BURNTSIDE LAKE FAULT ZONE, MINNESOTA—CANADA

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THE NATURE OF THE BOUNDARY BETWEEN THE WAWA AND QUETICO BELTS, BASSWOOD LAKE AREA, MINNESOTA—ONTARIO

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Detailed geologic mapping has been carried out for a distance of approximately 40 km. along the United States—Canadian International Boundary between Iron Lake on the west and North Bay on Basswood Lake on the east. The International Boundary crosses the junction of the Quetico and Wawa belts (Card and Ciesielski, 1986) in Basswood Lake approximately one kilometer southeast of Basswood Falls (Fig. 1). At this location, the junction is interpreted as a fault contact chiefly because adjacent outcrops show ductile shear (Font, 1989) and because of the strong northeast-southwest topographic lineament which mimics the junction over a distance of at least 30 km.

The rocks exposed in the Quetico belt northwest of the junction consist of folded meta-sedimentary and meta-volcaniclastic rocks interlayered with quartz monzonite sills (Woodard and Weaver, 1989). Recently, Dr. John Aleinikoff of the U.S. Geological Survey determined a U-Pb Concordia age from zircons extracted from one of the quartz monzonite sills located on the Basswood River. The specimen (Ha 1-BW-89)was collected on the United States shore, 0.2 km. southwest of the International Boundary turning point #632, which is located in the NE1/4 of section 24, Basswood Lake West, Minnesota. Geologically, the specimen was collected from a sill deformed in the trough of a major syncline. Therefore, the age of 2656 ± 1 Ma (see Fig. 2) represents the pre-folding age of crystallization and puts an older limit on the age of the folding. This date must be younger than the enclosing meta-sedimentary and meta-volcaniclastic rocks because the sill was injected and crystallized before the sequence was folded.

Immediately southeast of the Quetico belt, within the Wawa belt, is a younger shear zone, which in the vicinity of Jackfish Bay on Basswood Lake is at least 5 km. wide (Fig. 1). This fault zone is bounded on the southeast along Pipestone Bay by the youngest rupture within the zone, the Burntside Lake fault trace. For a distance of 50 km. from the southwest end of Pipestone Bay, where the the fault strikes N 50° E, northeastward to Kahshahpiwi Lake, where the strike is N 30° E, the fault trace forms an arcuate course around the southwest end of the Vermilion Batholith.

The junction of the Quetico and Wawa belts, through the same 50 km. distance, changes strike from N 70° E in the southwest near Nels Lake to N 45° E in the northeast at Yum Yum Lake. The relationship of these two lineaments is shown on Fig. 1, which demonstrates that both arcuate trends intersect and cross in the vicinity of Nest and Point Lakes, where they both intersect the southwest edge of the Vermilion Batholith. Where they cross, the Burntside Lake fault brecciates the Quetico-Wawa junction and therefore is younger in age. Many thin sections cut from a variety of rocks along the fault zone demonstrate that the characteristic brittle fracturing and cataclasis associated with the Burntside Lake faulting is superimposed upon an earlier ductile deformation (Font, 1986). This ductile phase presumably is associated with an earlier and more deeply seated shearing along the boundary of the two belts.

On the west side of Point Lake the major exposed shear surface within the breccia of the Burntside Lake fault dips 70° SE. The surface is deeply grooved and striated with these lineaments plunging 8° NE. Numerous tension fractures are developed at right angles to the grooves and striae. The direction of smoothing on this surface indicates right lateral displacement on the Burntside Lake fault.

North of Point Lake, in the area between Side and Kahshahpiwi Lakes, and within the Quetico belt, there is an intense zone of shearing with gentle dips 25-30° NW. Slickensides are developed on almost all shear surfaces and plunge gently about the horizontal, either southwest or northeast. This zone appears to intersect the Burntside Lake fault in the vicinity of Nest Lake but its genetic relationship to the steeply dipping Burntside Lake fault is not yet clear. Although no detailed mapping has been done northeastward from Kahshahpiwi Lake, a very strong topographic lineament trending northeastward through Kahshahpiwi and Keefer Lakes and the Kahshahpiwi Creek drainage strongly suggests that the Burntside Lake fault continues into the Quetico belt rocks for a distance of at least 25 km.

The rocks lying southeast of the junction of the Quetico and Wawa belts, within the Wawa belt, are a series of biotite schists overlain by thin- to thick-bedded meta-volcaniclastic rocks and probably underlain by meta-pillow basalts. In this regard they are not very different from the layered rocks in the Quetico belt. Pre-folding, this series was injected with thick sills of tonalitic to quartz dioritic rock and then the sequence was tightly folded around northeast-trending axes. Where these fold axes are cut by the Burntside Lake fault they typically are dragged in a

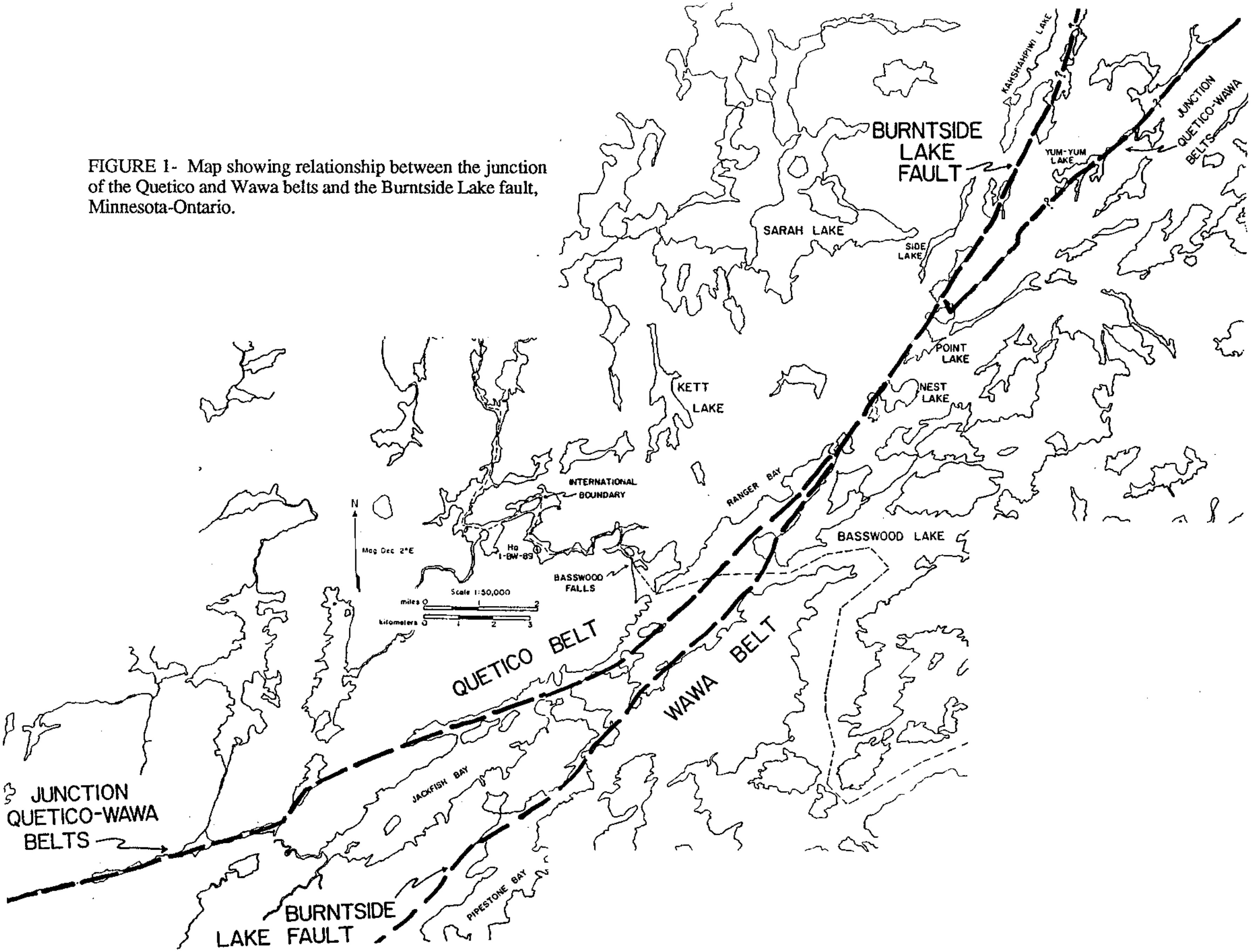

FIGURE 1- Map showing relationship between the junction of the Quetico and Wawa belts and the Burntside Lake fault, Minnesota-Ontario.

right lateral sense and the folds plunge moderately steeply southwestward. Away from the fault the major fold axes plunge 15-30° NE, which is essentially the same as the plunge of major folds in the adjacent Quetico belt (Kaszuba and others, 1983).

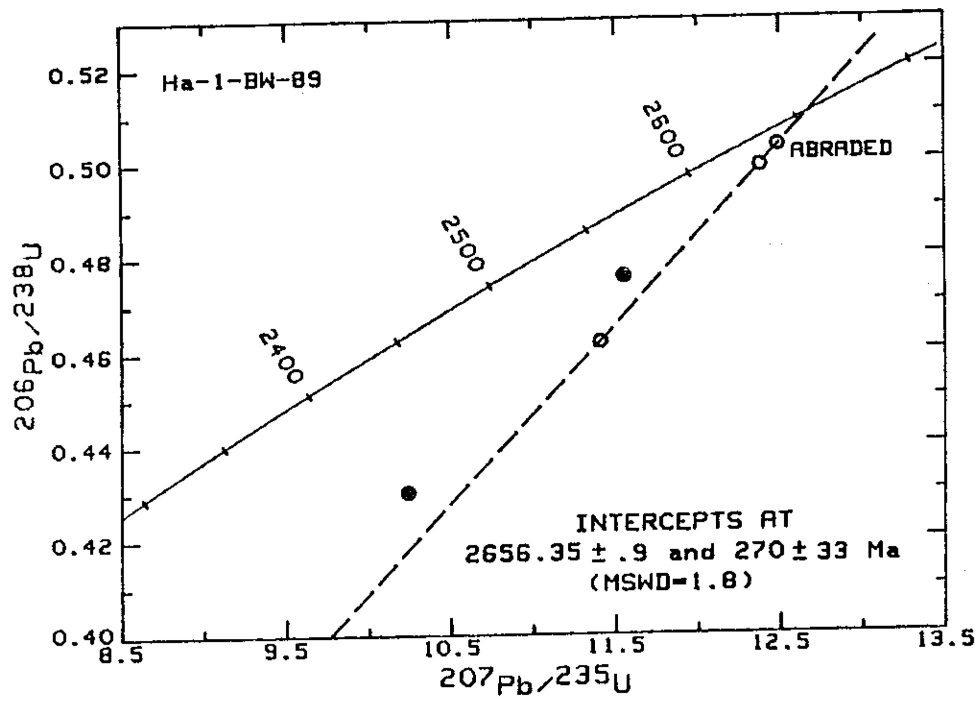

FIGURE 2- U-Pb Concordia diagram for zircon from folded quartz monzonite sill, Basswood River, northern Minnesota (specimen Ha 1-BW-89). Open cirlcles are abraded, solid circles are unabraded.

Both the Quetico and Wawa belt rocks exhibit a similar history of migmatitic and metasomatic alteration. Trondhjemite leucosomes develop early and often form complex ptygmatic structures in the troughs and crests of major folds. Therefore, they appear to be synchronous with the major folding that has affected both belts. Later the rocks are preferentially "soaked" by potassium and replacement perthites are developed to some degree in most pre-existing rocks (Mariano and Woodard, 1984). In the Quetico belt this metasomatic event is attributed to the late emplacement of the Vermilion Batholith. It is not yet clear that the potassium metasomatism of the Wawa belt rocks is also related to the Vermilion Batholith. In general, the rocks in the Quetico belt are more thoroughly migmatized and metasomatised than those in the Wawa belt. The grade of metamorphism and the degree of metasomatism appears to be lower in Wawa belt rocks.

In summary, our work to date along the junction of the Quetico and Wawa structural belts, in the vicinity of Basswood Lake, suggests that the main differences between the two rock sequences are the character of the early formed intrusive sills (quartz monzonite in Quetico and tonalite in Wawa) and the later emplacement of the Vermilion Batholith in the Quetico. As yet we have no U-Pb zircon dates from the Wawa tonalites so their age compared to the 2656 ± 1 Ma of the Quetico quartz monzonite is not known. Further, the rocks of the Quetico belt appear to be more highly migmatized and metasomatised.

On the other hand the geological development of the two belts appears remarkably similar except for the late emplacement of the Vermilion Batholith into the Quetico rocks. Recently, Percival (1989) has suggested that these two belts might be separate Archean terraines structurally docked adjacent to one another. Our work to date shows the junction to be ductally sheared and not conforming to the later cross-cutting Burntside Lake fault. The similar migmatitic and metasomatic history of both belts presumably could have developed in detached terranes or have been developed syn- or post-docking. The similar style and history of folding within the two belts suggests that the folds are related, conceivably produced during a docking event.

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A Petrographic and Field Study of Intrusive Bodies Found South of the Burntside Lake Fault Zone, Quetico Provincial Park, Ontario, Canada

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Introduction

The metamorphic Archean terranes flanking the Burntside Lake fault zone are intruded by many dikes and mineral veins of varying age and composition. This study attempts to define the mineralogy of these intrusions and examine their crosscutting relationships. The final purpose is to form a history of intrusion within the region. Specimens and hand samples were collected while mapping in the region west of Nest Lake during the summer of 1989 (Fig. 1).

Field and Lab Methods

In the field, 49 hand specimens were collected south of the fault zone for petrographic and mineralogic analysis. Field observations were made at other sites where specimen recovery was impossible. Most of the data and specimens were collected along lake shores, cliffsides, tree blowdowns, and outcrops where the moss could be rolled back from the exposure.

At each site a diagram was drawn showing dikes and their contacts with the wall rock and other intrusions. A rough field identification was made of each intrusion, and specimens were collected where possible. Special efforts were made to obtain specimens and data that show crosscutting relationships and contacts with other dikes.

In the lab 25 specimens were chosen for thin section analysis, so that each type of dike in the region was represented. Those specimens not thin sectioned were slabbed and examined with a binocular microscope. 15 of all the specimens were also stained for potassium feldspar, since hematite staining hinders the identification of potassium feldspar.

Results

There are three main types of intrusions in this region. The oldest are leucocratic in origin, next are pegmatites, and the youngest are veins of hydrothermally placed quartz. These dikes, especially the pegmatites, have been sheared, hydrothermally altered, and rehealed. Specimens collected further from the main fault show a cataclastic texture, while those found closer are mylonites. Hydrothermal alteration has broken down many feldspar crystals into kaolinite and stained the rocks with hematite.

The oldest intrusions are leucocratic. They are aphanitic in texture and composed mostly of plagioclase and quartz with very minor amounts of hornblende, biotite, sphene, zircon, and apatite. These appear as generally straight bands within the biotite migmatite and are very common. They are much rarer in the hornblende gneiss and amphibolite. The only two specimens collected were near the contact between these two units. There these intrusions form bands 3 to 5 centimeters wide folded and bent in the manner of migmatite bands.