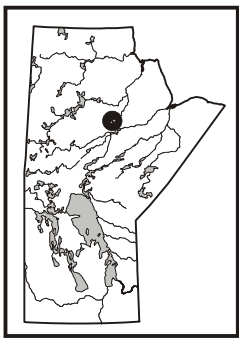
PROGRESS REPORT ON THE NORTHWEST SUPERIOR PROVINCE BOUNDARY PROJECT



by M.T. Corkery, Ch. Böhm[1] and L.M. Heaman[1]

Corkery, M.T., Böhm, Ch., and Heaman, L.M. 1999: Progress report on the northwest Superior Province boundary project; *in* Report of Activities 1999, Manitoba Industry, Trade and Mines, Geological Services, p. 41-43.

SUMMARY

The discovery of a segment of older crust with elements as old as 3.7 Ga in the Assean Lake area, and new results from Waskaiowaka Lake, show that the direct eastward correlation of Trans-Hudson Orogen domains in the Assean-Waskaiowaka lakes area needs to be reassessed. Exposures on Waskaiowaka Lake identified the Owl River structure as discrete 060°-trending high-strain zones overprinting generally east-trending granodiorite to tonalite gneisses. Preliminary Nd model ages of orthogneisses are ca. 2.6 Ga south of the "Owl River shear" and 2.2 Ga north of the structure. Our current interpretation is that Paleoproterozoic (1810 Ma) orthogneiss south of the Owl River shear zone is underlain and contaminated by Archean crust.

INTRODUCTION

The discovery of a segment of older crust, with elements as old as 3.7 Ga, in the Assean Lake area has been the focus of multidisciplinary mapping, structural, geochronologic and geochemical investigations. This ongoing research program was initiated in the Split Lake Block (Heaman and Corkery, 1996) to constrain the timing of intrusive, metamorphic and structural events along the northwest margin of the Superior craton. The study is redefining the nature and location of the Superior Boundary Zone (Fig. GS-11-1) and are being conducted, in part, to better constrain the setting of base- and precious-metal mineral occurrences and deposits in the area.

The 1999 field programs include: 1) mapping in the Waskaiowaka Lake area, 2) reconnaissance mapping and sampling in the Stephens Lake area and 3) sampling in the Campbell and Pukatawakan lakes area. As well, research being carried out at the University of Alberta includes: 1) Sm-Nd isotope geochemistry, 2) U-Pb geochronology and 3) geochemical studies. A number of reports, journal papers and abstracts have been generated in the last year (see Appendix A).

REGIONAL SETTING

The northwestern margin of the Superior craton consists of three high-grade terranes (dominantly granulite-facies lithologies): the Pikwitonei Granulite Domain (e.g., Weber, 1983) and two smaller, structurally bounded segments, the Split Lake Block (e.g., Corkery, 1985; Böhm et al., 1999) and the Orr Lake Block (Lenton and Corkery, 1981; Corkery and Lenton, 1990). The dominant lithologies in these areas are Archean meta-igneous units (e.g., variably retrogressed enderbites) with subordinate supracrustal rocks such as banded iron formation, metabasalt and paragneiss. In general, these high-grade domains along the Superior craton margin contain evidence for pre-2.8 Ga protoliths, 2708 Ma granodiorite magmatism and at least two late Archean high-grade metamorphic events at ca. 2695 and 2640 Ma (Weber and Scoates, 1978;

[1] University of Alberta, Department of Earth and Atmospheric Sciences, University of Alberta, Edmonton AB, T6G 2E3

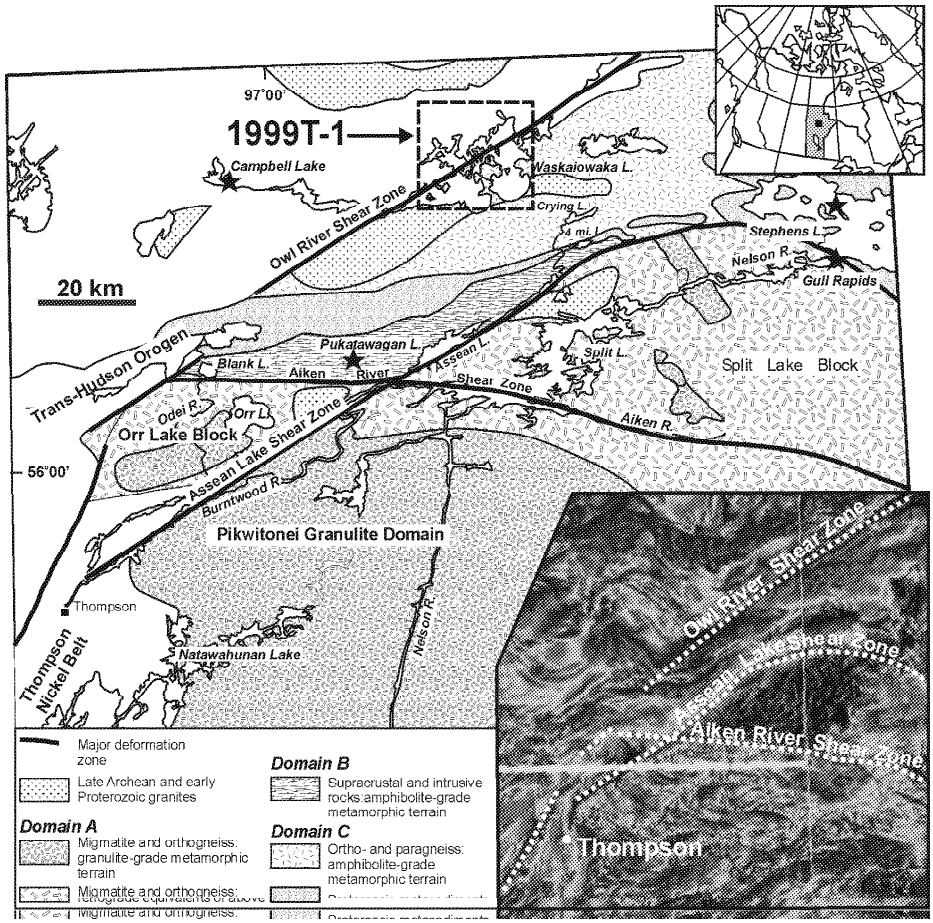


Figure GS 11-1: Geology of the northwestern Superior Province boundary zone showing areas of mapping (preliminary map 1999T-1, Böhm and Corkery, 1999) and sampling ($).

Corkery, 1985; Heaman et al., 1986; Heaman and Corkery, 1996; Böhm et al., 1998 and 1999). These lithologies have been intruded by a small number of Paleoproterozoic intrusions (e.g., 1825 Ma Fox Lake granite; Heaman and Corkery, 1996). Two distinct periods of Paleoproterozoic diabase dyke emplacement (ca. 2100-2070 and 1890-1860 Ma) have been obtained (Heaman et al., 1986; Heaman and Corkery, 1996; Halls and Heaman, 1997) for the prominent northeast-trending dyke swarm in this region.

The crust north and northwest of the margin of the Superior craton (i.e., north of the Split Lake and Orr Lake blocks in Fig. GS-11-1) preserves amphibolite-grade metamorphic assemblages, with no indication of granulite-grade assemblages common to the Superior Province rocks. Lithologies such as metamorphosed greywacke, arkose, granodiorite, basalt, etc. that have been previously correlated with well-studied Paleoproterozoic units in the Trans-Hudson Orogen (THO; e.g., Burntwood Group metasedimentary rocks, Ospwagan Group metavolcanic rocks) are common. Further, a belt-like pattern continuous with previously defined THO subdivisions was identified by Lenton and Corkery (1981) between Assean and Partridge Breast lakes. The belts are defined by alternating east-trending domains dominated by plutonic (e.g., Livingston, Baldock) and supracrustal (Kisseynew, Campbell-Waskaiowaka, and Partridge Breast-Northern Indian) lithologies. However, recent mapping (Böhm 1997b, Böhm and Corkery 1999), U-Pb zircon geochronology and Nd isotopic studies in the Assean - Waskaiowaka lakes area have shown that the direct eastward correlation of THO domains into this region needs to be reassessed.

Recent mapping in the Assean Lake area (Böhm, 1997a) is in general agreement with earlier mapping as far as the extent of the major lithologic units. However, new units were identified along the northern shoreline of Assean Lake, including numerous mafic, ultramafic and gabbroic dykes that were intruded into metasedimentary and granitic gneisses (Böhm, 1997a). These decimetre- to tens of metre- thick dykes are generally east trending and, although not dated, may speculatively be associated with a phase of the Molson swarm. It is noteworthy that the Paleoproterozoic diabase dykes of the Molson swarm are not observed in the THO domains to the north and west (Lenton and Corkery, 1981).

The revelations that 1) Assean Lake lithologies are older than their Archean neighbours in the Superior Province, 2) they were not affected by ubiquotous "Kenoran" regional metamorphic events at ca. 2.7 Ga, and 3) that they are significantly older than any other rocks known in the THO (Böhm et al., 1999) has channeled the research in new directions.

Goals of the 1999 field work were: 1) to test the hypothesis that the Owl River geophysical feature represents a significant geologic break, 2) to evaluate the nature of metasedimentary rocks in the Stephens Lake area previously interpreted as Kisseynew equivalent sequences, 3) to evaluate the interpretation that THO Domains can be traced from the west into the Assean - Waskaiowaka lakes region, and 4) to sample along extensions of the Superior Province- bounding fault zones.

WASKAIOWAKA LAKE

Previous mapping (Corkery, 1977) indicates that the Waskaiowaka Lake area is underlain by lithologies that are correlated with THO Paleoproterozoic rocks to the west. The geophysical anomaly that is interpreted to define the location of the Owl River shear zone trends northeast, through the north side of Waskaiowaka Lake (Fig. GS-11-1).

A suite of samples from archived material and from a limited reconnaissance-sampling program in 1998 provided material for analyses, in an attempt to define the location of the older crustal segment boundary at Assean Lake. Although the older crust was not found to extend into the areas sampled, analyses indicate that the rocks in the Waskaiowaka Lake region are not typical of the THO (Böhm et al., in prep.).

Specific goals of the 1999 mapping program were to focus on delineation and timing of structural trends, to identify the relative ages of various lithologies with respect to deformational events and to collect samples of each of the lithologic units for future analysis (to include analyses of selected specimens by Sm-Nd and U-Pb age determination).

Preliminary Nd model ages of orthogneisses are ca. 2.6 Ga south of the "Owl River shear" and 2.2 Ga north of the structure. The surface expression of the Owl River structure consists of discrete 060°- trending high-strain zones overprinting generally east-trending granodiorite to tonalite gneisses.

CAMPBELL AND PUKATAWAKAN LAKES

Campbell Lake lies to the northwest of the Owl River structure (Fig. GS-11-1). Previous mapping indicated that the metasedimentary, metavolcanic and granitic rocks on Campbell Lake represent the eastward extension of the Leaf Raids domain (Lenton and Corkery 1981). Samples of the metasedimentary rocks in the south and central areas and a tonalite from the northwest shore were collected for Nd isotope analysis.

Along the south shore of Pukatawakan Lake, east-trending mylonites potentially represent the westward extension of the Aiken River shear zone. Here the shear zone is interpreted to form the boundary between the Orr Lake Block and early Archean rocks. Samples of quartzo-feldspathic metasedimentary gneisses north of this structure and highly strained equivalents in the deformation zone were taken for comparison with the ancient lithologies documented 15 km to the east on Assean Lake.

STEPHENS LAKE - GULL RAPIDS

Stephens Lake lies to the east and north of the Split Lake Block (Fig. GS-11-1). At the southwest end of Gull Rapids, the Nelson River exposes a broad section across a southeast- trending segment of the Superior Province boundary zone. This area provides access to a unique segment of well preserved lithologies in this generally very poorly exposed region. A distinctive stratigraphic sequence composed of metasedimentary rocks and derived paragneisses exposed in several bays and along the north shore has been equated to THO Burntwood - Sickle groups stratigraphy in the north flank of the Kisseynew Basin (Corkery, 1985). The numerous channels in Gull Rapids provide an excellent oblique, well-exposed section through variably preserved lithologies of the boundary zone. Work in the Stephens Lake area therefore has a dual purpose: 1) to identify and sample metasedimentary rocks previously identified as Paleoproterozoic Kisseynew equivalents (Corkery, 1985) and 2) to sample sequences of rocks in the Superior Boundary zone at Gull Rapids to compare them to other boundary zone lithologies.

CONCLUSIONS

Results from this program indicate a more complex model for the Superior Boundary zone in the Assean-Waskaiowaka lakes area:

- the northwestern margin of the Superior Province consists of three major segments (Pikwitonei Domain, Split Lake Block and Orr Lake Block) of variably retrogressed granulite-facies lithologies that underwent regional metamorphism at ca. 2.70 to 2.62 Ga,
- the crust north of the margin of the Superior Province preserves amphibolite grade metamorphic assemblages. Metagreywacke gneiss containing 3.0-3.8 Ga detritus and ca. 3.5 Ga tonalite-granodiorite gneiss form a major part of an ancient crustal segment north of Assean Lake. The ancient crust shows no sign of been affected by granulite-grade metamorphism common to the Superior Province rocks. Therefore, the Assean Lake crust is exotic in nature and collided with the Superior craton after ca. 2.62 Ga.
- preliminary Nd model ages of orthogneisses are ca. 2.6 Ga south of the "Owl River shear" and 2.2 Ga north of the structure. The outcrop expression of the Owl River structure consists of discrete 060°- trending high-strain zones overprinting generally east-trending granodiorite to tonalite gneisses. Our current interpretation is that Paleoproterozoic (1810 Ma) orthogneiss south of the Owl River shear zone is underlain and contaminated by Archean crust.

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APPENDIX A

Böhm, Ch.O. and Corkery, M.T. 1999: Geology of the Waskaiowaka Lake area (part of 64A7,8,9,10); Manitoba Industry, Trade and Mines, Geological Services, Preliminary Map 1999T-1, scale 1:50 000.

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