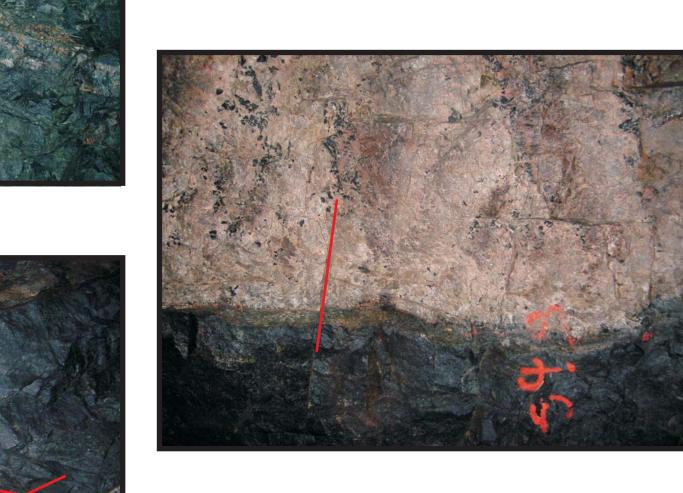


Figure 5 Though emplaced along fraction Tanco pegmatite is also affected by a trending, subvertical fractures consideformation. The presence of these crosscut the Tanco pegmatite suggestemplaced somewhat earlier in the geothe Bird River greenstone belt. Long edapproximately 3 ft.

prominent conjugate fracture set at the Tanco mine.

Brittle Emplacement - emplaced along brittle, conjugate fracture set (Fig. 3) predominantly within rheologically competent rocks (gabbro-diorite, massive Ductile Emplacement - emplaced into dilatant zones within and around large, steeply-dipping high strain zones

- fracture kinematics (Fig. 4), shear tearing, and increased fluid pressure from pegmatitic melt create conditions conducive to fracture growth suggestive of passive dilation.

- fracture orientations measured at the Tanco mine are consistent with N-S shortening (σ_3 : subvertical) - locally offset by dextral strike-slip movement associated with D₃ deformation

- late fractures crosscut both the host rock and pegmatite at the Tanco mine (Figure 5) - interpreted to be emplaced in late stages of D_1 deformation

- folding and incipient boudinage

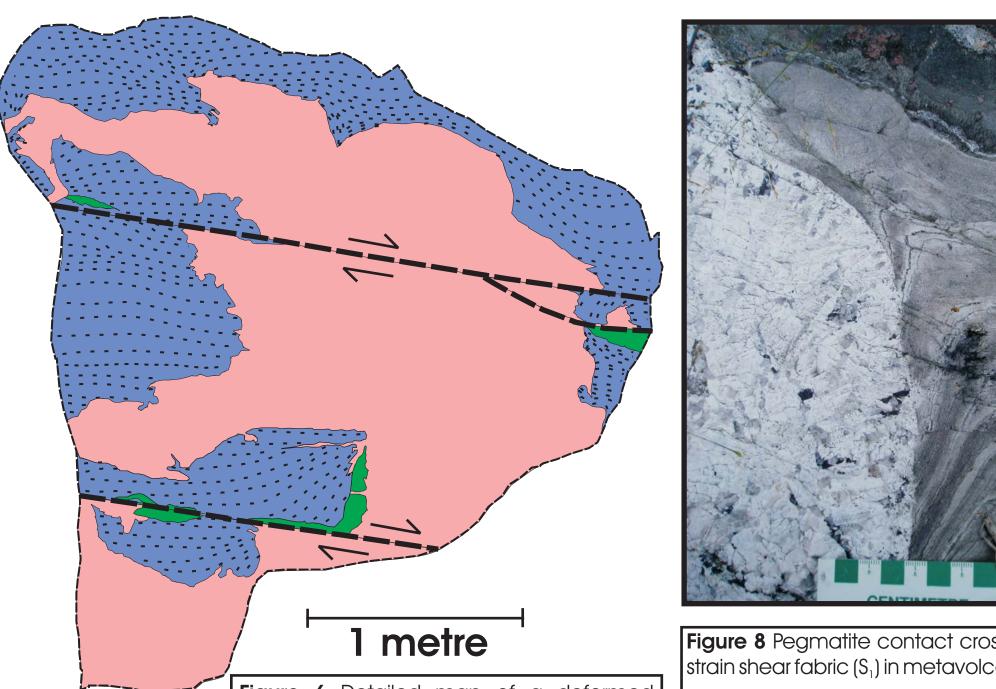
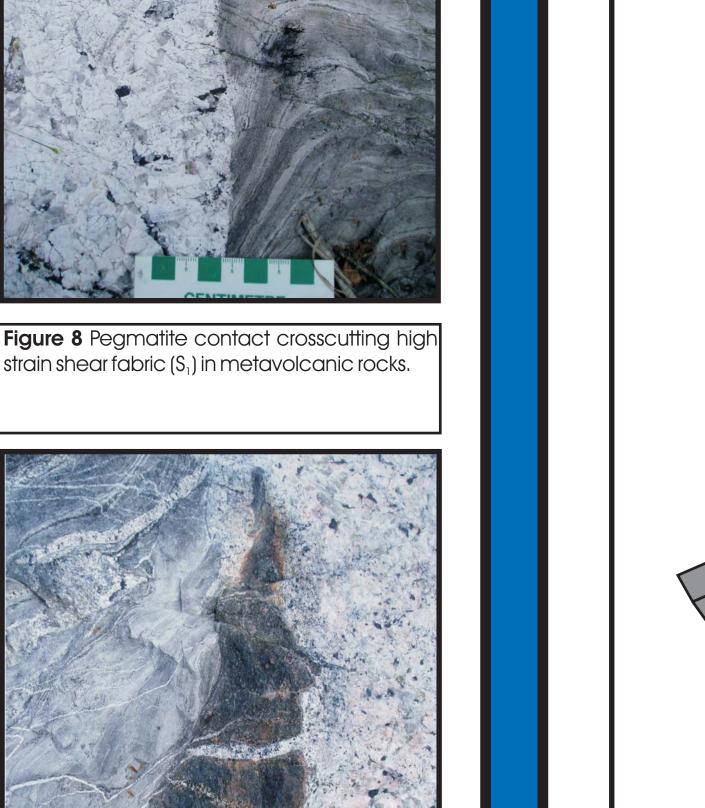




Figure 9 Zones of garnet-biotite metasomatism occur near pegmatite gesting emplacement in the late stages of D₁ deformation. Attral offset occurs along post D₁ brittle faults.



emplacement associated with D₁. North-south directed shortening on volcanic and syn-volcanic rocks (a) caused development of an anticline-syncline pair (b). Strain accumulation focused at the hinge of the syncline leads to side-up sense of shearing in mafic volcanic rocks, while rheologically competent lithologies display a brittle, conjugate style of deformation. Granitic magma ascends from depth along the shear zone and late stage pegn fluids are emplaced in dilatant zones during the final stages of deformation. Shear tearing and fluid pressure as dilatancy of the conjugate fracture set allows for emplacement of subhorizontal tabular pegmatites along from planes in rocks displaying brittle deformation (c)

Discussion

Pegmatites east of Bernic Lake show evidence of ductile deformation that has not been described in the Tanco pegmatite, though mineralogical and geochemical studies indicate that they are genetically related. Geochronological and geochemical samples from representative pegmatites in each location were collected and are pending analysis to further constrain the relationship between deformed and undeformed pegmatites within the Bernic Lake formation. Two possibilities seem feasible:

1) if data is returned showing identical ages for pegmatites with different structural characteristics, then it may be a function of rheological contrasts between respective host rocks (gabbro-diorite versus sheared metavolcanics) that are responsible for the different emplacement styles and mechanisms (Figure 10);

2) there may be multiple generations of pegmatite emplacement, whereby late D_1 pegmatite emplacement into ductile dilatant zones was followed by the emplacement of shallowly dipping tabular pegmatites (Tanco, Buck) along late fracture sets associated with D_3 deformation;

The tendency of pegmatites of the Bernic Lake group to be spatially associated with a large shear zone suggests that the shear zone may have acted as a plane of weakness within the stratigraphy along which magma ascended through the crust. If the fracture-hosted, highly-fractionated Tanco pegmatite is shown to be coeval with deformed pegmatites east of the lake that record the final increments of D_1 strain, then large-scale dilatant zones associated with this structure become of interest with regards to potential locations for the accumulation and crystallization of rare-element bearing pegmatitic fluids.

Acknowledgments

The author would like to thank B. Foster, K. Lewis, and L. Osadchuk for their capable and enthusiastic assistance throughout the course of the field season, as well as M Duguet and C. Mealin for sharing insights from their respective projects. C. Galeschuk P. Vanstone, and S. Moran from the Tanco mine are thanked for their support throughout the course of the summer and for sharing their time, opinions, and ideas The project would not be possible without the continued logistical support, assistance and encouragement of the Manitoba Geological Survey.