Sweeping Up: A Preliminary Geologic Map of Broomstick Ledges

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Introduction

Broomstick Ledges (BL) is part of the Northwoods public land preserve. Geologically, this area is in close proximity to the Eastern Border fault (EBf) and sits on the boundary between the sedimentary Hartford basin, part of the Newark supergroup, and the exotic accreted Bronson Hill terrane. At the end of the Triassic the land west of the EBf subsided, creating a rift valley. This failed rifting resulted in the Hartford basin. North of the Hartford Basin, the EBf represents the boundary between low-grade metamorphic rocks and high-grade metamorphic rocks of the Vermont and New Hampshire series respectively. Knowing this, BL is valuable in understanding the metamorphic grade disparity between Western and Eastern Connecticut. Geologic field mapping was conducted to characterize the main rock types of the region. The four main rock types were pegmatite, two-mica quartz schist, banded biotite quartz hornblende magnetite schist, and biotite quartz magnetic schist. The predominant strike direction is ~20-200 NE to SW. Field samples were powdered and pressed pellets were prepared for x-ray fluorescence (XRF) analysis to determine trace element content and genetic relationships of sampled rocks. Additionally, we conducted the first radiation survey of this area, measuring ionizing radiation produced by decaying U, Th, and K isotopes. This new mapping helps to clarify local bedrock geology and will be expanded to inform Connecticut tectonic history.

Methods

Geological field mapping was our primary method in order to create our preliminary map of the Broomstick Ledges. In BL we looked at different rock outcrops identifying the rock type and recording measurement at the outcrop. This information was compiled into StraboSpot in order to create our map in ArcGis. In addition, Field samples were collected from various rock outcrops. Field samples were then powdered, and pressed pellets were prepared for x-ray fluorescence (XRF) analysis to determine trace element content and genetic relationships of sampled rocks.

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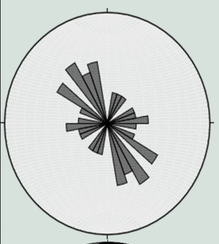

Figure 1. Stereographic projection of 25 quartz veins measurements, veins strike predominantly NW to SE.

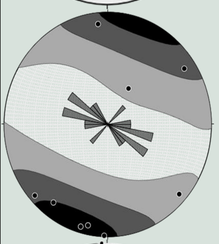

Figure 2. Stereographic projection of 9 joint measurements found in BL, joints strike NW to SE. Fractures open perpindicular to EBf.

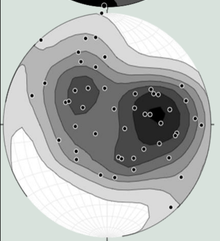

Figure 3. Stereographic projection of 49 poles to foliation measurements, predominant dip direction is NW, with poles clustering on right. A second major cluster is seen on left signifying SE dip and strike-parallel fold axes.

Map

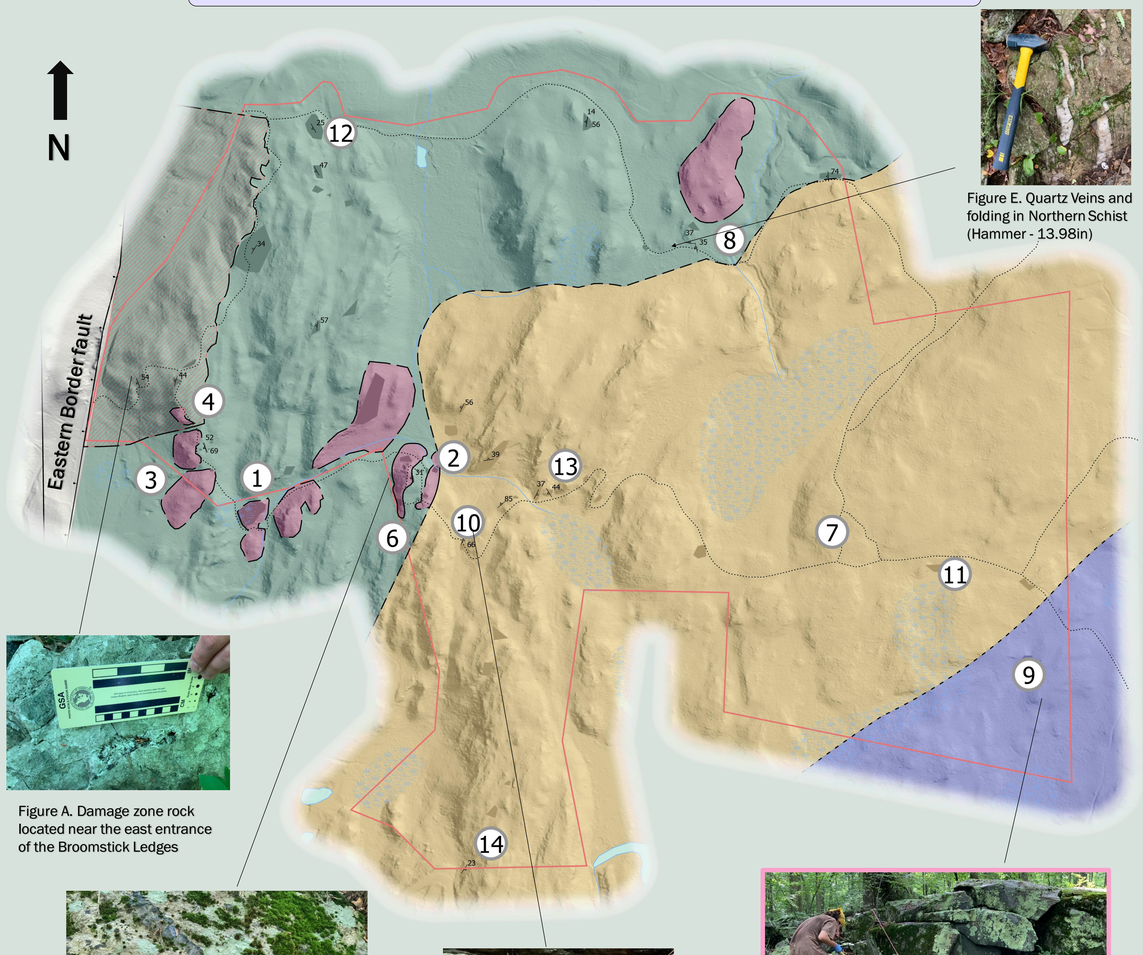

Figure E. Quartz Veins and folding in Northern Schist (Hammer - 13.98in)

Figure A. Damage zone rock located near the east entrance of the Broomstick Ledges

Figure B. Pegmatite with cross cutting quartz veins located at the center of the park

Figure C. Banded layers that are seen in Central schist (Hammer - 13.98in)

Figure D. Guy at an outcrop of Southeastern Schist (Guy - 73in)

Trails

Contacts and Faults

Confidence (m)

- 0
- 25
- 5
- 50

Normal Fault

Park Boundary

Geochemical Samples

Planar Orientation

foliation

Lithology

- Central Schist
- Pegmatite
- South East Schist
- North Schist
- Damage Zone
- Rock Outcrop

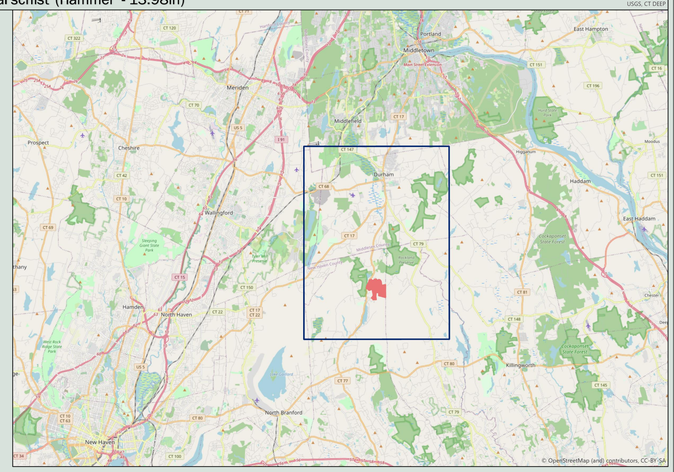

Figure 4. Geologic field map of Broomstick Ledges (up). Context map with Durham Quadrangle in blue (right). North Schist is characterized as a two-mica quart schist and closely correlates to Rodger's Ordovician Collins Hill formation. South East Schist is characterized as a magnetic biotite dominant schist and closel correlates to Rodger's Ordovician Middletown formation. Central Schist is a banded magnetic hornblende biotite dominant schist that closely correlates to Rodger's metavolcanic Ordovician Collins Hill.

Geochemistry

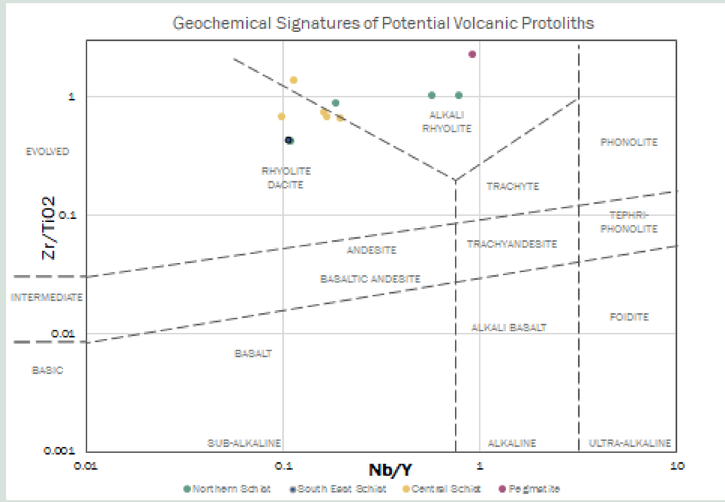

Figure 5. Geochemical plot of trace element data (Nb/Y) Vs. (Ga/SC) from samples of the Broomstick Ledges. Nb/Y is an indicator for alkaline , Za/TiO_2 is an indicator of the evolution from Mantle rock.

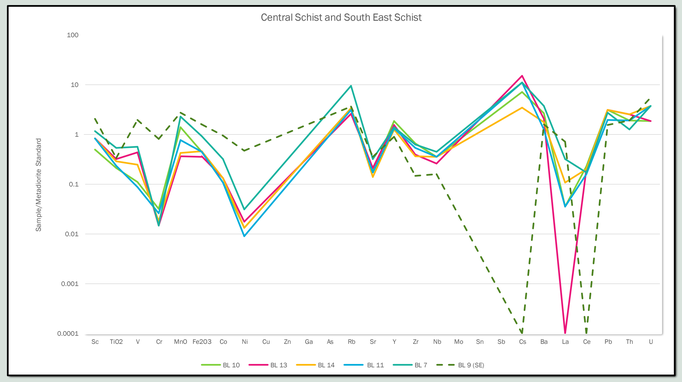

Figure 6. Geochemical plot of trace element data for Central and South East schist. South East schist is represented by the dotted line and in comparison to Central Schist.

Conclusion

Four main rock types Pegmatite, North schist, Central schist, and South East schist were found in our preliminary geologic field map of the BL. We categorized North schist as a two-mica quartz schist, Central schist as banded biotite quartz hornblende magnetite schist, and South East schist as a biotite quartz magnetite schist. Field observations such as grain size, rock texture, and mineralogy were corroborated with geochemical analysis. Rocks in the west of the BL are primarily of sedimentary origin like Middletown formation. Rocks to the eastern side of the preserve are more volcanic in origin like the rocks in the Collins Hill formation XRF major element analysis is required to gain a better understanding of rock makeup and genetic relationships. Additionally, Geologic field mapping in the immediate areas outside the preserve will provide a better understanding of contacts between rock types within, significantly increasing the accuracy of the map. Observed small scale folding in the field and some of the contact relationships in the map suggest large scale folding.

Citations

Allmendinger R.W. (2020) Stereonet Software Version 11.3.0

Borges, C. C. A., Toledo, C. L. B., Silva, A. M., Chemale, F., Jost, H., & Lana, C. de C. (2017). Geochemistry and isotopic signatures of metavolcanic and metaplutonic rocks of the Faina and Serra de Santa Rita greenstone belts, Central Brazil: Evidences for a Mesoarchean intraoceanic arc. Precambrian Research, 292, 350–377. https://doi.org/10.1016/j.precamres.2017.02.017

Hastie, A. R., Kerr, A. C., Pearce, J. A., & Mitchell, S. F. (2007). Classification of Altered Volcanic Island Arc Rocks using Immobile Trace Elements: Development of the Th–Co Discrimination Diagram. Journal of Petrology, 48(12), 2341–2357.

Rodgers, John (1985) Bedrock Geological Map of Connecticut. CGNHS