

Controls on the Geomorphology of Rounds Mountain, Massachusetts-New York

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Introduction

Our field area, one of five adjacent areas studied, was Rounds Mountain located in the Stephentown Center N.Y.-Mass. 7.5 by 15' quadrangle. Two rock types, marble and phyllite, are found in the Rounds Mountain field area. Both were originally sediments deposited on the passive margin that developed on the eastern edge of the North American craton around 650 Ma. The phyllite was deposited as deep water muds to the east; the marble was deposited as shallow water shelf carbonates to the west. During the Taconian Orogeny, a mountain-building event occurring between 480-460 Ma (Karabinos *et al.*, 1993), thrusting displaced the deepwater facies over the shallow water facies (Stanley and Ratcliffe, 1985).

The marble is generally found in the valleys surrounding Rounds Mountain (684 m) up to a maximum elevation of 400 m. The upper portion of the mountain is composed of phyllite, which can be divided into four types. These include a greenish-gray chlorite-muscovite phyllite, a dark gray phyllite, and a muscovite-rich silver phyllite. A fourth type is similar to the silver phyllite but contained layers of siliceous ooze and is found near the fault zone at the southwestern base of the mountain.

Goals

- To collect structural and lithologic data in order to reconstruct the underlying structure of Rounds Mountain.
- To determine the extent of structural and/or glacial controls on the local geomorphology.

Methods

We collected data during ten days of field work on Rounds Mountain. Our traverses were made mostly along streams where the probability of outcrop was greatest. Measurements were made on foliation, joint sets, lineations and fold axes with a Brunton compass. We determined rock type using acid testing, relative hardness, and color. We used an altimeter to help us determine our location in the field. The orientations of the streams on Rounds Mountain were estimated by dividing the stream into 50-meter segments, measuring the orientations of each section, and plotting the results on rose diagrams. We calculated the direction of the last glacial advance by averaging the orientations of the rock drumlins in order to find the direction of original till gradient. Data was compiled using the Macintosh programs Stereo 4.0 for stereonet plots, Rosy for rose diagrams, and Adobe Illustrator for the maps.

Data/Results

The attitude of the foliation throughout the field area is fairly uniform, generally striking northeast and dipping in a southeast direction. The attitude of the average foliation surface is $014^{\circ}; 38^{\circ}$ southeast (Fig. 1). The joints were much less consistent. The primary joint directions strike $030-040^{\circ}$ and $110-120^{\circ}$. However, there are numerous minor joint sets that strike between $000-030^{\circ}$ and $080-180^{\circ}$ (Fig. 2).

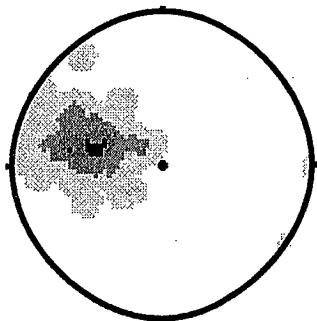


Figure 1. Contour plot of poles to foliation for the Rounds Mountain field area.

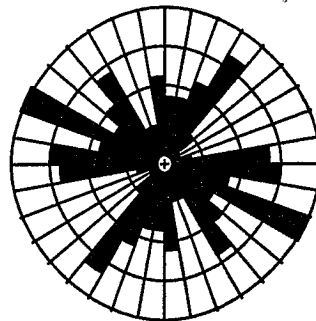


Figure 2. Rose diagram of all joint directions for the Rounds Mountain field area.

We divided our field area into three sections, the east, west and south. The rose diagrams from the south and east show fairly prominent sets of joints that strike north, northeast, east and southeast. The rose diagram from the west side is significantly different because the north-striking joint set is absent and the southeast-striking joint set is not prominent.

The orientations of the streams were averaged for the eastern and western sections. The eastern streams had an average orientation of about 130-140° with variations of up to 30°. The western section had three major orientations of 0-10°, 40-50° and 80-100°.

We determined by measurement of rock drumlin axes that the movement of the last glacial advance was approximately 105°. The drumlins on Rounds Mountain have very scattered orientations which suggest that their shape may be caused by something other than glacial processes. The only striations found during this project were on Berry Hill in the Pittsfield State Forest which were oriented at approximately 120°. However, striations with orientations of 160±5° have been observed on the north end of Brodie Ridge (DeSimone, personal communication).

Discussion

After compiling our structural and lithologic data into a geologic map (Fig. 3), we interpreted the Rounds Mountain structure as a series of asymmetrical, gently inclined folds. By comparison to the interpreted structures of the four surrounding field areas, the folds are hypothesized as resulting from imbricate thrust faulting.

The possible controls on the streams that we studied were both structural and glacial. The structural controls included the effects of joints and foliation. The last glacial advance that affected Rounds Mountain was the Wisconsin Stage which reached its maximum coverage between 22-21 Ka and retreated from Williamstown around 15-14 Ka (Cadwell, 1986). The direction the glacier flowed across the mountain affected the thickness and orientation of the resulting till deposits, and therefore could affect the direction the streams subsequently flow down the mountain.

The orientation of the streams in the western section had a very strong correlation with the joints. The western section contains two streams, one of which follows along a northeast trending joint set. The other stream flows down the east-trending joint but has a large jog in the middle in which it flows north (Fig. 4). Our joint data from the western section does not include a set of north-south joints; however, data collected to the north of our area and also on the west side of the ridge contained a prominent north-south joint set. Another structure that could be controlling the stream was a large-scale fold that was interpreted from the lithologic data (Fig. 3). The stream may be eroding a path parallel to the fold axis, exploiting axial planar cleavage along an inferred synclinal axis.

The streams to the south flow in a radial pattern down the end of the ridge. During our traverses, we noted that there was a thick blanket of till around the southern end of the ridge. Based on these observations, we concluded that the streams flow down the gradient of the till deposits, and continue to flow down gradient even where the streams are cutting down into bedrock. It is a noted occurrence in the larger region that downcutting streams can cut through a bedrock protuberance in an area otherwise composed of thick till and not have the course altered (DeSimone, personal communication).

The eastern section streams correlate most closely with the dip slope of the foliation. The changes in the orientation of the stream closely follow measured changes in the dip direction of the foliation (Fig. 4). Although the joints found in the eastern section are similar to the stream orientations, the relationship is not as strong as that of the foliation. The joints therefore may have a minor influence on the direction of the streams.

No correlation was found between the stream direction and the direction of glacial advance.

Conclusions

- The underlying structure of Rounds Mountain is proposed as large-scale asymmetrical gently inclined folds, possibly formed as a result of imbricate faulting.
- The streams in the Rounds Mountain field area were controlled by three major factors which include the following:
 1. The joint and fold structures in the bedrock,
 2. The attitude of the foliation, and
 3. The presence of the large blanket of till at the southern end of the ridge.

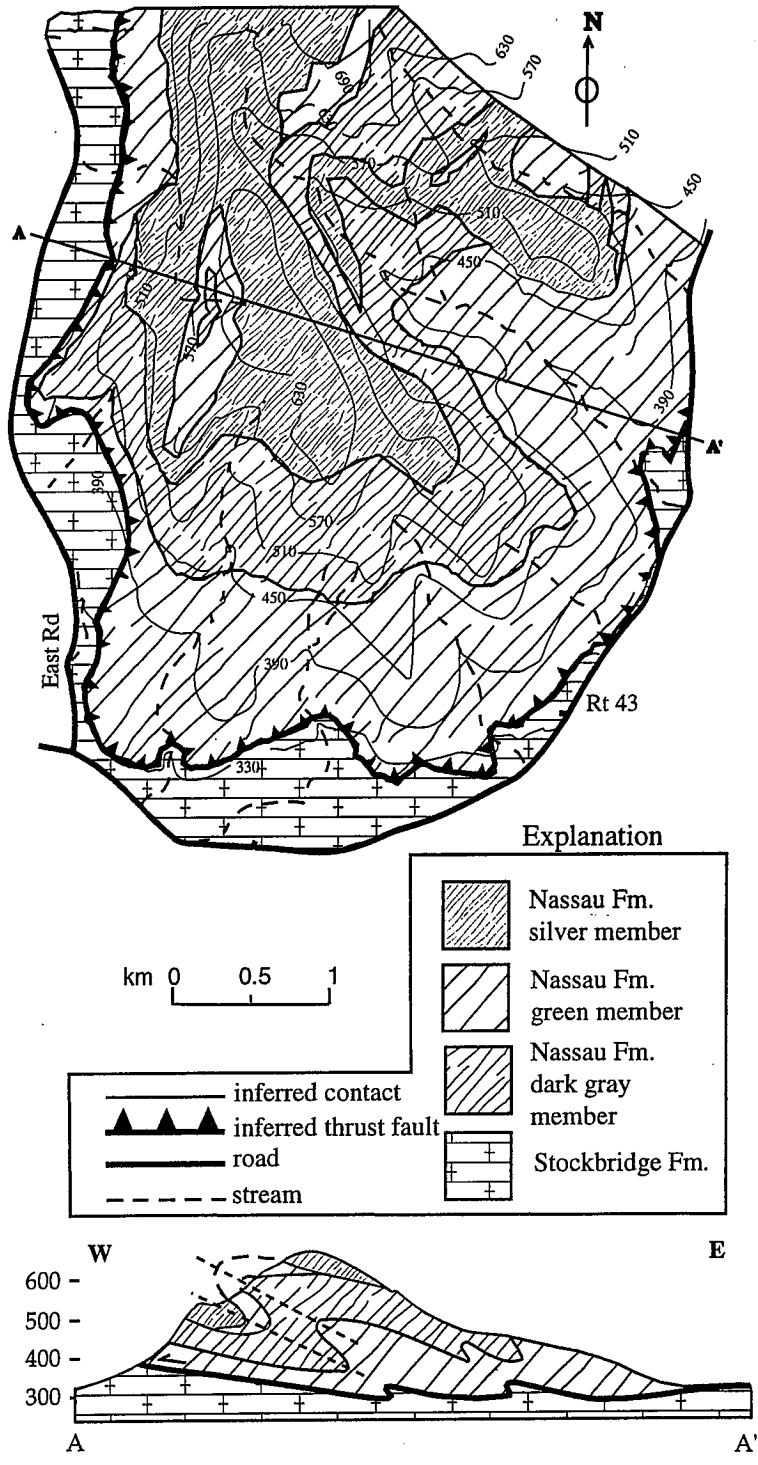


Figure 3. Geologic map and cross section of Rounds Mountain.

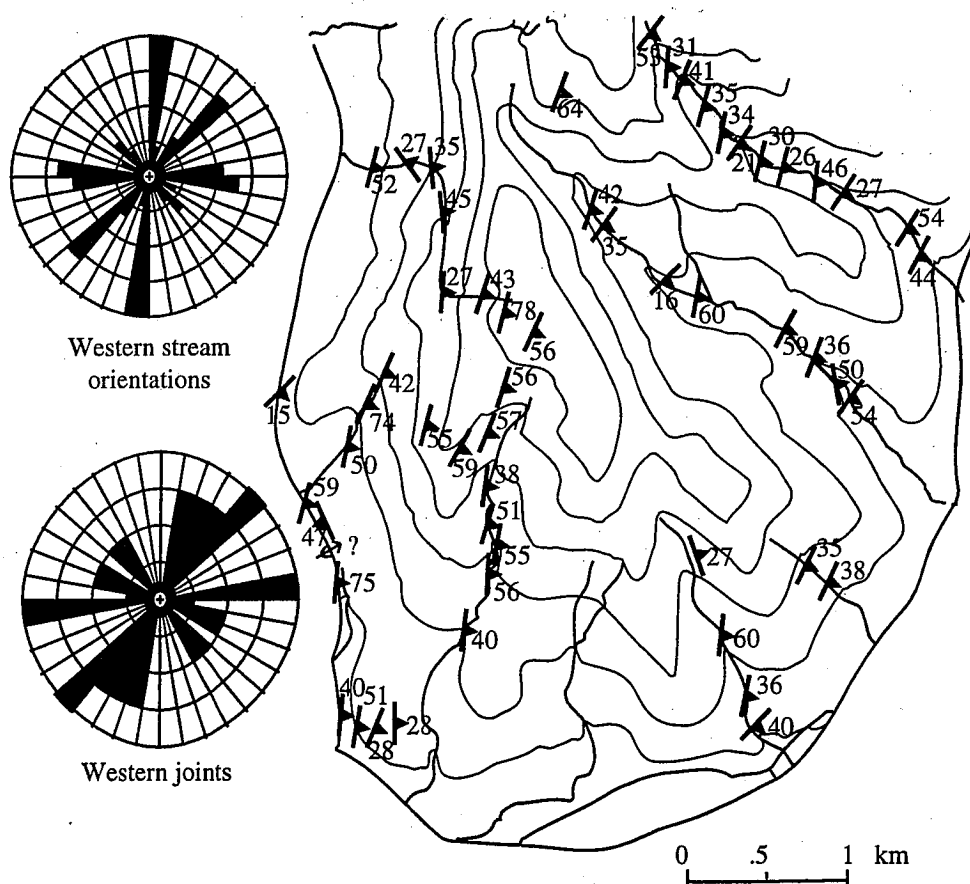


Figure 5. Map of Rounds Mountain and foliation attitudes. Stream orientations of the two eastern streams follow the dip of the foliation. The two less prevalent western stream orientations follow the two major joint directions.

References

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- Karabinos, Paul, Stoll, H.M., Hepburn, J.C., and Tucker, R.D., 1993, The New England segment of the Laurentian margin: continuous tectonic activity from early Ordovician through Early Devonian, *Geological Society of America, Abstracts with Programs*, 25, p. A-178.
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