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

William K. Burris
The College of Wooster

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.

References cited

Card, K. D. and Ciesielski, André, 1986, Subdivisions of the Superior Province of the Canadian Shield: Geoscience Canada, v. 13, p. 5-13.

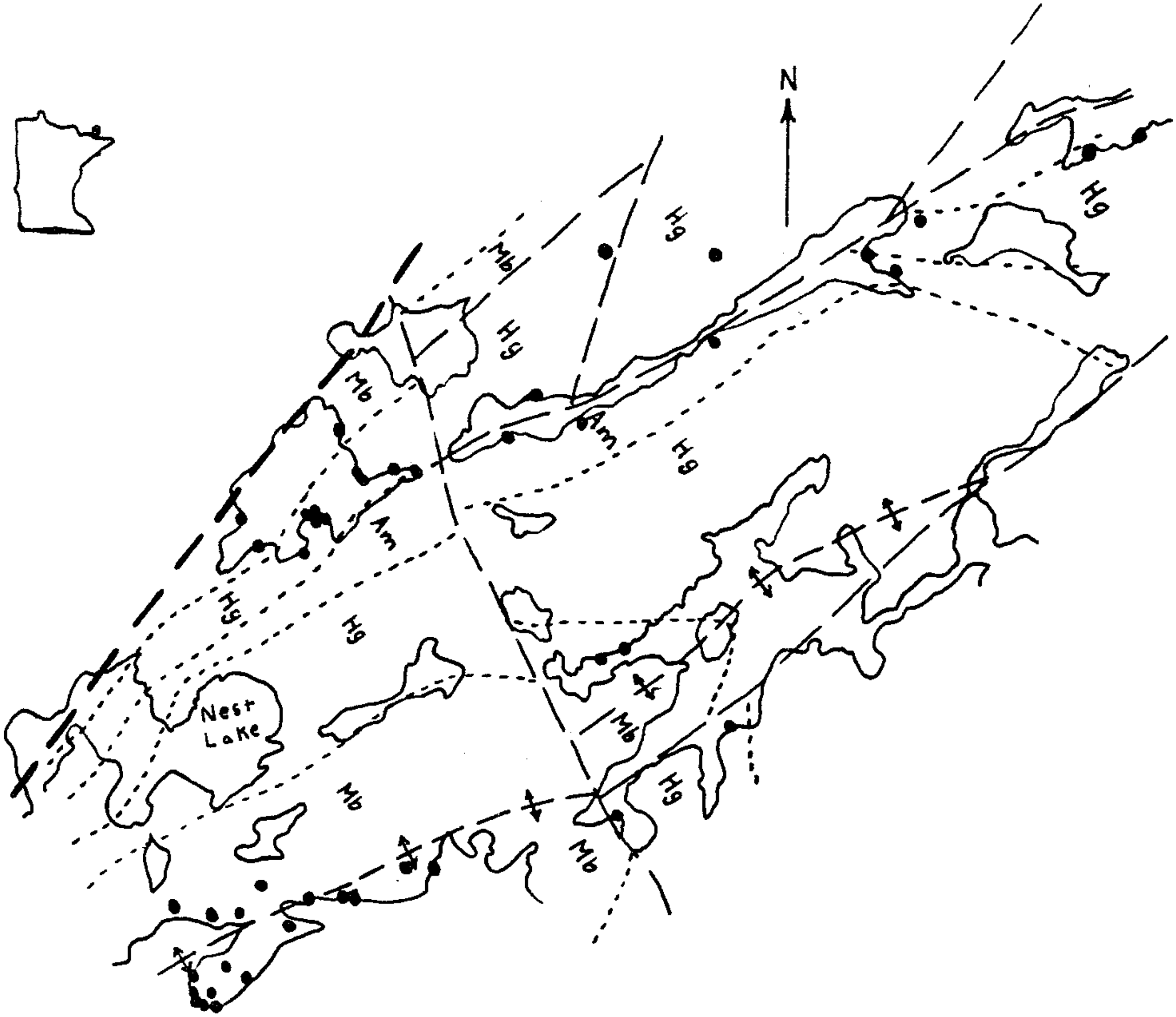
Font, K. R., 1989, The Burntside Lake fault zone: A study of two faults in Basswood Lake: in Woodard, H. H., ed., Second Keck Research Symposium in Geology, Beloit, Wisconsin, p. 156-160.

Kaszuba, J. A., Schwartzweller, P. A., and Woodard, H.H., 1983, Folded rocks in the eastern contact zone of the Vermilion Batholith: Institute on Lake Superior Geology, Twenty-Ninth Annual Meeting, Houghton, Michigan, Abstract Volume, p. 23-24.

Mariano, Anthony and Woodard, H. H., 1984, Potassium metasomatism of trondhjemite migmatite wallrock, Vermilion complex, northern Minnesota: Institute on Lake Superior Geology, 30th Annual Meeting, Wausau, Wisconsin, Proceedings and Abstracts, p. 32-33.

Percival, J. A., 1989, A regional perspective of the Quetico metasedimentary belt, Superior Province, Canada: Canadian Journal of Earth Sciences, v. 26, p. 677-693.

Woodard, H. H. and Weaver, S. G., 1989, Geology of Archean rocks, Basswood Lake, Crooked Lake region, northern Minnesota—Southern Canada: in Woodard, H. H., ed., Second Keck Research Symposium in Geology, Beloit, Wisconsin, p. 150-152.



1 Mile

Fig. 1 Simple Geologic Map Showing Data and Speciman Collection Sites

Legend

- Contact

Hg - Hornblende Gneiss
Mb - Biotite Migmatite
Am - Amphibolite

● - Collection Site

- Main Fault

- Splay Fault

- Anticline Axis

The second type of intrusions are pegmatites. Of all the types of intrusions this one has undergone the most shearing and alteration. Many of the pegmatite intrusions have under gone so much cataclasis that they appear as aphanitic granite and trondhjemite in the field. Other pegmatites have only been slightly sheared and still retain a coarsely crystalline texture. The dominant composition of the pegmatites is one third quartz, one third plagioclase, and one third potassium feldspar. This composition does vary widely though. Some specimens have little or no potassium feldspar while others are close to one hundred percent potassium feldspar.

The youngest intrusions are quartz veins. These veins are very common and are found cutting all rock types. Intrusions of quartz are also found in fractures caused by the faulting. The quartz forms thin veins one to one half centimeters wide and is usually a dark red color due to hematite staining. In the fractures, the quartz is in varying shapes and sizes but mostly appears to have filled rhombochasms and similar openings. The immediate contacts between this quartz and the surrounding rock show a high degree of staining and chloritization of mafics, showing a hydrothermal origin.

There is another type of rock that is examined in this study. Specimens were initially collected because they appeared to be intrusive bodies in the field. Later lab analysis showed some of these to actually be zones of sheared wall rock. Most of the specimens of this type were found in the amphibolite and hornblende gneiss near splay faults. The few specimens that were recovered were found next to or contacting a sheared pegmatite intrusion. These zones have a finely crystalline texture, and appear to have been enriched with quartz and feldspar during shearing. Where the neighboring pegmatite consisted of only plagioclase and quartz the sheared wall rock contained no potassium feldspar. Where the neighboring pegmatite did contain potassium feldspar the sheared wall rock did as well.

Interpretations

The first rock type to intrude the region are the migmatite, leucocratic intrusions. Evidence shows them to be a result of partial melting of the wall rock during metamorphism. It may be possible that this event is responsible for the amphibolite zone in the region. The amphibolite could be a belt of hornblende gneiss where most of the quartz and plagioclase has be removed by this migmatite event.

The next intrusions were pegmatites. Some of these pegmatites contain no potassium feldspar, like the surrounding wall rock. These are most likely another partial melting event. For those that do contain potassium feldspar there are two possibilities. First, they could be a result of a granitic intrusion, an example being the batholith found north of the main fault. Second, they could be a partial melting associated with or accompanied by large scale potassium metasomatism

Some of the intrusions followed these two events. Because the degree of shearing is most extensive near the main fault, it is most likely that this shearing is a result of the faulting itself. The pegmatites were affected the most by this event, since they had probably formed in previous zones of weakness. The sharp contact between the sheared pegmatites and the wall rock suggest that the wall rock is on a whole resistant to this shearing.

The rare places where the wall rock has been sheared there are two certain characteristics, an enrichment in feldspar and quartz and a very fine crystalline texture. The shearing could easily grind down the size of crystals within the shear zone, and the nearby pegmatite supply the feldspar and quartz that enriches the zone. Intermixing of crystals within the zone during shearing could account for the movement and enrichment of feldspars and quartz.

The faulting itself was either accompanies or followed by one or more periods of hydrothermal activity. This activity accounts for the hematite staining found through out the region. It also accounts for the small Quartz veins that cut through the entire region as well. This phase of hydrothermal activity is most likely responsible for the alteration and break drown of the intrusions as well as the healing of cataclastic zones.

Conclusion

The history of intrusion in this region is far more complicated than the chronology given above. The shearing that has occurred along the dikes has obscured most of the cross cutting relationships found in the region. This shearing and hematite staining also obscured field data and caused an initial misidentification of dikes.

The pegmatites themselves deserve more study. The of pegmatite intrusion is most likely composed of at least two or three complicated phases. Exactly how these relate to the increase in potassium feldspar and any metamorphic events is at this time poorly understood. A comparison between the pegmatites and the granitic intrusion should also be looked into. More study should also be given to the amphibolite in the region and it's origin.

This study truly only scratches the surface of the intrusive history in the this region. It shows that any further study must acknowledge and recognize the shearing that has occurred within dikes at the field. Only by accounting for this shearing will any such study be successful.

PETROGRAPHIC AND CHEMICAL COMPARISON OF GRANITIC-RICH MIGMATITE WITH THE LEUCOGRANITE OF VERMILION BATHOLITH, QUETICO PROVINCIAL PARK, ONTARIO.

Miquette Gerber
Department of Geology
Beloit College
Beloit, Wisconsin

INTRODUCTION

The southeast margin of the Vermilion Batholith is located northwest of the Burntside Lake fault in southern Ontario. Positioned between the fault and the batholith, Granitic-rich Migmatite generally forms an outer zone surrounding the batholith(Figure 1). Granitic migmatite can contain up to 50% biotite schist rafts. These rafts make up the melanosome while the leucosome of the migmatite is granitic in character, and is often foliated. If no biotite schist rafts are evident in an outcrop, distinguishing between the batholithic rocks and migmatite is difficult. In general, the biotite schist rafts are aligned within the migmatite, and southwest, in the vicinity of Kett and Wilson Lakes, Thackray and Klug(1984) demonstrated that the aligned rafts could be used to delineate major folds within the migmatite(Figure 1).

Theoretically, migmatites may form from either partial melting, igneous injection, or both processes. The purpose of this study is to compare these two rock types to determine if they are petrogenetically related. Both petrographic and chemical data obtained with an inductively coupled argon plasma atomic emission spectrometer (I.C.A.P.) will be used.

OBSERVATIONS

Foliation

Cataclastic foliation is present in the migmatite leucosome. This structural element can be identified both in hand specimens and in thin section. The foliation approximately parallels the strike of the Burntside Lake fault suggesting that it is in large part related(Figure 1). Although most of the foliation measurements are in the general direction of the fault, not all of the foliations measured in the field are exactly parallel, giving evidence of two periods of shearing. The original shear foliation was further developed by the later movement along the Burntside Lake fault, as the original planes of weakness again became active. The leucogranite shows very little foliation and is therefore described as massive. This lack of foliation can be accounted for by noting the position of the leucogranite in relation to the Burntside Lake fault zone and because the emplacement of the batholith is later than the formation of the original foliation in the migmatite. Thus, the batholith does not exhibit foliation while the migmatite. Because the batholith is pre-movement on the Burntside Lake fault, foliations do develop locally associated with splays which enter the leucogranite.

Mineralogy

Mineralogically, there is little difference between the migmatite leucosomes and the leucogranite. Both have quartz, plagioclase(An_{37-42}) and two varieties of potassium feldspar; perthite and microcline. Small amounts of biotite and myrmekite are present along with the accessory minerals magnetite, zircon and allanite. Sericite is present as an alteration product of plagioclase but muscovite is rarely present. Secondary hematite can be seen in plane polarized light following the foliation within the rock. This hematite staining gives both rock types a pink color that is most prevalent in rocks closer to the fault trace. Remnant plaid twinning, indicative of microcline, is often found within the larger perthite grains. Even though the perthite grains are secondary, they do exhibit strain features and thus formed pre-shearing. Two ages of potassium feldspar also occur in the unfoliated leucogranite, but to a lesser degree. The microcline found in the leucogranite is generally less engulfed by perthite than the microcline in migmatitic rocks.

Petrography and Chemistry

Point count analyses were done on fifteen thin sections, five from the leucogranite and ten from migmatite rocks. When plotted on an IUGS classification triangle for igneous rocks, all specimens plot as granites (Figure 2). The results of this analysis show no distinct difference in mineralogy between the two rock types mapped as separate units(Figure 1). Chemical data compiled on the leucogranite were completed by my field partner, Mark Newcomb, while I gathered data on the migmatite rocks. Both data sets were