FRACTURE AND STRUCTURAL ANALYSIS OF ARCHEAN ROCKS NORTHERN EXTENSION OF THE BURNTSIDE LAKE FAULT ZONE: NORTHEASTERN TIP OF RANGER BAY TO "SHARK LAKE" THE QUETICO PROVINCIAL PARK, CANADA

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The purpose of this study was to map northeast along the Basswood Lake trace of the Burntside Lake fault zone into Canada to determine the northern extension of the fault. Fracture orientation data were collected in order to determine the sense of movement along the fault and the primary stress directions. Subjective fracture orientation measurements were taken at each outcrop examined for a regional study of the area to determine the overall predominant trend. A more localized analysis of specific outcrops was done to observe change in fracture orientations within different lithologies and to determine any changes in fracture orientations further from the fault zone. In addition to collecting fracture data, zones of cataclastic texture, displacement of veins along fractures, and the shearing of feldspar crystals were observed.

Four main lithologic units were mapped in the study area. The first is a leucocratic biotite granite which comprises the Vermillion batholith. It has no rafts and does not seem to have gone through the major phase of deformation. It is, however, moderately fractured, particularly near the fault. The second unit is a hornblende tonalite gneiss. It is an intrusive sill which appears to be a granite, but it is actually only stained pink from hydrothermal alteration. This unit is not fractured as intensely as other lithologies in the area. It has responded to stress during earlier deformation more readily by folding and kinking. Third, is a biotite rich migmatite. The biotite rafts in this unit are the oldest rocks and the most intensely fractured. Finally, there is a granite rich migmatite with more than 50% leucocratic material and biotite rafts. It is cut by quartz veins and metasomatic pegmatites. In addition to these lithologies, there is a zone along the fault of intensely fractured, altered rock which has been deformed beyond recognition. This zone has been called the "breccia zone" but since very little of this rock is actually a fault breccia perhaps it would be more accurate to call it the fractured or altered zone.

Data collection began at the northern tip of Ranger Bay and continued northward to the lake informally referred to as "Shark Lake"(see Fig. 1). A subjective regional overview of fracture orientations was done measuring the prominent orientations at each outcrop. It was often difficult to collect data because of the dense undergrowth and lichen and moss covered outcrops. The N30W trending fault zone was followed and mapped as an intensely fractured zone of altered, highly silicified and chloritized rock. A zone of cataclastic texture follows a N25E trend, from Nest Lake to the northwest side of "Shark Lake". Side Lake also exhibits extensive cataclastic texture which suggests, along with the alignment of the lake, the possibility of a splay fault through it. Four large outcrops in Point Lake, as well as one in "Bump Lake" and one in Nest Lake are extremely well exposed. These outcrops were sites of more intensive study. Areas of detailed fracture analysis were set at 5 feet in diameter in different areas on each outcrop. These well exposed outcrops have other easily recognizable structures including kinking in the amphibolite rafts in the hornblende gneiss, small folds with axes oriented N40-60E and large feldspar crystals sheared left laterally along N30E. Veins displaced by fractures were observed with the most prominent displacements oriented left laterally along N30E and right laterally along N30W. Also present are large feldspar crystals sheared left laterally along N30E.

The data are presented in the stereoplot diagrams, Figures 3-8. The rose diagrams (Fig. 3, 5 & 7) are plots of the strikes of the planes entered with a petal width preset to 10° increments. The length of each petal is calculated as the percentage of the total number of data points that fall within the 10° width. The Kamb contour method (Fig. 4, 6, and 8) uses a "variable area counting circle and calculates the number of standard deviations (Sigma) from a uniform distribution of points on the projection." The plots show fields of point density with Sigma 3 defined as a uniform distribution (Allmendinger, 1988, pp. 15-16). Figures 3 and 4 summarize all fracture data collected at the six sites of fracture analysis. Figures 5 and 6 summarize all subjective fracture measurements taken at outcrops throughout the region. Figures 7 and 8 are a compilation of all fracture orientations recorded in the study area.

The overall predominant fracture orientation is N20-30W, with other distinct directions at NS-N10E and N30-40E. The prominent displacement of veins and rafts left laterally along N30E and right laterally along N30W, and the left lateral shearing of feldspar crystals along N30E leads to the conclusion that the sense of movement along the main trace of the fault, running N30E, is sinstral. Fracture sets at N30E and N30W could be a conjugate pair related by pure shear with the strike of the maximum principle stress oriented NS (Fig. 2). This could also explain the prominent 0-10° fracture orientation as an extension fracture striking parallel to the maximum principle stress. This conclusion is consistent with those of former fracture and lineament studies (Stevens, 1988 and Tremper, 1988) but because of the possibility of more than one episode of faulting and intense deformation, more study must be completed in order to unravel the entire structural history of the area.

References

Allmendinger, R. W., 1988, Absoft Corp., Stereonet: A Plotting Program for Orientation Data for the Macintosh Computer, pp. 1-24.

Stevens, L., 1988, Fracture Analysis of the Pipestone Trace, Boundary Waters Canoe Wilderness Area, Minnesota: Second Keck Research Symposium in Geology, Abstracts Volume, pp. 169-171.

Tremper, C.W., 1988, Aerial Photo Lineament Analysis of a Portion of the Burntside Lake Fault Zone, Boundary Waters Canoe Area, Northern Minnesota, and Quetico Provincial Park, Southern Ontario: Second Keck Research Symposium in Geology, Abstracts Volume, pp. 175-178.

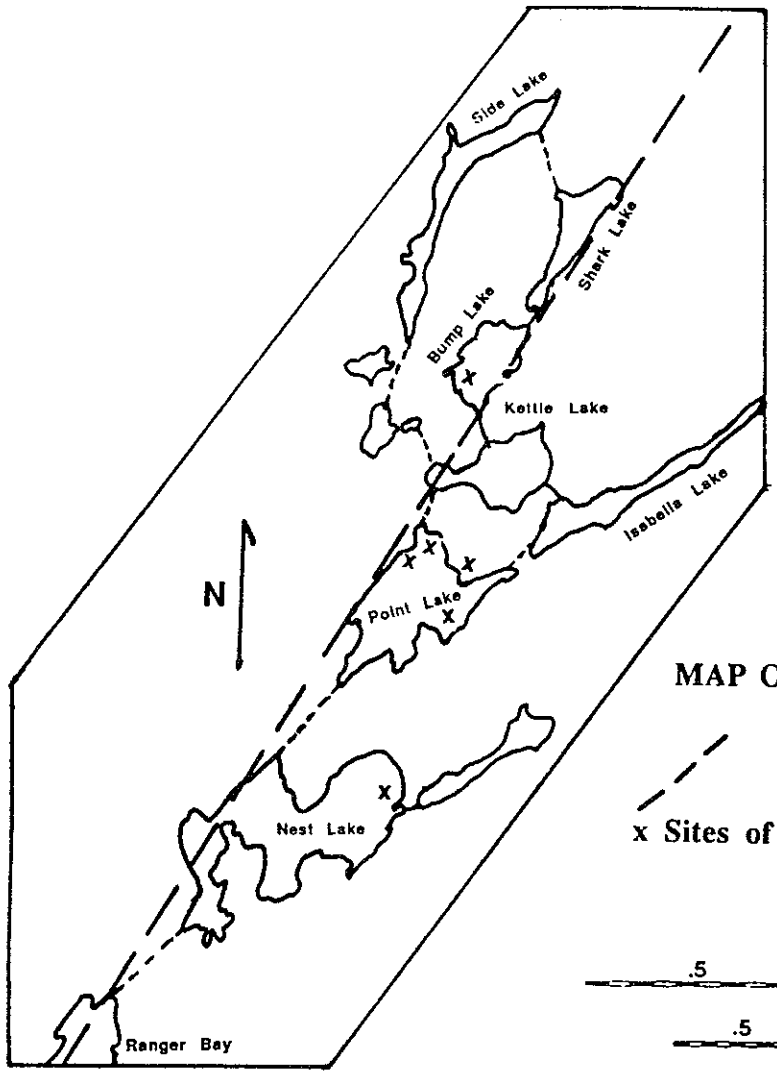

FIGURE 1

MAP OF STUDY AREA

Main fault trace

x Sites of Fracture Analysis

SCALE
1:50,000

.5 0 1 mile

.5 0 1 kilometer

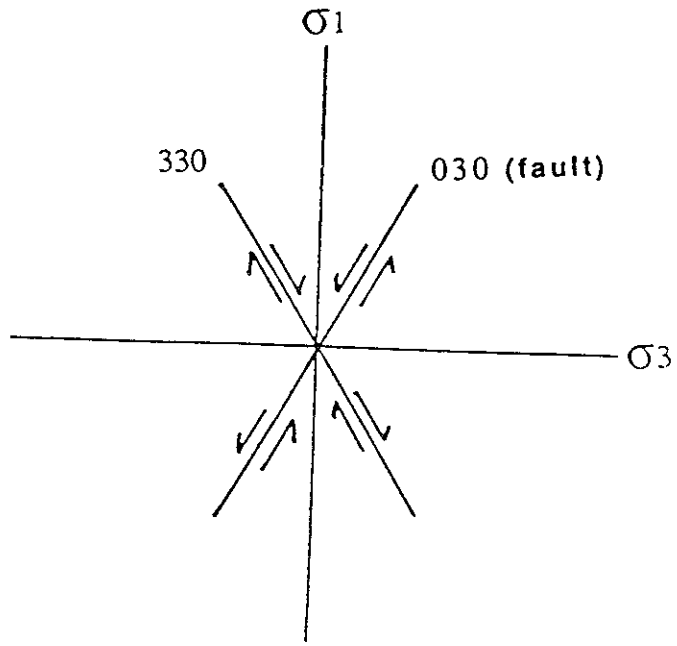

FIGURE 2

Sigma 1 ($\sigma 1$) and Sigma 3 ($\sigma 3$) principle stress directions as determined from fracture orientations and structural data.

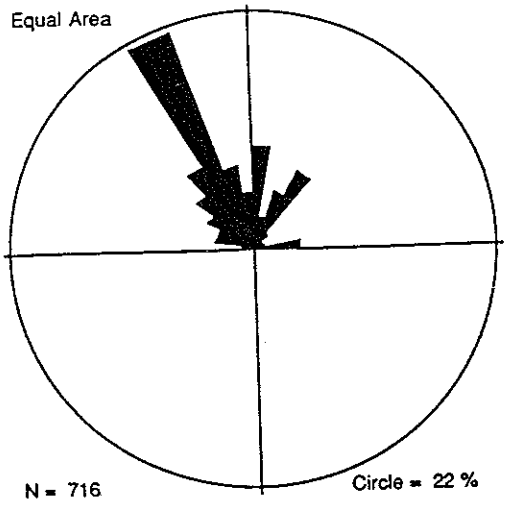

FIGURE 3

Rose Diagram summarizing all fracture data collected at six sites of fracture analysis.

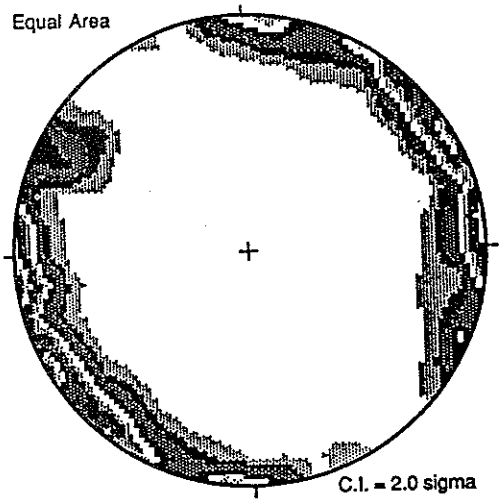

FIGURE 4

Kamb Contour Diagram summarizing all fracture data collected at six sites of fracture analysis.

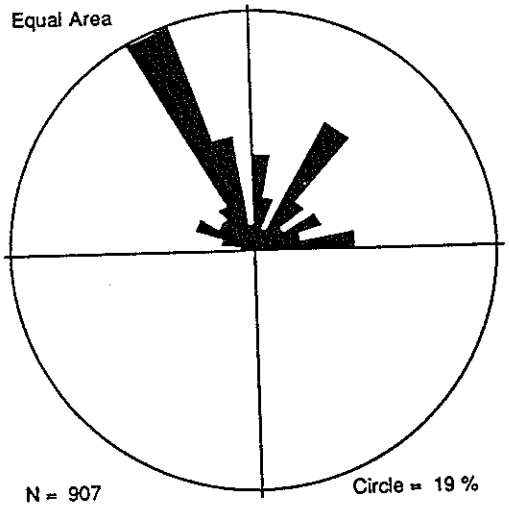

FIGURE 5

Rose Diagram summarizing subjective fracture measurements at all outcrops examined throughout region.

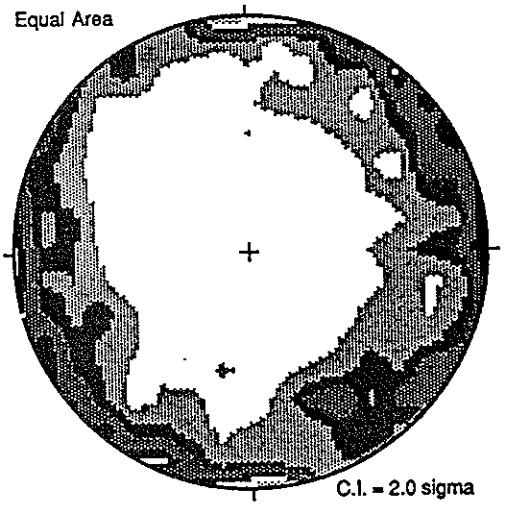

FIGURE 6

Kamb Contour Diagram summarizing subjective fracture measurements at all outcrops examined throughout region.

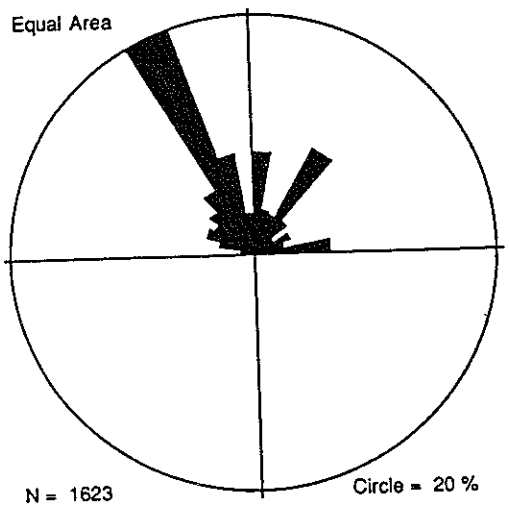

FIGURE 7

Rose Diagram summarizing all fracture orientations recorded

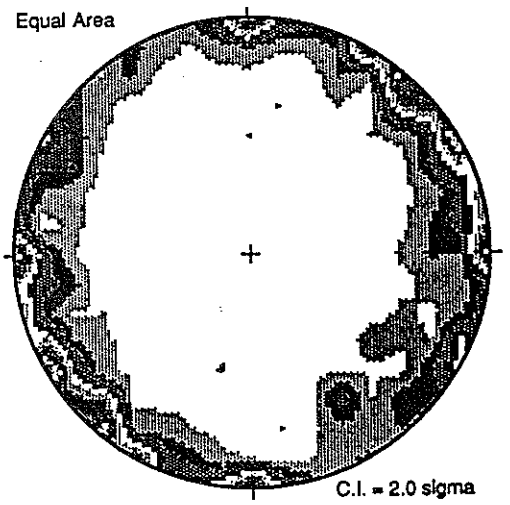

FIGURE 8

Kamb Contour Diagram summarizing all fracture orientations recorded