STRUCTURE IN THE AREA NORTHEAST OF MCNIECE LAKE, QUETICO PROVINCIAL PARK, ONTARIO, CANADA

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Introduction

Quetico Provincial Park, a wilderness area in Ontario, Canada just north of the United States boundary, is a rugged, forested land, sprinkled with thousands of lakes and underlain by Archean rocks. Outcrops occur both inland and along the lake shores, forming cliffs in many places. The area is contained within the Quetico subprovince of the Superior Province within the Canadian Shield. It is bordered on the northwest by the Wabigoon subprovince and on the southeast by the Wawa subprovince (Figure 1). The Wawa belt near the junction with the Quetico belt is characterized by biotite schists, meta-volcaniclastic rocks, meta-pillow basalts, and tonalitic to quartz dioritic sills (Woodard and Weaver, 1990). The Quetico belt is characterized by meta-sedimentary rocks, granitic migmatites, and granitic plutons, and has undergone a period of folding and migmitization. Dr. John Aleinkoff of the U.S. Geological Survey has narrowed the date of folding and migmitization to after 2.678 +/-6 Ma but before 2.662 +/- 1 Ma years (H. H. Woodard, personal communication).

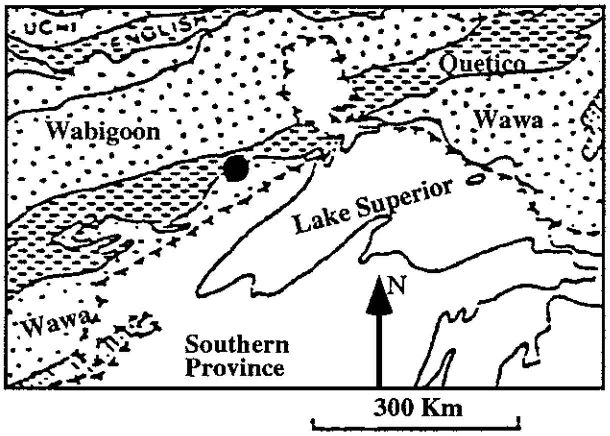

Figure 1. An index map showing the Quetico and Wawa belt junction, located within the Superior Province (Card and Ciesielski, 1986). The circle shows the location of the area studied.

The study area (Figure 1) is the region in the Quetico belt northeast of McNiece Lake, bordered on the east by the Quetico-Wawa belt junction and on the west by the Burntside Lake fault (Figure 2). The Burntside Lake fault is a post-folding and migmitization, high-angle fault within the Quetico belt, striking to the northeast (Kambhu and Russin, 1993). Most lakes directly to the northwest and southeast of the area of study tend to be elongate, trending roughly northeast following the regional structures. However, some lakes in the area, particularly McNiece Lake, do not follow this trend. McNiece Lake is arcuate in shape and convex to the north. This shape is also defined by two chains of small lakes lying about 2.5 km and 6 km to the northeast of McNiece Lake, respectively. The purpose of this study was to investigate the cause(s) of this shape anomaly. Folding was considered a possible cause since folding along with associated complex ptygmatic structures is common to Quetico belt rocks (Woodard and Weaver, 1990).

Methods

In the Quetico the only modes of transportation available are canoe or on foot. Some sites were accessible by canoe, but the bulk of the data were collected while traversing overland. The Brunton and pace method, along with the aid of aerial photographs and topographic maps, was utilized to map the location of the stations. Aerial photographs were also examined to locate possible contacts, folds and other structures. Attitudes of foliation planes were plotted on a stereonet and contoured, with the software program *Stereonet*.

Mappable Rock Units

The mappable rock units found in this region of the Quetico belt are hornblende quartz monzonite (Ha) and granitic migmatites (Mg, Mb, and Mm). The hornblende quartz monzonite is characterized by potassium feldspar augen and significant hornblende. The granitic migmatites are characterized by rafts of both biotite schist and amphibolite. The granitic migmatites are further divided into two units: Mb, containing greater than 50% biotite-schist rafts and Mg, containing less than 50% biotite-schist rafts. A third, recently discovered granitic migmatite containing muscovite (Mm) is found also in parts of this region (Burgy and Peck, 1993). Both the hornblende quartz monzonite and the granitic migmatites developed prior to, or contemporaneously with, major folding and thus show

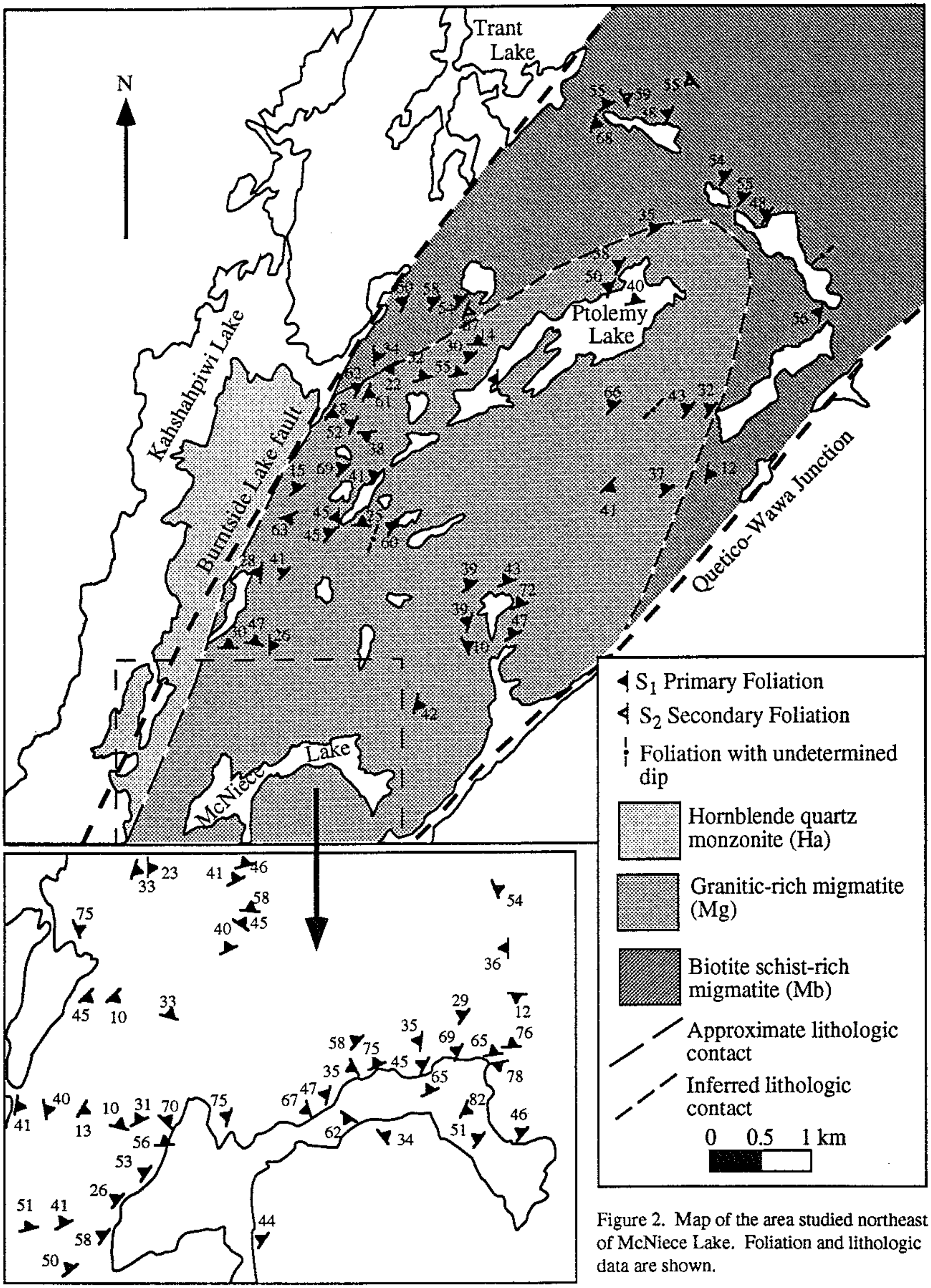

Figure 2. Map of the area studied northeast of McNiece Lake. Foliation and lithologic data are shown.

strong foliation associated with this folding. Later leucogranite (Lg) was intruded after folding and thus shows little to no pervasive foliation.

Data

To help determine the structure in this region, field measurements of foliation orientations were compiled. Data collected by Gupta and Weng (1991) were also included. An equal area scatter plot of the data pictorially represents the dispersion of the poles to these foliation planes (Figure 3). An equal area contour plot of all the data represents more clearly the areas of greater pole concentration (Figure 4). Both plots illustrate that the general strike of the foliation planes is to the northeast. The foliation planes vary in direction of dip from northwest to southeast; however, dip direction is dominantly to the northwest. The magnitude of the dips also vary, approximating a girdle about an axial line. This line strikes N38°E with a plunge of 9°.

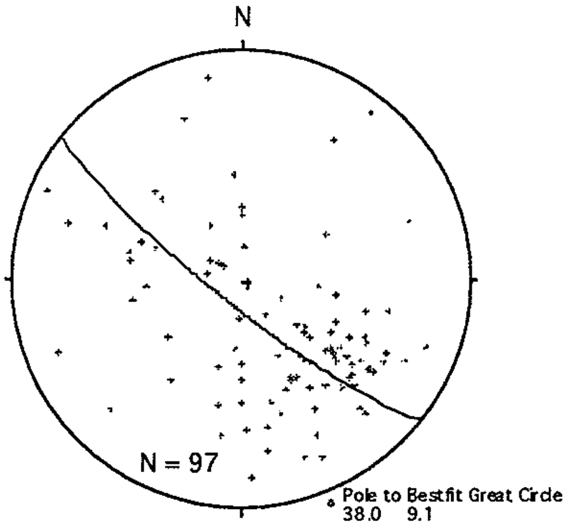

Figure 3. Equal area scatter plot of the poles to the primary foliation planes of all data.

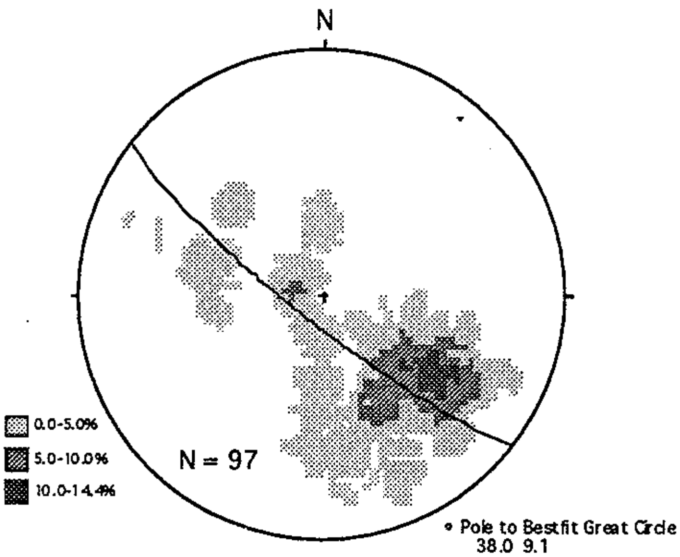

Figure 4. Equal area contoured stereoplot of the poles to the primary foliation planes of all data.

Eight secondary foliations, crosscutting the primary foliation were observed; the majority of which trend northwest. The secondary foliation is assumed to be related to some shearing event occurring after the folding event (Chastain and Kolinsky, 1992). Five small folds were observed and recorded, all of which have axes striking to the northeast.

Finally, the lithologic unit at each station was identified and recorded. From these identifications, contacts were inferred to determine if they indicated folded structures (Figure 2). Within the region of study, lithologies are dominated by the following units: biotite schist-rich migmatite (Mb), granitic-rich migmatite (Mg), and hornblende quartz monzonite (Ha). The leucogranitic unit (Lg) is found within the region, but was intruded after the event of folding and migmatization within the Quetico belt, and thus provides no evidence about structure in the area of study.

Discussion

From the data collected, it is evident that a distinctive structure trending northeast exists in the area. The initial hypothesis of a fold or folds as the dominating structure within the region is in agreement with the stereonet plots (Figures 3,4). The presence of a fold would cause the foliation planes to fan outward from the fold axis and their strikes to be subparallel. Such a configuration would produce a girdle on a stereonet projection. The poles to the foliation planes approximate a girdle about a central line, 9°N38°E.

It is possible that the region in question includes more than one major fold. A scenario of multiple folds with subparallel axes would also yield stereonet plots similar to those produced from the compiled data. However, when topography of the area, especially that of the lakes, is taken into account it becomes difficult to explain their configurations while still maintaining a theory of multiple major folds. It would be expected that McNiece Lake and the chains of lakes to the northeast would form more than one arc each. This is not seen; only single arcs are formed by the lakes throughout the area studied.

One lake within the immediate area of study, Ptolemy Lake, does not follow the arcuate trend of McNiece Lake and the previously mentioned chains of lakes. Instead, it shows an irregular northeast trend: elongate and striking about N40°E. A possible explanation for this different orientation is that Ptolemy Lake lies along the fold axis. Its strike is similar to the strike of the possible fold axis, N38°E, represented on the stereonet projections (Figures 3, 4). Geographically, Ptolemy Lake is located almost half-way between the Burntside Lake Fault and the Quetico-Wawa junction, the borders of the region.

If the region is indeed influenced by one major fold, then it is likely that the southeast limb of the fold has been overturned. A slight bimodal distribution is observed with a greater concentration of foliation planes dipping steeply to west and a second, lesser concentration of foliation planes dipping more gently to the east (Figure 4). This is in agreement with the data of Woodard (1992) who demonstrated that the biotite schist-rich migmatite rocks along the west side of the Quetico-Wawa junction are overturned. A fold overturned to the southeast would suggest compression from the northwest, possibly indicating that the Quetico belt was thrust over the Wawa belt during a docking event.

From the lithologic data collected, an attempt was made to define contacts between the different units. Aerial photos and structural data were used to assist in the interpretation. A probable contact trending northeast along the Burntside Lake fault was identified between hornblende quartz monzonite and granitic-rich migmatite. Since the division between the granitic-rich and biotite schist-rich migmatite units is set arbitrarily at a content of fifty percent biotite schist, contacts between them are gradational and therefore difficult to define. However, a change from biotite schist-rich to granitic-rich migmatite does exist in the area studied with Mb dominantly found to the north and Mg to the south. A possible contact is shown in Figure 2.

Only five minor fold axes were documented, all of which trend to the northeast in concordance with the regional structure of the area. The eight secondary foliations show a different trend, to the northwest. These measurements, however, may not be representative of the region; more data are needed before drawing any conclusions.

Conclusions

After analyzing the data collected from the region northeast of McNiece Lake, bordered on the west by the Burntside Lake fault and on the east by the Quetico-Wawa junction, few definitive conclusions can be drawn. However, some understanding of the structure within this area has been reached. Much of the data, especially the primary foliation orientation measurements (Figures 3,4), support the hypothesis of folding. Aerial photo interpretations also agree, showing a northeast trend, but they are highly speculative. If more lithologic data had been collected, they might have given some insight into the structure of the area.

It is still not clear whether one or more major folds exist. If the topography of the area, including the shapes and orientations of the lakes, reflects the structure, then it is likely that there is only one major fold present. Foliation interpretations reveal several probable minor folds within the major structure of the area.

The foliation orientation measurements provide evidence that the folded structure has been overturned to the southeast. This suggests that during the docking of the Quetico and Wawa belts compression was from the northwest.

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