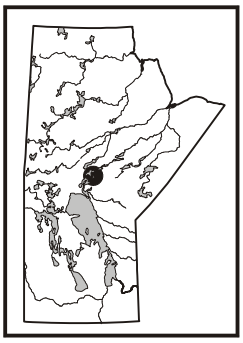
GS-19

STRUCTURAL STUDY IN THE SOUTHEASTERN PART OF THE CROSS LAKE GREENSTONE BELT, NORTHWESTERN SUPERIOR PROVINCE, MANITOBA

by A.C. Parmenter[1], S. Lin[1] and M.T. Corkery



Parmenter, A.C., Lin, S., and Corkery, M.T. 1999: Structural study in the southeastern part of the Cross Lake greenstone belt, northwestern Superior Province, Manitoba; *in* Report of Activities 1999, Manitoba Industry, Trade and Mines, Geological Services, p. 81-83.

SUMMARY

To date, geological investigations within the Cross Lake greenstone belt have mainly dealt with stratigraphic mapping, geochronology, and metamorphic history. This study focuses on the kinematics of a large east-trending shear zone that runs the length of the southeast arm of the greenstone belt. Initial observations indicate dextral shearing as the most recent recognizable movement along this zone. Evidence for two possibly earlier generations of fabrics is also documented. One is an east-trending gneissic foliation that is best developed in the Clearwater Bay batholith to the south of the shear zone. The other is a northeast-trending fabric that is spatially associated with the Whiskey Jack Channel and overprints the gneissic foliation.

INTRODUCTION

An M.Sc. structural study of part of the Cross Lake greenstone belt was initiated in 1999, supported by LITHOPROBE and Manitoba Energy and Mines. A main focus of this study is to investigate the kinematic history of the South Pipestone Lake Shear Zone (SPLSZ), a large-scale east-trending shear zone that dissects the southeast arm of the Cross Lake greenstone belt. Understanding this shear zone may help in developing a regional tectonic model for the northwestern Superior Province. Relationship between the shear zone and other structures is also investigated.

Fieldwork in the summer of 1999 was focused on 1:20 000 scale mapping of the area from Pipestone Lake in the southeast to the northeastern trending Whiskey Jack channel (Fig. GS-19-1). Detailed stratigraphy and geological history of the area have been previously outlined by Rousell (1965) and Corkery (1983; 1985), Corkery et al. (1988), Corkery and Lenton (1989) and Corkery et al. (1992). Breedveld (1988) undertook a reconnaissance tectono-metamorphic study of the Cross Lake greenstone belt.

GEOLOGICAL SETTING

The Cross Lake greenstone belt is flanked to the northwest by the high-grade metamorphic Pikwitonei and meta-plutonic God's Lake domains, and to the south by the meta-plutonic Molson Lake Domain. As described by Corkery et al. (1992), the oldest supracrustal rocks found in the belt are the Pipestone Lake Group (ca. 2760 Ma) metavolcanic and minor metasedimentary rocks. This group is dominated by extensive weakly to strongly deformed pillowed basalts and minor massive basaltic flows. The Gunpoint Group (ca. 2744-2728 Ma) unconformably overlies the Pipestone Lake Group and consists of fining-upward successions of metasedimentary rocks with interbedded felsic volcaniclastics. The Cross Lake Group (ca. 2713-2695 Ma), a generally fining-upward fluvial sequence with minor interbedded volcanic rocks, unconformably overlies both the Pipestone and Gunpoint Groups.

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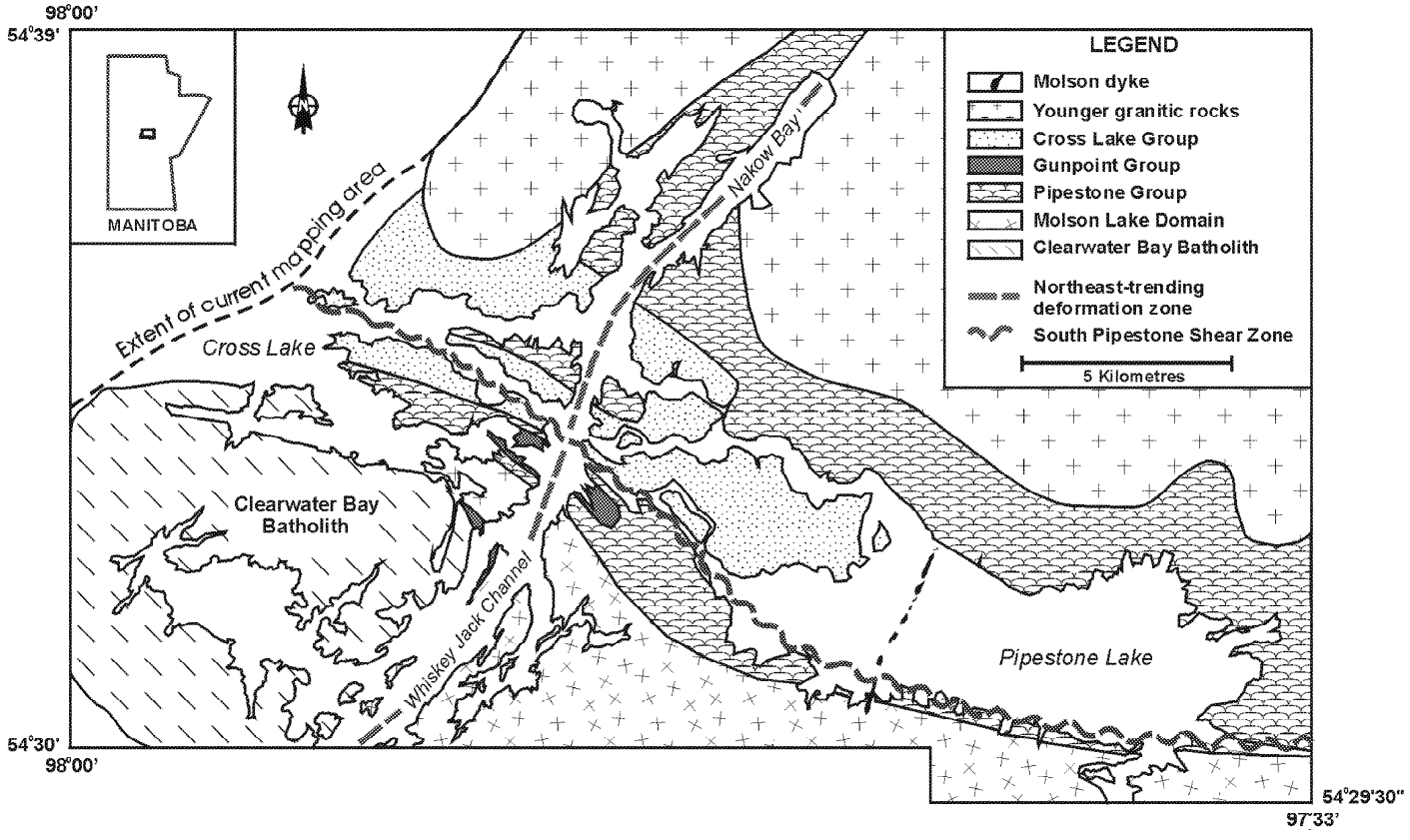

Figure GS-19-1: A simplified geological map of the southeastern part of the Cross Lake greenstone belt (Modified from Corkery et al., 1992).

PRELIMINARY RESULTS

There are two main structural trends in the map area, each characterized by distinct structural features and timing of development. East-trending structures consist of the SPLSZ, a penetrative gneissic foliation developed in the Clearwater Bay batholith, south of the shear zone; and a penetrative fabric in Cross Lake Group metasediments, north of the shear zone, that may be related to the gneissic fabric. Northeast-trending features consist of low to high intensity crenulation, fold, and transposition structures. The latter is spatially associated with the northeast-trending Whiskey Jack Channel.

The SPLSZ follows an east-southeast trend along the entire length of the Cross Lake greenstone belt, and is potentially part of a major east-trending shear zone that extends from Manitoba to Ontario (Richardson and Ostry, 1996). It is well exposed along the south shore of Pipestone Lake, where mylonites formed under greenschist facies conditions are well developed within basaltic sequences of the Pipestone Lake Group and sedimentary rocks of the Cross Lake Group. Mylonitic foliations strike east-southeasterly and dip steeply, and lineations plunge shallowly. Shear sense indicators (e.g. asymmetrical boudinage and shear bands) indicate dextral movement (Fig. GS-19-2). Deformation is in general heterogeneous. Where deformation is strong, primary features like pillow structure in the Pipestone Lake Group are obliterated.

South of the SPLSZ, a generally east-trending, steeply dipping gneissic foliation is well developed in the Clearwater Bay batholith. Towards the Whiskey Jack Channel it is crenulated into a northeast-trending structural trend (Fig. GS-19-3). Within the channel, the east-trending fabric is fully transposed and the new northeast-trending, steeply dipping fabric is dominant. North of the SPLSZ, a penetrative fabric within metasediments of the Cross Lake Group is folded and also gradationally transposed into the northeast trend. The intensity of transposition increases along the length of Nakow Bay away from the SPLSZ. Along the north edge of Nakow Bay, Pipestone Group basalts contain a mylonitic fabric similar to that seen along the southern shore of Pipestone Lake.

As described above, the northeast-trending fabric overprints and is thus younger than the east-trending gneissic foliation in the Clearwater Bay Batholith. It is also likely that the SPLSZ is younger than the gneissic fabric considering that the former formed under greenschist facies conditions and overprints amphibolite facies rocks. For a similar reason, we also suspect that the SPLSZ is younger than the northeast-trending fabric. However, no conclusive overprinting relationship has been observed between the latter two. The SPLSZ transects the northeast-southwest structural trend with no apparent offset, and the zone of intersection is characterized by a strong steeply plunging lineation and a very weak or no foliation (L-tectonite, indicating prolate strain). The significance of the L-tectonite for the relationship between the SPLSZ and the northeast-trending fabric will be a focus of further study. So is the geological significance of the earlier east-trending gneissic fabric and the northeast-trending fabric.

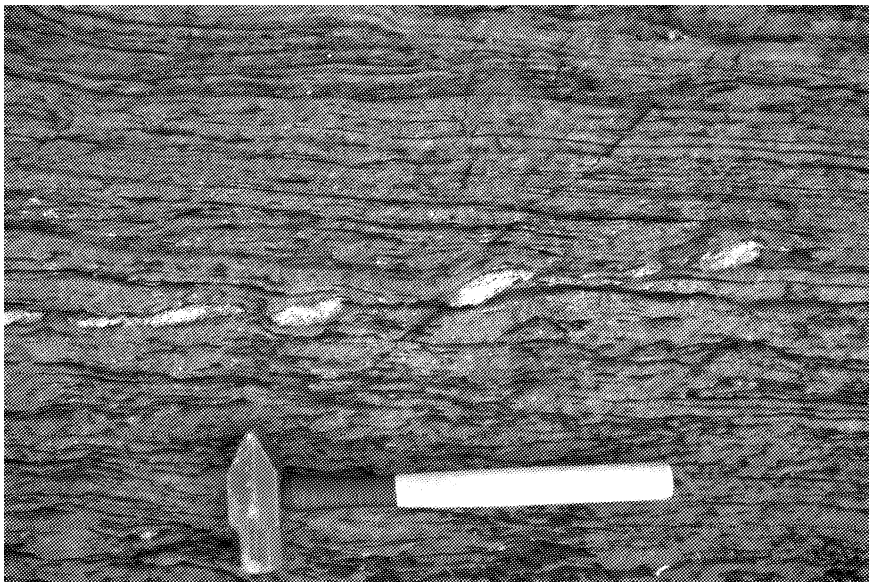

Figure GS-19-2: Asymmetrical boudinage indicating dextral shear of a quartz vein in mylonitized Pipestone Lake Group basalt. South shore of Pipestone Lake.

Figure GS-19-3: Northeast-trending crenulation cleavage overprints the gneissic foliation in the Clearwater Bay.

ACKNOWLEDGEMENTS

The project was supported by LITHOPROBE and Manitoba Energy and Mines. We would like to thank Neill Brandson for his support and Dave Duarte for his tireless assistance in the field.

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