STRUCTURAL ANALYSIS OF THE PROTEROZOIC FIVE POINTS GULCH SHEAR ZONE, WET MOUNTAINS, COLORADO

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INTRODUCTION

The main focus of this mapping project is an assessment of the internal structure of the Five Points Gulch shear zone (Siddoway and others, 2000). The Five Points Gulch shear zone is a Proterozoic structure located in the Wet Mountains of south-central Colorado. A fundamental problem in deciphering the tectonic history of this region is unraveling the polyphase deformation fabrics found in this shear zone.

This study will focus on late stage brittle-ductile structures that overprint ductile shear zone fabrics. The findings may identify the final Proterozoic deformation present within the Wet Mountains.

The Five Points Gulch Shear Zone

The Five Points Gulch shear zone consists of gray, fine-grained, sillimanite-garnet-muscovite-biotite-plagioclase-AFS-quartz gneisses (‘gray gneisses’). The penetrative planar fabric of this shear zone strikes north-south and is steeply dipping. The gray gneisses contain a mineral lineation carried by synkinematic sillimanite. Some sillimanite occurs as muscovite-rich, light-colored pods, typically <1 cm wide. The penetrative planar fabric of these gray gneisses transposed an older Paleoproterozoic S_2 fabric found in adjacent rocks (Siddoway and others, 2000). Following the terminology of Clark (2002), the Five Points Gulch shear zone planar fabric is referred to as S_{SZ}. Assessment of the mineral assemblage of these rocks suggests that metamorphism and shear zone deformation occurred at peak temperatures just above muscovite breakdown (garnet present) and below wet granite melting (600-650 ºC) and at pressures of 3 Kb (Siddoway and others, 2002; Acevedo, 2002). Acevedo (2002) has inferred that the gray gneisses record two episodes of ductile shearing and two episodes of sillimanite growth.

Contoured poles to the S_{SZ} planar fabric and lineation attitudes (L_{SZ}) recorded in the field

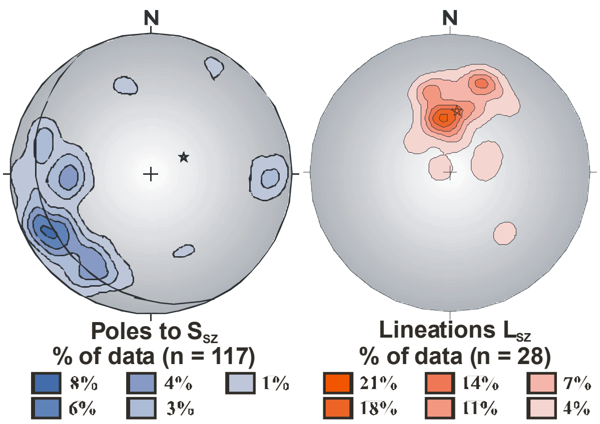

Figure 1: Equal-area projections of contoured poles to S_{SZ} and lineations (L_{SZ}) of the gray gneisses.

are plotted on equal-area projections (Figure 1). Tight clustering of poles to S_{SZ} data and the presence of small-scale parasitic folds (Figure 2) suggests isolcinal folding of S_{SZ}.

The gray gneisses contain zones of compositional layering. Adjacent sillimanite-rich and sillimanite-poor zones or adjacent biotite-rich and biotite-poor zones define these layers. The biotite variations result in dark gray to light layering of the gneisses. I interpret these compositional layers to be the

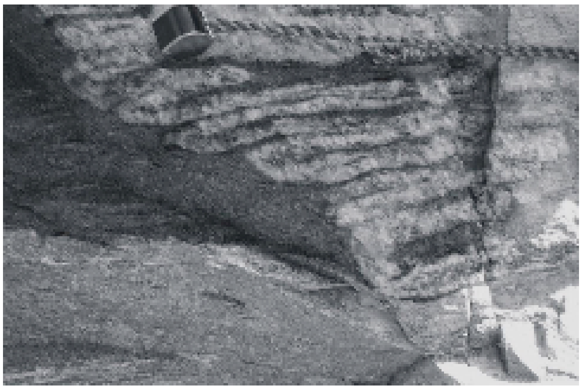

Figure 2: Small-scale, parasitic, isolcinal folds found in the gray gneisses.

original sedimentary bedding (sedimentary protolith) or an early deformational fabric of these rocks. These layers were preserved in low strain zones.

Younger Brittle-Ductile Structures

Several outcrop scale brittle-ductile structures cut the penetrative foliation (S_{SZ}) of the Five Points Gulch shear zone. These structures consist of small to moderate displacement brittle-ductile fold-thrust structures and melt-filled tension gashes associated with normal displacement brittle-ductile faults. The tension gashes are either sigmoidal (Figure 3) or triangular-shaped and are commonly truncated by normal displacement brittle-ductile faults (Figure 4). Normal displacement faults associated with the tension gashes sometimes reactivate fold-thrust structures (Figure 4). Therefore, the fold-thrust structures are older than the normal displacement faults and tension gashes.

The following is a list of descriptions of the brittle-ductile fold-thrust structures: Fold-Thrust 1: (Figure 5; found along highway 50) asymmetric, elliptical, cylindrical-looking, close

fold of S_{SZ} fabric. This fold is gently NW-plunging, with an axial plane moderately inclined to the NE. Fold-thrust 1 is associated with a brittle top-to-the SW, NE-dipping thrust with 10 or more cm of top-to-the SW displacement. Thrust 2: (Figure 6; found along highway 50) Cliff-size, curving, brittle-ductile thrust with top-to-the SW displacement. The thrust offsets dark gray and light gray layering in shear zone rocks and has

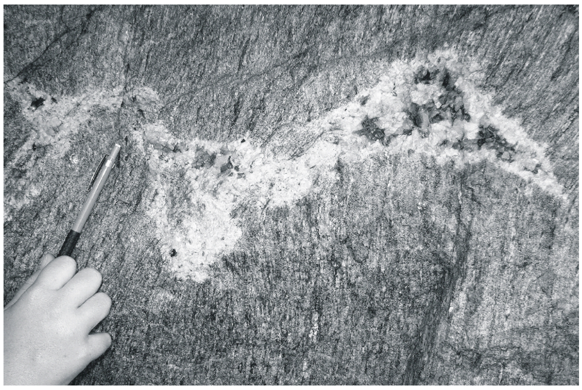

Figure 3: Melt-filled, sigmoidal tension gash cutting the gray gneiss.

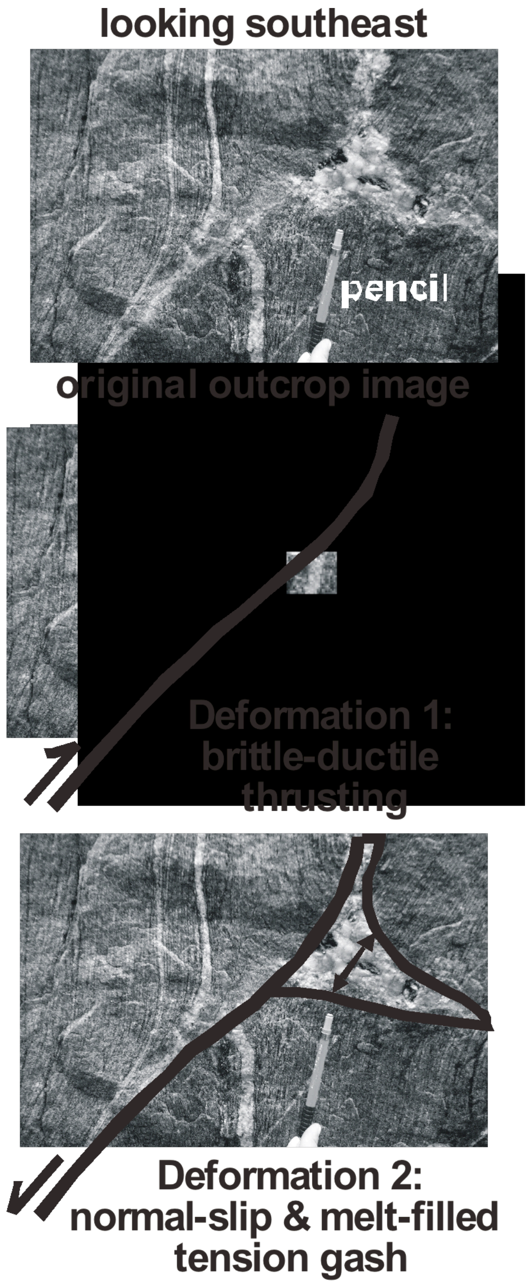

Figure 4: Reactivation of a brittle-ductile thrust by a brittle-ductile normal fault and associated triangular-shaped tension gash.

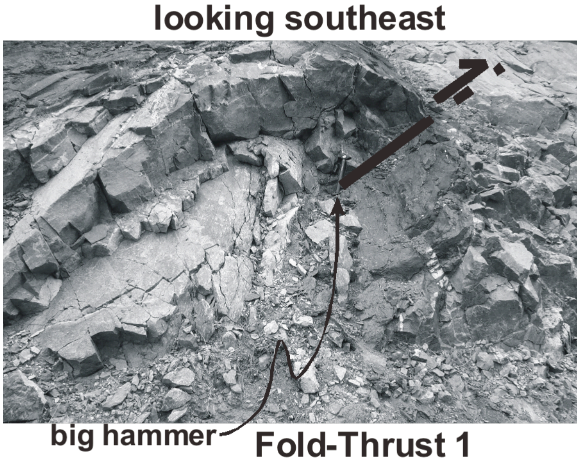

Figure 5: Cylindrical-looking, close fold of S_{SZ} fabric of gray gneiss.

several meters of displacement. A post to synkinematic pegmatitic intrusion several meters thick fills thrust 2. <u>Faulted Boudins</u>: (Figure 7; found along highway 50) Outcrop-scale, brittle-ductile thrust structures with several cm's of top-to-the SW thrust displacement. These small-scale, brittle-ductile thrusts offset a series of vertical sills in a manner suggestive of faulted boudins ('foudins'). <u>Sheep Basin Thrust</u>: (Figure 8) An asymmetric, mesoscopic Z-fold attenuated by a NE-dipping, top-to-SW brittle-ductile thrust with 10 cm of displacement. All of these structures dip gently to the NE and have top-to-the SW thrust displacement (Figure 9).

CONCLUSIONS

Gray gneisses of the Five Points Gulch may represent a Mesoproterozoic shear zone (Siddoway and others, 2000). Metamorphism and deformation of the gray gneisses is, however, polyphase and complex and includes isolcinal folding of the gneisses. Surprisingly, original bedding or an earlier deformation fabric is sometimes preserved in the form of alternating layers of sillimanite/biotite-rich to sillimanite/biotite-poor zones.

A series of small to moderate displacement brittle-ductile structures cut the ductile fabrics of the Five Points Gulch shear zone of the Wet Mountains. These structures record the final Mesoproterozoic deformation in the Wet Mountains. It is not clear whether these structures represent a minor, local deformation related to synkinematic granitic intrusions or a final regional Mesoproterozoic deformation.

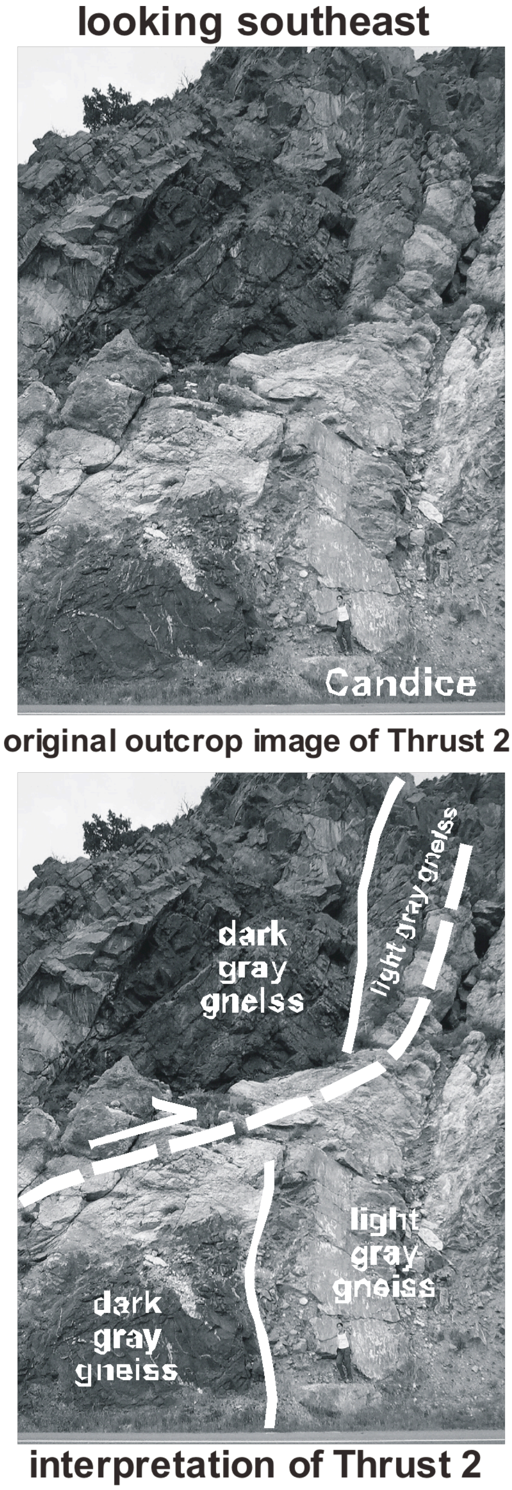

Figure 6: Cliff-size, brittle-ductile trust offsetting the light and dark gray layering in gneisses.

REFERENCES CITED

Acevedo, G., 2002, Petrologic and Thermobarometric Analysis of Sillimanite Pod Gneiss of Five Points Gulch, Wet Mountains, Colorado: this volume.

Clark, E., 2002, Analysis of deformational and metamorphic history of cordierite schist, east gulch, Colorado: this volume

Siddoway, C.; Givot, R. M.; Bodle, C. D., and Heizler, M.T., 2000, Dynamic setting for Proterozoic plutonism: information from host rock fabrics, central and northern Wet Mountains, Colorado. Special issue: Proterozoic Magmatism of the Rocky Mountain Region, Carol Frost (ed.), Rocky Mountain Geology, v. 35, no. 1, 91-111.

Siddoway, C. and others, 2002, 1.4 Ga tectonics recorded by synchronous high temperature deformation, retrogression of granulite gneisses, and magmatism, Wet Mountains, CO: EOS Trans. AGU, Fall Meet. Suppl., Abstract S31B-0596.

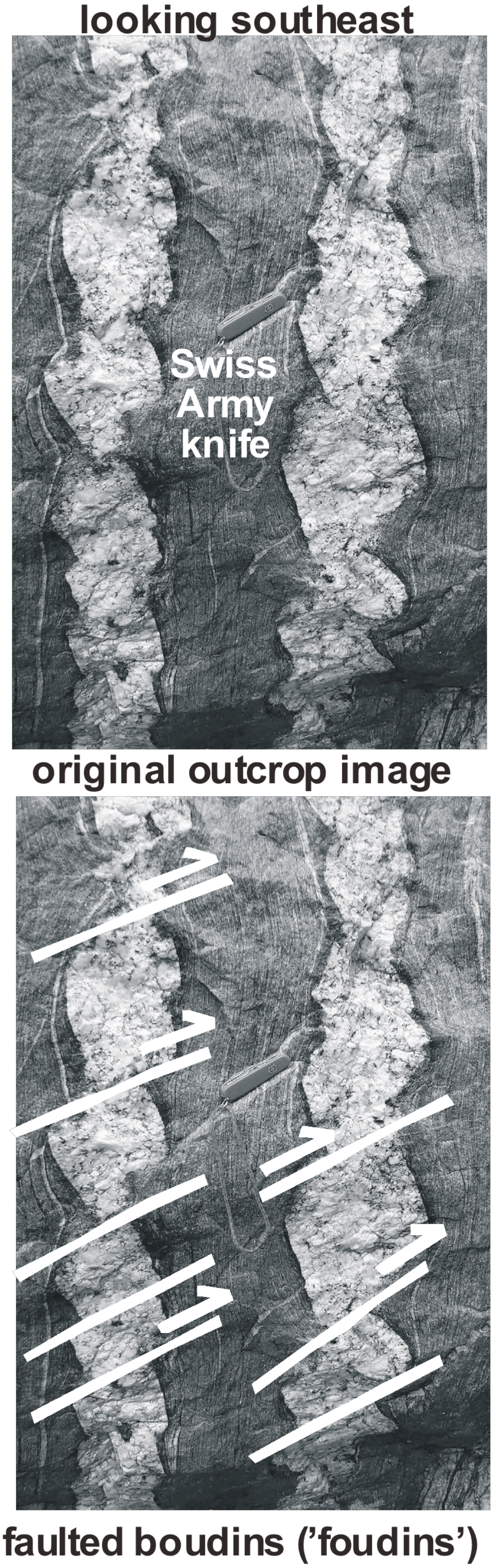

Figure 7: Outcrop scale faulted pegmatite boudins showing top-to-the-SW

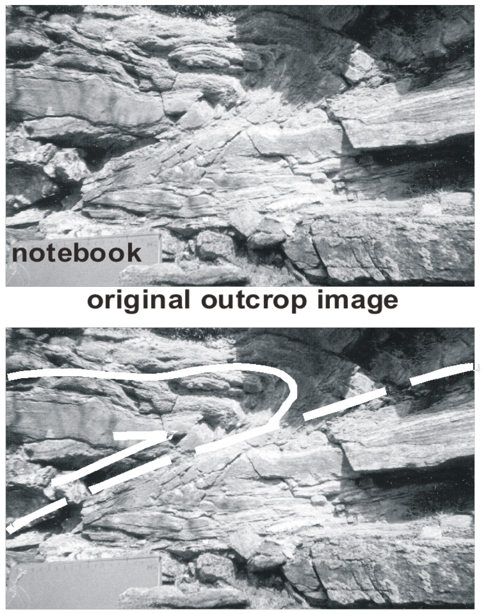

Figure 8: Asymmetric, mesoscopic Z-fold truncated by a brittle-ductile thrust.

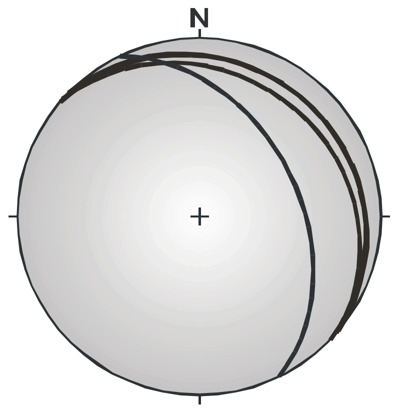

Figure 9: Equal-area projection of planes of brittle-ductile thrust structures.