Age relationships of intrusions along the junction between the Quetico-Wawa subprovinces in Reid and Northern Agnes Lakes, Quetico Provincial Park, Ontario.

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Introduction

Reid and Northern Agnes Lakes are located on the junction between the Quetico and Wawa structural belts of the Superior Province. The Quetico belt is believed to be an accretionary prism of an Archean volcanic island-arc system, where the Wawa and Wabigoon belts form the converging arcs (Percival and Williams ,1989). The research area on the subprovincial junction provides an opportunity to examine a sequence of intrusive events with respect to the deformation and accretion of the subprovinces. The focus of this study is to determine the number of intrusive events, examine the apparent age relationships of apparent bodies, and describe each intrusion petrographically.

Rock units have previously been recognized and described by Woodard (1992). A study of intrusions and age relationships along the Quetico-Wawa belt junction has been conducted by Ho and Small (1992) in the Gray Lake region of the Wawa belt, located several Kilometers south of the field area under examination in this abstract. The source and timing of the intrusions along the belt junction has been an area of dispute for some time.

There have been various suggestions regarding the source of the igneous intrusions which exist within both the Quetico, and Wawa subprovinces. According to Percival and Williams (1987), peraluminous granites formed as a result of thermal relaxation within the metasedimentary units after the docking of the Wawa and Wabigoon subprovinces. Ho and Small (1992) accounted for five different intrusive events, which are suspected to be related to the partial melting of crustal material and the injection of the Vermilion Batholith (Ho and Small, 1992). Southwick (1991) supports the theory of partial melting of the metasedimentary rocks in the Quetico belt to produce intrusive granitoid leucosomes.

The age of the Quetico-Wawa Belts accretion has been constrained to between 2689 Ma and 2684 Ma (Percival, 1989). Percival described three intrusive events in the Quetico belt, "granodiorite sills" that pre-date, and "pink, white granites" and "pegmatite" that post-date the accretion. Percival also described two intrusive events in the Wawa belt, "early intrusions" that pre-date, and "late granites" that post-date the accretion (Percival, 1989). A summary of these events are outlined in Table 1. It is believed that the Vermilion Batholith was emplaced after major deformation occurred, before Burntside Lake faulting events (Gerber, 1990). A pink, biotite granite found on both sides of the junction, but predominately in the Quetico Belt, is believed to stem from the Vermilion complex as a late magmatic injection of Lac La Croix granite, which suggests that the Vermilion Batholith may have formed as a stitching pluton along the Quetico-Wawa belt junction (Gardner et al., 1988). This pink, biotite granite cited in many articles pertaining to this area, (Percival, 1989; Ho and Small, 1992; Gardner et al., 1988; and Newcomb, 1990), may refer to the same late phase intrusive event, with the same characteristic texture and mineralogy.

Methods

The age relationships of intrusions on the Quetico-Wawa belt junction were determined by field observations of cross-cutting relationships, mineralogy, and texture. Hand samples of intrusive bodies were analyzed for feldspar distribution by sodium cobaltinitrite staining, and for mineral assemblages by petrographic microscope.

Observations

The Quetico belt in the field area is primarily composed of metasedimentary units with cross-cutting intrusive bodies. The Wawa and Quetico belts appear to have similar, if not the same, lithologies directly along the belt junction and could be identified as a melange zone.

This study focuses on the characteristics of two distinct felsic dikes. One dike appeared to be a medium to fine-grained, granitic intrusion containing relatively equal amounts of potassium feldspar, quartz, and plagioclase. This intrusion contains 5% - 15% biotite, minor amounts of zircon and apatite, and a large amount of sericite alteration. The fine grained felsic intrusion cross-cuts all other lithologies, hence, it must be a very late stage event. A second intrusion, a typical pegmatite, is coarse grained, contains a larger percent of potassium feldspar, and is cross-cut by the finer grained felsic intrusion. The pegmatite's relationship with the fine grained felsic dike is one that suggests that the pegmatite is an intermediate stage intrusion, which occurred after major deformation, and before the last intrusive event in the field area. This pegmatitic intrusion, which is dominated by potassium fedspar, contains 2% - 7% biotite, relatively equal amounts of quartz and plagioclase (10% - 20%), minor amounts of zircon

and apatite, deterioration of the microcline, and a large amount of seritization in the plagioclase feldspar. Both intrusions are present in the Quetico and Wawa belts, each with respective structural features and mineral assemblages.

The fine grained felsic intrusion is the youngest intrusion and is seen cross-cutting all units described in this region on both sides of the belt junction. This intrusion has distinct boundaries, contians two major fabric directions, and frequently cuts the dominant foliation in the surrounding rock. The Pegmatite intrusion is older than the fine grained felsic body, and contains fine grained finger dikes that stem from the larger body and fold into the surrounding rock. The fabric structures within the pegmatite are difficult to distinguish, because the coarse grained texture resists the tendency to form linear fabrics under stresses that would cause finer grained material to realign.

Discussion

The origin and tectonic setting for these intrusions is difficult to interpret. The pegmatitic intrusion appears to be intensely deformed, and the ptygmatic folding of the finger dikes may indicate ductile deformation in an intense kinamatic environment. The finer grained intrusion tends to follow foliation, and folds less than the pegmatitic intrusion. the finer grained intrusion has a block-like, massive appearance, which suggests a cooler country rock during emplacement that did not allow the dike to flow. The idea generated from this analysis represents an active plate boundary, which creates enough heat to melt material for several stages of intrusion. Possible sources with enough heat and pressure to create these intrusive events are: 1) Vermilion Batholith, 2) Island-arc accretion (Percival and Williams, 1989), 3) local hot spot activity due to thermal relaxation after the accretion of terrains, or 4) any combination of 1, 2, or 3.

Extensive petrographical analysis offers evidence of a one-source explanation for the similar mineralogies, with a possible relation to the Vermilion Batholith. Thin sections of hand specimens were point-counted with a 10 X 10 grid, so that an accurate mineral distribution could be obtained. The point-counting of samples from the pegmatitc intrusion and the fine grained intrusion revealed similar mineralogies from samples with variable textures and grain size. Figure 1 displays the distribution of samples as they appear on a ternary diagram plotting the percentage of quartz, orthoclase and microcline, and plagioclase. The majority of hand samples examined petrographically are classified in the granite field, which are those rocks having 20%-60% quartz, 10%-65% plagioclase, and 90%-35% orthoclase. The sections contained little to no hornblende, 5%-10% biotite, 5%-10% chlorite as an alteration product of biotite, and minor amounts of apatite, zircon, and muscovite.

Conclusion

From the petrographic evidence, the accretion model by Percival and Willaims (1987), the evidence of Newcomb's (1990) analysis of the Vermilion Batholith as a possible source for injection into the Quetico belt, we can create a convenient model. The accretion of island-arcs formed a metasedimentaray unit in between. During a phase of thermal relaxation, while the metasedimentary unit was undergoing anatexis, the Vermillion Batholith injected a series of intrusions into the overlying terrain.

The Vermilion Batholith exists in the area northwest of the Burntside lake fault, between Basswood and Sarah Lakes, many kilometers to the southwest of our field area. Ho and Small studied an area several kilometers to the southwest of our field area, and found several more intrusive events. The model we have illustrated indicates a larger number of intrusions as one moves toward the Vermilion Batholith from our research area in northern Agnes and Reid Lakes, suggesting the batholith as the source of the intrusions, or at least a major contributor.

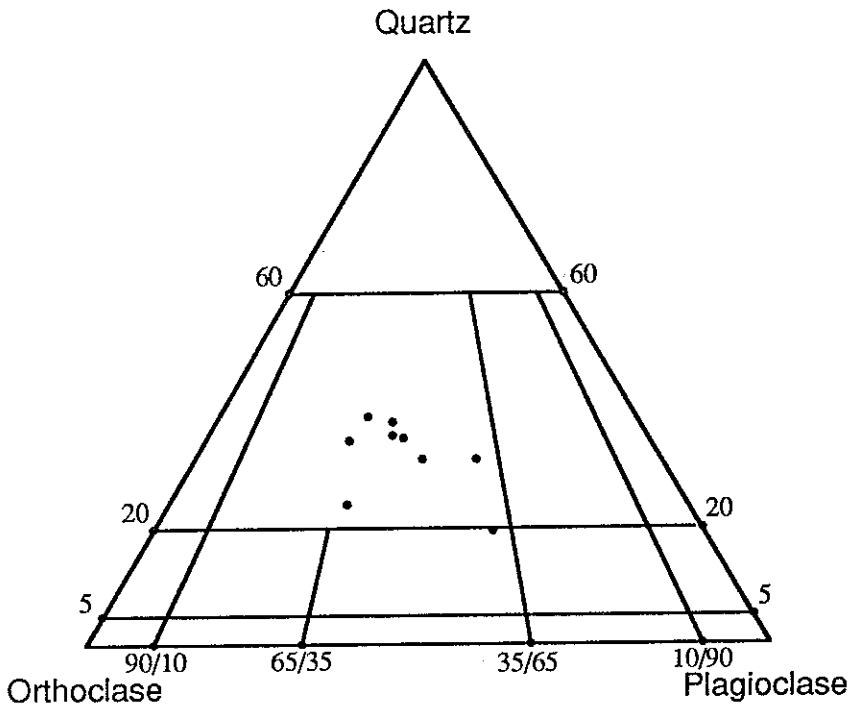

Figure 1. Classification of all hand samples, examined in thin section . The Samples dominate the granite field of classification. All hand samples are intrusions from the Quetico-Wawa Belt junction, northern Agnes and Reid Lakes. (Adapted from the IUGS Subcomission on the Systematics of Igneous Rocks, *Geotimes*, October, 1973.)

Age (Ma)	Wawa	Quetico
2650		Pegmatite
2670	Late granites	Pink, white granites
2690	"Timiskaming" volcanics	Granodiorite sills
2710	"Keewatin" volcanics	Sedimentation
2730	Early intrusions	
2750	"Keewatin" volcanics	
2990		

Table 1. Summary of dated units in the Quetico and Wawa Belts, modified after Percival (1989).

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