EMPLACEMENT GEOMETRY AND DEFORMATION OF A MESOPROTEROZOIC(?) GRANITE SILL COMPLEX, NORTH HARDSCRABBLE CREEK, WET MOUNTAINS, COLORADO

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INTRODUCTION

The purpose of this project is to describe a complex of Mesoproterozoic(?) granite sills intruded into structurally deep levels of Paleoproterozoic gneiss in the central Wet Mountains (Fig. 1). Exceptional exposures along North Hardscrabble Creek provide cross cutting relationships between Paleoproterozoic shear fabrics that pre-date the granite, the granitic sills, and deformational fabrics superimposed on the granites. An important question is: How much (if any) deformation occurred during Mesoproterozoic time (Nyman, et al., 1994; Kirby et al., 1995; Siddoway et al., 2000)?

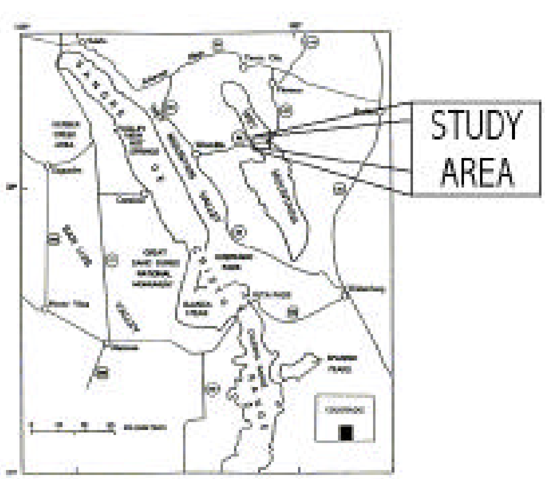

Fig. 1. Location of North Hardscrabble Creek study area.

METHODS

I mapped a continuous strip of roadcuts and outcrops along 4 km of Highway 96, east of McKenzie Junction. I measured foliations and lineations in granite and host rocks as well as orientations of crosscutting dikes. I also photographed key field relationships showing intrusive margins of the granites and superimposed deformational features. In the laboratory I studied thin sections of oriented samples and calculated shortening strains of buckled granite dikes.

RESULTS / INTERPRETATION

My geologic map (Fig. 2) shows the geometry and structure of the granite sill complex. The dominant Paleoproterozoic host rock is mafic gneiss (quartz-feldspar-hornblende-biotite gneiss and amphibolite). Interlayered with the mafic gneiss are 10cm to 30m-thick layers of fine-grained quartzo-feldspathic gneiss and 5cm to 1m-thick augen gneiss (Fig. 3). Rare outcrops (Fig. 4) show that the augen gneiss (too small to map at the scale of Fig. 2) was a porphyritic biotite granite intruded into previously layered mafic and felsic gneisses. These Paleoproterozoic gneisses are intruded by a pervasive swarm of Mesoproterozoic(?) leucocratic biotite +/- muscovite granite sills (Fig. 5). Less abundant, conspicuously

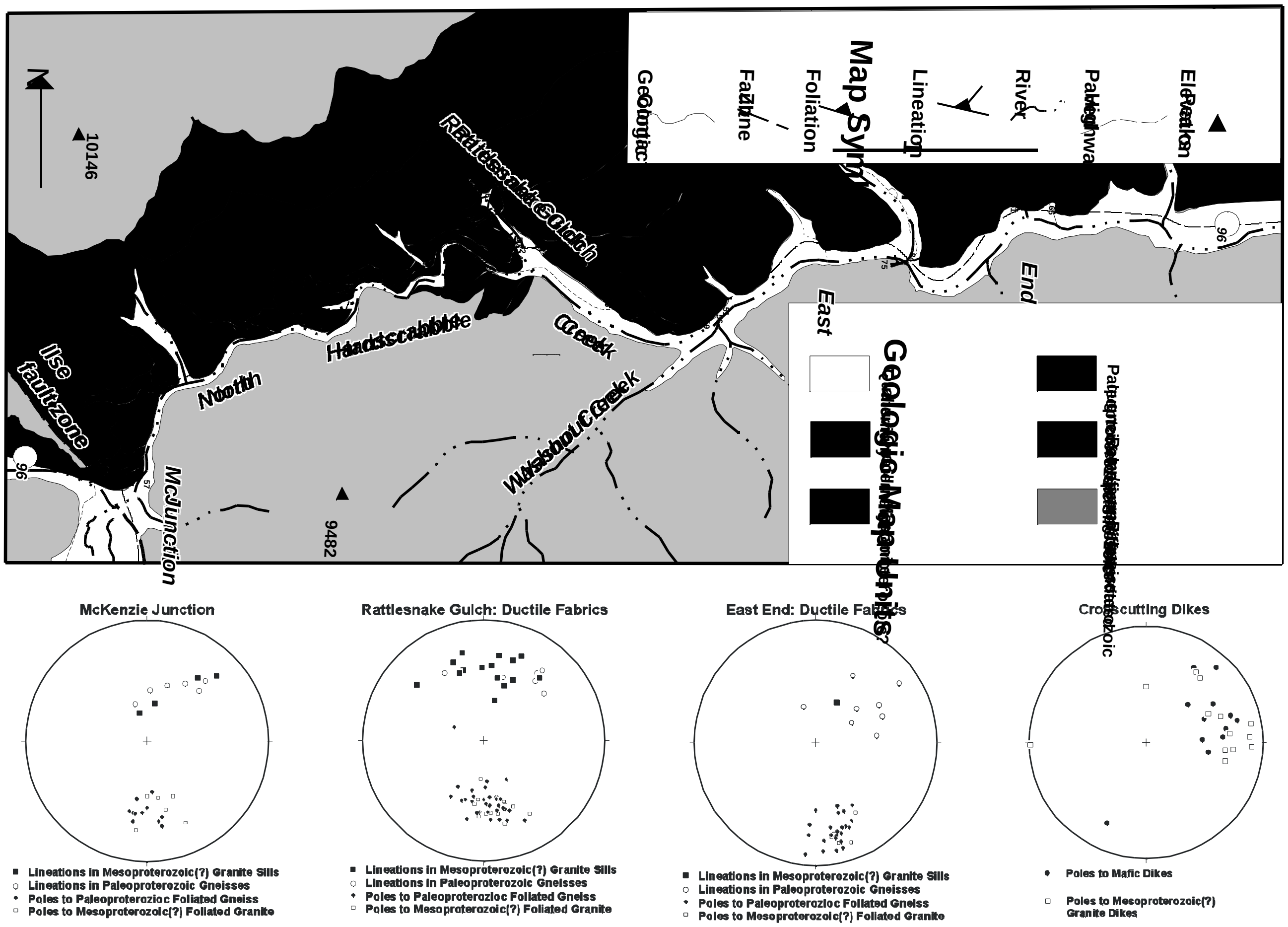

Fig. 2. Geologic and structural map of the North Hardscrabble Creek area, showing Stereonet compilations of structural measurements.

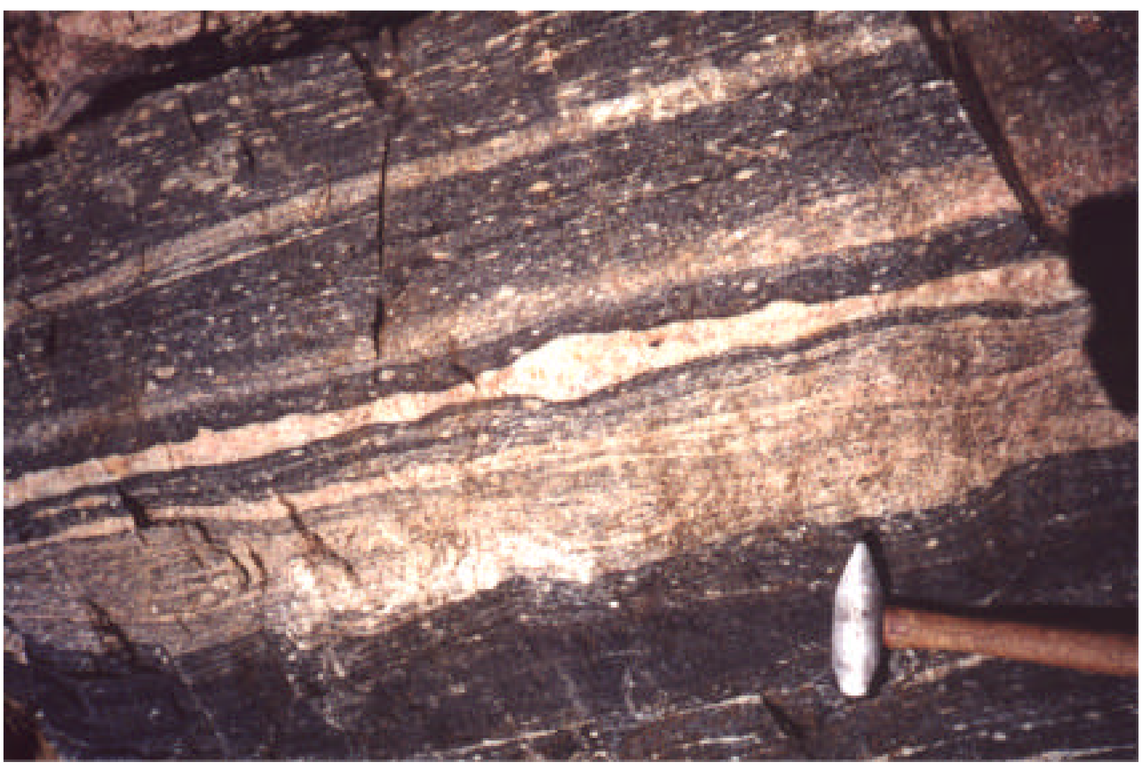

Fig. 4. Tightly folded intrusive contact between augen gneiss and mafic gneiss host. Arrows indicate moderately deformed crosscutting granite dike.

buckled dikes (Fig. 6) connect these sills, which may range in thickness from 2cm to 300m. All of the aforementioned foliated rocks are intruded by undeformed pegmatite dikes and fine-grained mafic dikes (Fig. 7).

Fig. 5. Sills of Mesoproterozoic(?) granite intrude Paleoproterozoic mafic gneiss.

The Paleoproterozoic gneisses and granite sills share a moderately north-northwest dipping foliation and north-northeast plunging lineation (Fig. 2). The section mapped along Hardscrabble Creek has a structural thickness of 1600m. Observations near McKenzie Junction and East End are at deeper structural levels than those at Rattlesnake Gulch, and contain more abundant augen gneiss exposures. McKenzie Junction is roughly on strike with the east end of the study area. Many of the augen gneiss outcrops and thin sections display a south-vergent S-C fabric oriented subparallel to compositional layering in the mafic and quartzofeldspathic gneisses. This older fabric is overprinted by a similarly oriented foliation present in the intrusive granite sills. Hence the older gneisses preserve a polygenetic deformational fabric.

Subsolidus structures in the Mesoproterozoic granites include dikes buckled perpendicular to foliation (Fig. 6) and sills boudinaged parallel to wall rock foliation (Fig. 3). The symmetry of these features with respect to biotite foliation in the granite suggests a strong component of flattening strain. Measurements of buckled dikes on joint surfaces oriented at high angles to host rock foliation yield shortening strains between 40% and 70%.

Two sets of crosscutting dikes were observed. Pegmatitic to medium grained granite dikes of suspected Mesoproterozoic age exhibit steep west or south west dips. Fine-grained mafic dikes of unknown age dip steeply southwest.

Fig. 6. Mesoproterozoic granite dikes buckled perpendicular to foliation in mafic gneiss host.

Age relations between these two dike sets were not observed.

Fig. 7. Mesoproterozoic(?) pegmatite dike intrudes across mafic gneiss and foliated granite sills.

CONCLUSIONS

The granite sill complex of North Hardscrabble Creek experienced significant ductile strain after its emplacement into the Paleoproterozoic gneisses. Buckled granite dikes demonstrate wall rock shortening strain on the order of 40% to 70%. Foliation and boudinage in the granite sills record considerable subsolidus flattening strain. The Paleoproterozoic gneisses preserve a composite foliation recording separate deformations at 1.7 Ga(?) and 1.4 Ga(?). To better constrain the timing of Mesoproterozoic tectonism, it is imperative to date representative samples of the foliated granite and the crosscutting pegmatite dikes.

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