Geology of the Snaggy Ridge Rhyolite

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The Snaggy Ridge rhyolite is a distinct geologic unit in the volcanic terrain of the South Mountain region of south-central Pennsylvania (Tucker, 2024). It originated as glassy lava that erupted and rapidly cooled to form vitreous rhyolite and obsidian. The rock was subsequently altered by the process of devitrification and in most places has lost its glassy character.

The Snaggy Ridge rhyolite occurs in two outcrop areas – one in the vicinity of Snaggy Ridge and another east of Green Ridge (Figure 1). The outcrop area in the vicinity of Snaggy Ridge measures about 2.5 miles by 3.5 miles. The outcrop area east of Green Ridge is about 8.5 miles long and 0.5 miles wide. The Snaggy Ridge rhyolite is interlayered with other volcanic rock units in the region. It is overlain stratigraphically by the Culp Ridge tuff, a pyroclastic ash flow tuff. It is underlain by older interlayered rhyolite and metabasalt flows. The Snaggy Ridge rhyolite has an estimated thickness of 2,500 feet based on outcrop width. Radiometric age dating of nearby volcanic rocks provides an age of 570 million years coinciding with the Neoproterozoic (Aleinikoff et al, 1995).

The Snaggy Ridge rhyolite has characteristics indicating an origin as a glassy lava flow (Figure 2) including a cryptocrystalline groundmass, porphyritic texture and structures such as flow banding, mottling, axiolites and flow breccia. These characteristics are described in more detail below.

The Snaggy Ridge rhyolite is often porphyritic with phenocrysts of feldspar and quartz. The feldspar phenocrysts are white and often contrast sharply with the dark gray matrix (Figure 3A). Feldspar phenocrysts are typically euhedral to subhedral with rectangular lath-like crystals 3 to 6 mm in length. Quartz phenocrysts are smaller, averaging 0.5 to 1 mm and have a dark gray color. Quartz phenocrysts are subhedral to anhedral. The groundmass is typically aphanitic where individual grains cannot be distinguished with the naked eye. Under the petrographic microscope the groundmass commonly has a felsic texture composed of a quartz and feldspar with a stippled appearance.

Structures observed in hand samples include flow bands, axiolites, mottles and flow breccia. These are primary structures formed at the time of solidification of the lava or shortly thereafter. Flow banding originated due to the segregation of minute dark minerals in different proportions

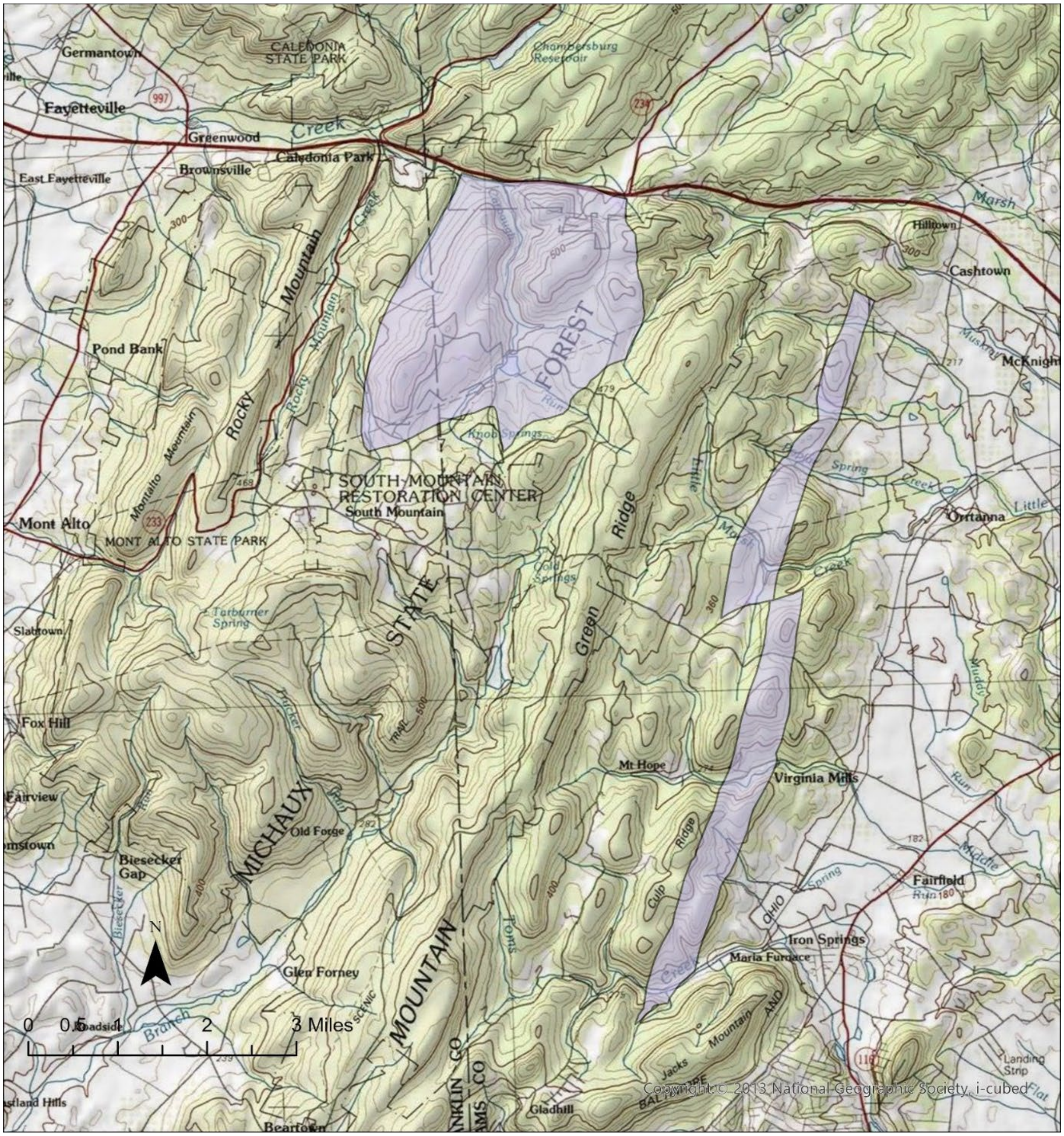

Figure 1. The Snaggy Ridge rhyolite occurs in two outcrop areas (shaded) in the South Mountain region of Pennsylvania. The unusual outcrop pattern is due to regional folding and faulting.

while suspended in the molten lava (Bascom, 1893). Flow banding ranges from laminae measuring several millimeters in width to bands several centimeters in width. The flow bands are typically parallel and continuous indicating laminar flow in the original lava prior to solidification.

Mottles are irregularly shaped light and dark regions that measure from several millimeters to several centimeters (Figure 3B). Mottling is formed by the segregation of microscopic dark-

Figure 2. The Big Obsidian Flow in central Oregon is about 1.5 miles long and 0.5 mile wide. Magma erupted on the left side of the photo and flowed like pancake batter to the right. The Snaggy Ridge rhyolite originated in a similar manner. Photo source: U. S. Geological Survey.

colored minerals from light-colored minerals when the original lava was in a molten state (Bascom, 1893). In thin section, the dark regions of the mottles can be seen to contain a greater amount of dark-colored magnetite and ilmenite that appears as a diffuse dusting.

Axiolites are thin zones of crystallization that contrast with the aphanitic matrix. Axiolites have the appearance of thin veinlets typically measuring 1 to 2 millimeters in width (Figure 3C). Axiolites often contain a thin central black line composed of gray crystalline quartz and iron-titanium oxides sandwiched between thin white lines composed of white crystalline feldspar. Axiolite bands occur in samples that also contain flow bands and often are a continuation of flow lines.

Flow breccias contain large subangular rhyolite clasts embedded in a rhyolitic matrix (Figure 3D). Flow breccias occur at multiple stratigraphic horizons within the Snaggy Ridge rhyolite. Flow breccia originated when the flowing lava formed a solidified crust that was subsequently fragmented and reincorporated into liquid lava. Flow breccias occur at the top of lava flows. The presence of flow breccias at multiple horizons indicates the presence of multiple stacked lava flows.

The color of the rock is most often dark gray. Other less common colors are bluish gray and grayish red. The gray and bluish gray color originated as sub-microscopic iron suspended in the original glassy matrix, and the grayish red color originated by alteration of the iron to the ferric state (Bascom, 1893).

Figure 3. Photographs of the Snaggy Ridge rhyolite. (A) Porphyritic devitrified obsidian containing prominent white feldspar phenocrysts that contrast with dark gray aphanitic groundmass. (B) Mottled rhyolite with microscopic iron-titanium oxides segregated from felsic components. (C) Axiolitic rhyolite containing thin layers of crystalline feldspar and quartz within a dark gray aphanitic matrix. (D) Rhyolitic flow breccia with subangular breccia clasts in a rhyolitic matrix.

Outcrops occur along the crest of Snaggy Ridge in the Caledonia Park quadrangle (Figure 4) and along Little Marsh Creek in the Iron Springs quadrangle. An outcrop at the spillway of the Carbaugh Reservoir in the Iron Springs quadrangle contains columnar jointing (Figure 5) as described by Fauth (1968) and Reese (2012).

Figure 4. Outcrops of the Snaggy Ridge rhyolite occur on the crest of Snaggy Ridge. These snaggy-looking outcrops undoubtedly gave Snaggy Ridge its name.

Figure 5. Columnar joints at the Carbaugh Reservoir. Photo source: Reese (2012).

At many places, the rock has lost its original glassy character due to devitrification, a spontaneous process that occurs at the earth's surface. Other than devitrification, the rock is remarkably unaltered. It does not contain metamorphic minerals or metamorphic microstructures such as schistosity. Unlike some of the geologic units in the South Mountain region, the Snaggy Ridge rhyolite has not been metamorphosed (Tucker, 2024).

The Snaggy Ridge rhyolite has a relatively uniform cryptocrystalline matrix and often breaks with a conchoidal fracture. These characteristics are favorable for the manufacture of stone tools, and it was formerly quarried extensively by prehistoric Native Americans. The quarrying activities are evidenced by the presence of numerous shallow pits on Snaggy Ridge (Marr, 2018). Examples of projectile points manufactured from the Snaggy Ridge rhyolite are shown in Figure 6.

The prehistoric quarries are only found within the Snaggy Ridge rhyolite and not within other geologic units. Why was the Snaggy Ridge rhyolite the only rock body used for stone tools? The answer - it breaks with a conchoidal fracture that produces a sharp edge that can be crafted into tools for cutting and piercing. The conchoidal fracture is due to its uniform cryptocrystalline texture, which in turn is due to its origin as a glassy lava.

Figure 6. Prehistoric points recovered in an archaeological excavation at Snaggy Ridge conducted by the Pennsylvania Historical and Museum Commission led by Dr. Kurt Carr.

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