Bedrock Geologic Map of The Old Mine Park Area, Trumbull, Connecticut

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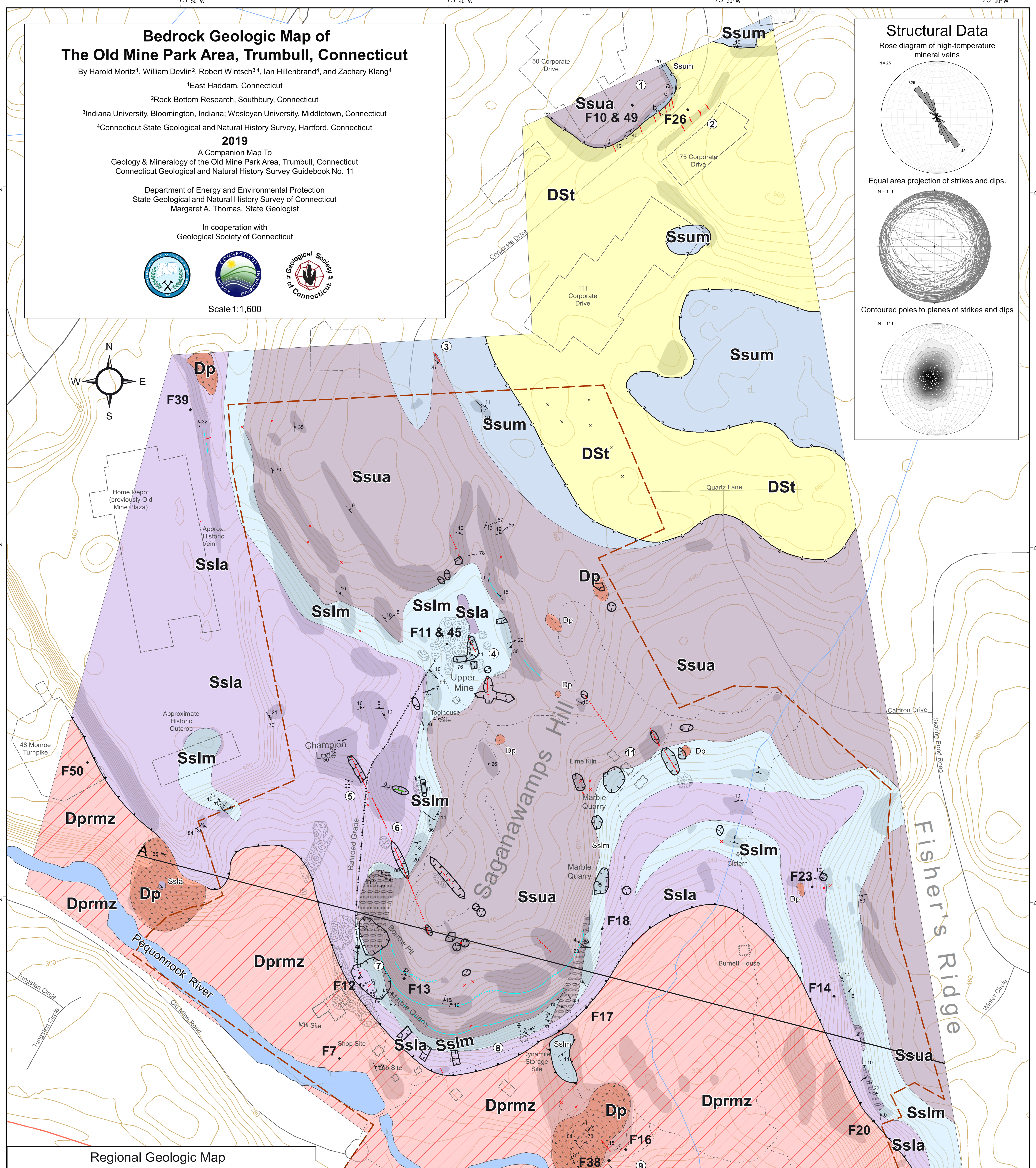
A Companion Map To
Geology & Mineralogy of the Old Mine Park Area, Trumbull, Connecticut
Connecticut Geological and Natural History Survey Guidebook No. 11

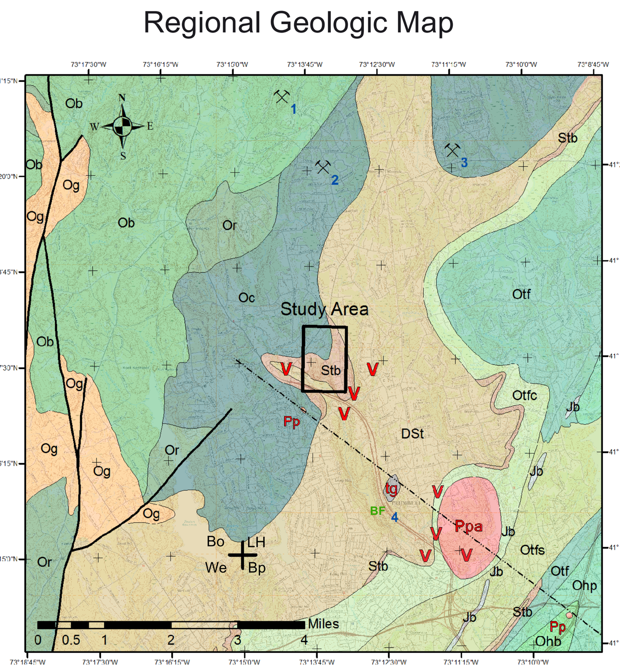
Department of Energy and Environmental Protection
State Geological and Natural History Survey of Connecticut
Margaret A. Thomas, State Geologist

In cooperation with
Geological Society of Connecticut

Scale 1:1,600



Regional Geologic Map



Regional geologic map showing the study area's context with nearby geologic formations based on Crowley (1968) and Rodgers (1985). High-temperature mineral veins found or reported outside the study area are shown as are nearby historic mines and a small mineralized brittle fault. The alignment of the Permian Pinewood intrusive suite (Ppa and 2 small porphyries), as shown by a dashed line, passes near the study area and parallels the major trend of high-temperature mineral vein traces. Bold black lines depict probable early Mesozoic brittle faults.

Regional Geologic Map Legend

Bedrock Formations (modified from Crowley, 1968 and Rodgers, 1985)

tg	tonalitic gneiss (Crowley, 1968)
Jb	Buttress Diabase
Pp	porphyritic intrusives
Ppa	Pinewood Adamellite
DSt	The Straits Schist
Stb	The Straits Schist basal member
Ob	Brookfield Orthogneiss
Oc	Collinsville Formation
Og	unnamed orthogneiss
Ohb	Harrison Orthogneiss Beardsley member
Ohp	Harrison Orthogneiss Pumpkin Ground mbr.
Otf	Trap Falls Formation
Otfc	Trap Falls F. Carrington Pond member
Otfs	Trap Falls Formation schist member
Or	Ratlum Mountain Formation

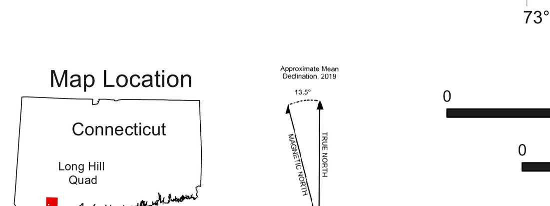
7.5-minute Quadrangles

Bp	Bridgeport
Bo	Botsford
LH	Long Hill
We	Westport

Symbols

- 1 Lane's Copper Mine
- 2 Lane's Bismuth Mine
- 3 Booth's (Lane's) Bismuth Mine
- BF 4 Mineralized brittle fault
- Trend of Permian (P) intrusive rocks
- V High-temperature mineral vein

Base map data from www.ct.gov/deep/gisdata
National Hydrography Dataset 2018 edition, 1:24,000
Pequonnock River digitized from 2016 Statewide LiDAR
Transportation 2006 edition, 1:24,000
Topography from 2011 DEM
Building locations from Open Street Map
Historic building locations from Hobbs W.H., 1901
Coordinate System NAD 1983, State Plane
Connecticut FIPS 0600 (US feet)
Datum: North American 1983



DIGITAL COMPILATION AND CARTOGRAPHY
Connecticut Geological Survey, Office of Information Management
Department of Energy and Environmental Protection
Melissa (Luna) Mostowy, Thomas Nosal, Ian Hillenbrand, Zachary Klang

Explanation

The Old Mine Park area of northern Trumbull in southwestern Connecticut includes a town-owned recreation area encompassing the mineral-rich *Saganawamps Hill* and surrounding residential, retail and commercial development. The bedrock exposed in the park and at some of the surrounding developments displays significant ductile deformation features and hosts multiple, distinct episodes of overlapping mineralization, some unique to the state and the region. The wooded and rocky 62-acre park preserves the first tungsten mine and the first topaz locality identified in the U.S., as well as the type locality for the mineral tungstite. Long before prospecting by European settlers, the term Saganawamps, after the Paugussetts' term for "on the side of the hill", alluded to a large vein of white "bull" quartz used by Native Americans. The hill became a locus for prospecting, quarrying and mining from about 1800-1900. Mining at Saganawamps Hill has varied from quarrying for agricultural lime and quartz, to gathering of minerals of scientific importance like scheelite, ferberite, tungstite and topaz, to attempted tungsten mining as recently as 1901.

The area hosts excellent exposures of Rodgers' (1985) lithologically heterogeneous, "basal member" of the Siluro-Devonian The Straits Schist (DSt). The protolith of The Straits Schist was a quartz-rich aluminous mudstone that Rodgers interpreted to overlie a regional (Silurian-Devonian) unconformity with Cambro-Ordovician Rowe-Hawley Zone metasediments. This erosional surface was interpreted as post-Taconic orogeny (post mid-Ordovician ~450 Ma). Detrital zircons from DSt indicate derivation from multiple sources, including peri-Gondwanan and Ordovician arc components (see Geochronology of Long Hill area, Trumbull, Connecticut). Hatch and Stanley (1973) recognized that the "basal member" represented an important lithostratigraphic and potentially time-stratigraphic marker and correlated the interval with the Russell Mountain Formation in southern Massachusetts. The Silurian "basal member" in Old Mine Park consists of a thick, well-exposed section dominated by amphibolite and marble plus minor quartzite and is informally referred to herein as the Saganawamps section. All rocks in western Connecticut were metamorphosed to upper amphibolite facies during the Acadian Orogeny (~400-360 Ma).

The Saganawamps section and DSt occur above this regional unconformity and are among the youngest meta-sediments preserved in western Connecticut. Although the Saganawamps section stratigraphically underlies DSt, exposures in the southeastern map area show that it was also structurally thrust over DSt during the Acadian Orogeny. The mapped thrust is associated with a syn-tectonic igneous unit designated herein as the Devonian Pequonnock River migmatite zone (Dprmz), an intrusive interval demarcated by granitic pegmatite with included screens of amphibolite and schist. Exposures in the map area show the Saganawamps section in contact with both DSt and Dprmz. A separate episode of diapiric granitic pegmatites intruded the DSt, Dprmz and Saganawamps section subsequent to Dprmz emplacement.

Approximately 100 million years after the Acadian Orogeny, renewed heating and associated stresses during the Alleghanian Orogeny are recorded in the area by a regional trend of Permian intrusives (inset **Regional Geologic Map**) with associated metasomatic alteration of the amphibolites in the Saganawamps section. This intrusive episode also included the emplacement of ~1m thick, steeply-dipping, high-temperature hydrothermal mineral veins. The Old Mine Park area lies within a ~N40°W alignment of undeformed Permian intrusives that includes the Pinewood Adamellite (291 ± 4 Ma (Sevigny and Hanson, 1993)). The strikes of the high-temperature hydrothermal veins cluster around a similar orientation. These coarse-grained, compositionally-zoned veins contain primarily quartz, muscovite, topaz and/or albite and fluorite variety chlorophane (a rare few contain primarily calcite). They probably crystallized above 400°C, or before about 275 Ma, with the veins cooling down to below 350°C by about 267 Ma. These veins were the locus of commercial quartz mining at the Champion Lode and mineral specimen collecting. Similar veins are present in and around the Pinewood Adamellite. Proximal metasomatic alteration of host amphibolite to phlogopite, scapolite and albite, with traces of scheelite, is similar to, and apparently related to, discontinuous zones of metasomatically altered amphibolite characterized by very coarse-grained quartz, clinozoisite, scapolite, albite and/or scheelite. Other rock units appear unaffected. One limited zone of altered amphibolite situated in the northern part of Old Mine Park shows replacement of scheelite crystals by ferberite and some subsequent weathering to tungstite. It was the locus of the short-lived tungsten mining attempt. The chemical and structural correlation between middle Permian intrusive bodies, high-temperature vein emplacement and amphibolite metasomatic alteration suggests that a body of felsic rock of comparable age underlies the park. Fluids rising from it invaded fractures upon its emplacement, bringing late mineralizing fluids to the park area.

Early Mesozoic crustal extension, Triassic sediment loading and Jurassic brittle-faulting/hydrothermal mineralization heated the rocks for a third time. Mesozoic brecciated, brittle faults in the map area, many of which were only temporarily exposed during area land development, host low-temperature hydrothermal mineralization consisting primarily of calcite, fluorite, quartz, sphalerite, galena and pyrite. While exposed they produced a wealth of mineral specimens.

Map Units

Dp — **Devonian Pegmatite:** Very coarse- to medium-grained, massive, unzoned granite pegmatite, composed of albite, quartz and microcline with accessory muscovite, annite, and rarely schorl. Present mostly as two large bodies intruding into the Pequonnock River migmatite zone, but also as small bodies throughout the map area.

Dprmz — **Devonian Pequonnock River migmatite zone:** Zone of medium- to coarse-grained granitic pegmatite locally intermixed with and/or graded or infused into fragments of the adjacent lower amphibolite unit of the Saganawamps section and The Straits Schist. The igneous host forms the bulk of the exposed bedrock but also preserves the foliation found in the metamorphic fragments, which are typically semi-conformable or preserved in their general structural position relative to the surrounding map units.

DSt — **Devonian – Silurian The Straits Schist:** Uniform, medium- to coarse-grained, rusty weathering garnet-plagioclase-biotite-muscovite-quartz schist. Schistosity is usually irregular, with abundant quartz and/or pegmatite boudins.

Saganawamps section

Informal Member Names

Ssum — **Silurian upper marble unit:** The term "marble" is used to describe calcite-rich rocks in the section. The upper marble is a white to grey, fine- to medium-grained, locally quartz-rich and/or feldspar-rich marble. The unit also contains variable amounts of accessory minerals (grossular, diopside, actinolite, titanite). Feldspathic quartzite occurs below the contact with the Devonian-Silurian The Straits Schist.

Ssua — **Silurian upper amphibolite unit:** Dark grey to black, fine- to medium-grained amphibolite to amphibole gneiss composed of magnesio-hornblende and plagioclase with accessory quartz and biotite. Locally may show zones of altered composition rich in quartz, clinozoisite, scheelite, marialite and/or albite. Iron and copper-iron sulfides are also locally present. Up to 3 marble interlayers, generally less than 1 m thick but up to 2 m thick, occur in this unit and these calcareous layers can include thinner, laterally persistent quartz-feldspar layers/boudins. Pattern delineates areas of mappable boudins characterized by finer-grained margins, and tight to isoclinal folds and generally coarser-grained, massive-textured interiors.

Sslm — **Silurian lower marble unit:** Lithologically similar to the upper marble in places (e.g. the upper mine area), but mostly coarsely crystalline marble that contains numerous, laterally persistent quartz-feldspar layers and boudins. Individual quartz-feldspar layers are generally <10 cm thick, but are typically grouped into packages of multiple, closely-spaced layers separated by zones of marble. Also includes a few amphibolite layers (<30 cm) too small to map.

Ssla — **Silurian lower amphibolite unit:** Similar to the upper amphibolite unit but can include multiple packages of quartz-feldspar layers and boudins as observed outside of park west of Home Depot. Locally may show zones of altered composition rich in quartz, clinozoisite, actinolite, scheelite, marialite and/or albite. Iron and copper-iron sulfides are also locally present. A massive quartz-clinozoisite-scheelite layer 0.1 to 0.5 m thick is locally present at the top of this unit, which at the upper mine area includes ferberite pseudomorphs after scheelite crystals. Locally includes mappable interlayers or boudins of lower marble unit. Pattern delineates areas of mappable boudins characterized by peripheral deformation and generally coarser-grained, massive-textured interior.

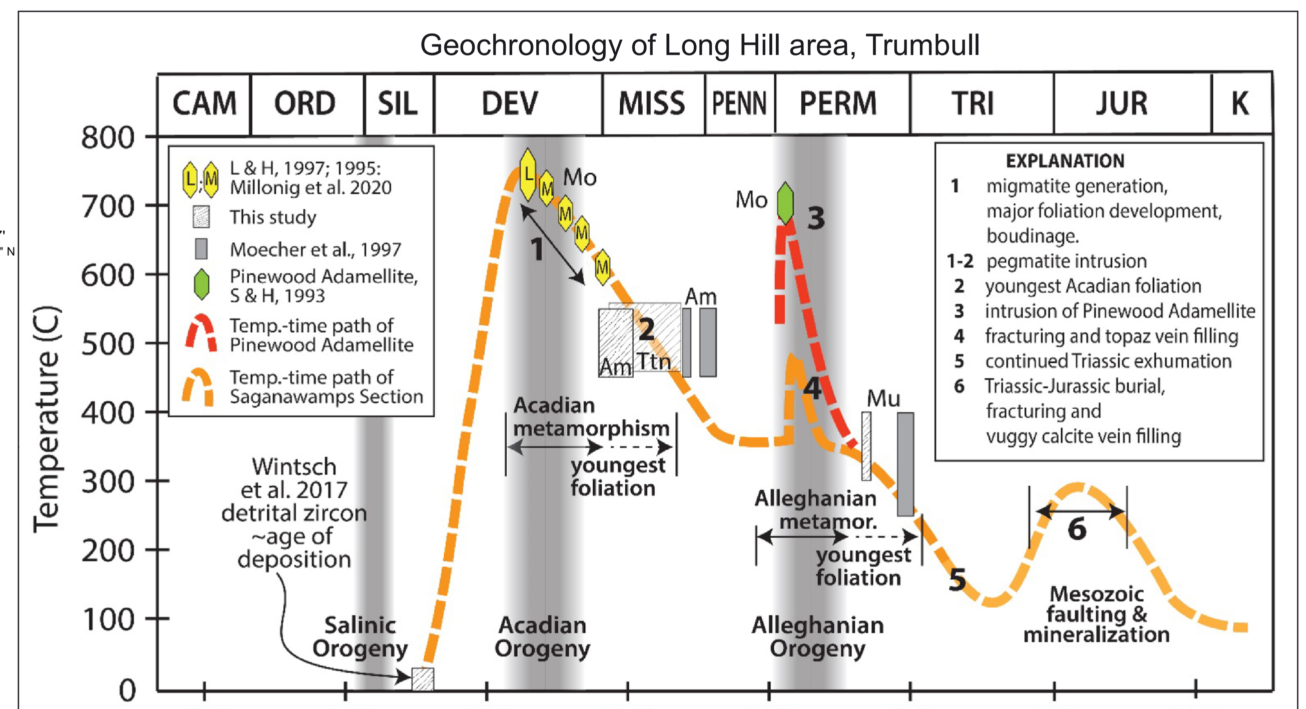
High-Temperature Mineral Veins

Typically <1m thick, planar, steeply-dipping, non-brecciated veins composed primarily of variable amounts of quartz, topaz (or margarite alteration of topaz), albite, muscovite, and/or fluorite variety chlorophane. Rarely, calcite is the dominant mineral. Accessory minerals include marialite, clinochlore, beryl, fluorapatite, scheelite, metallic sulfides, and/or ilmenite. Usually coarse - to very coarse-grained and strongly compositionally zoned with muscovite in a wall zone, topaz/albite/chlorophane in an intermediate zone, and quartz in a core zone. Fine-grained scheelite and fluorapatite may be present along the vein/host-rock contact, visible only under short-wave ultraviolet light. Calcite-dominant veins have a wall zone of albite, marialite, quartz, pyrrhotite and/or beryl. Open spaces are rare and generally <2 cm but commonly host euhedral crystals of topaz, albite, clinochlore and/or muscovite. Small crystals and/or thin, inter-grain coatings of calcite, pyrite and fluorite from a later low-temperature hydrothermal event may also be present. Amphibolite host rock typically shows metasomatic alteration zones containing fine- to medium-grained phlogopite and marialite within ± 10-20 cm of the vein contact. Mapped float indicates proximity to vein source.

Symbols

Inclined foliation and layering	Cataclastic Foliation	High-temperature Mineral Vein	Old Mine Park Boundary
Horizontal foliation and layering	Foliation in Schlieren	High-temperature Mineral Vein (Concealed)	Trails
Joint	Joint filled with Chlorite	Brittle Fault (quartz,clinochlore)	Inferred Fault
Silicified Fault Breccia	Axial Plane	Marble Interlayer	Pits and Quarry Walls
Contact	Fold Axis	Marble Interlayer (Concealed)	Historic Structure
Amphibole Lineation	L-Tectonite Penetrative Lineation	Contact	Modern Structure
Trench	Adit	Contact (Location approx.)	Outcrop
Float	Thermochronology locality (Moritz et al. 2022) a,b	Thrust Fault	Mining Dump
Mineral Vein float	Field Guide Photograph Site F12	Line of Section	Field Guide Stop

Geochronology of Long Hill area, Trumbull



The temperature – time path for the history of the rocks of the Long Hill area. It is established by joining the numerical geochronological and thermochronological data from this study (see Appendices II and III) and from the cited literature (see guidebook text) with metamorphic, structural and cross-cutting relationships observed in the field. The time ranges for 3 well-known orogenies are indicated by the vertical shaded zones. Abbreviations: Am – amphibole, Mo – monazite, Mu – muscovite, Tnt - titanite. References in Moritz et al. (2022).

Geochronology and Thermochronology

Location	Unit	Mineral	Method	Age(Ma)*
a	upper amphibolite	Titanite	U-Pb	346 ± 13
a	upper amphibolite	Amphibole	$^{40}Ar/^{39}Ar$	355 ± 3
b	high-temperature mineral vein	Muscovite	$^{40}Ar/^{39}Ar$	266.7 ± 1.4

*Moritz et al. 2022

Acknowledgements

Scientific contributions from Shinae Lee, SookJu Kim, and Keewook Yi for U-Pb SHRIMP analyses of titanite grains, and Ryan McAleer for $^{40}Ar/^{39}Ar$ cooling ages of amphibole and muscovite, are sincerely appreciated as they enhance the value of the map and provide context for its use in regional mapping efforts.

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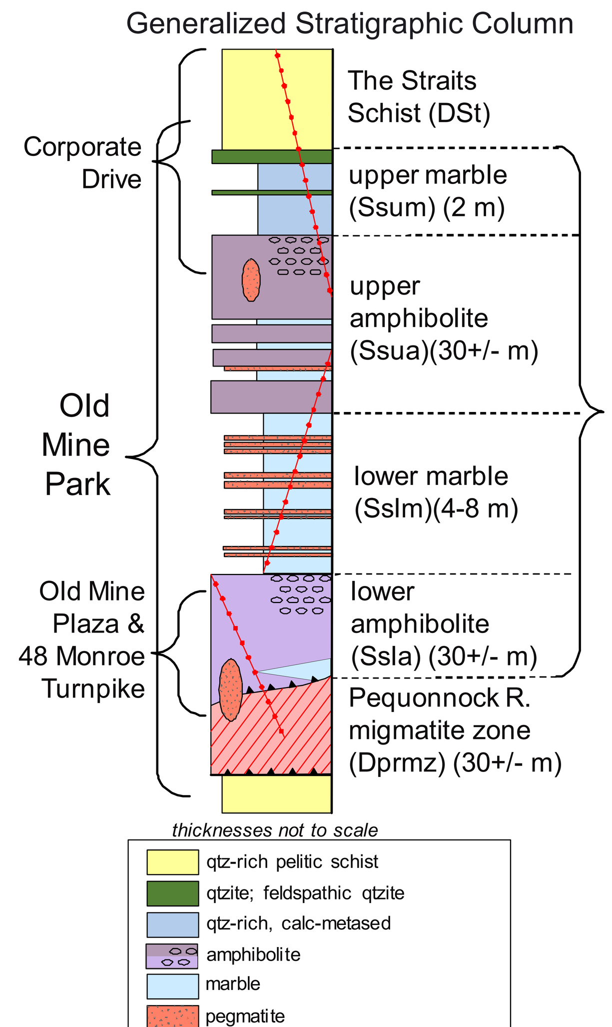
Moritz, Harold; Wintsch, Robert P.; Devlin, William; McAleer, Ryan J.; Shinae Lee; SookJu Kim and Keewook Yi, 2022, Geology and Mineralogy of the Old Mine Park Area, Trumbull, Connecticut: State Geological and Natural History Survey of Connecticut Guidebook No. 11, 76 Pages

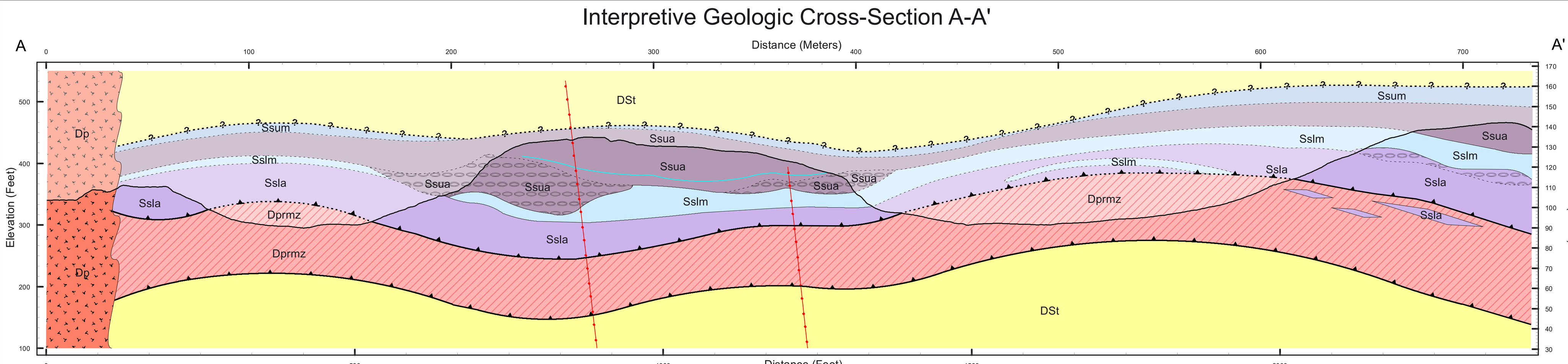
Rodgers, John (compiler), 1985, Bedrock Geological Map of Connecticut: State Geological and Natural History Survey of Connecticut, scale 1:125,000. 2 Sheets

Generalized Stratigraphic Column



Generalized depiction of the interpreted stratigraphic succession for the rocks exposed in the study area. Thicknesses for the 2 marble units were measured in the field, while the ranges in thickness for the amphibolites were derived from map and cross-section compilation. Most notable thickness variations are observed in the zone of boudinage. High-temperature mineral veins collectively penetrate all the rock units, but any single one may not so multiple short veins are shown. The portions of the column exposed in different parts of the study area are indicated at left.

Interpretive Geologic Cross-Section A-A'



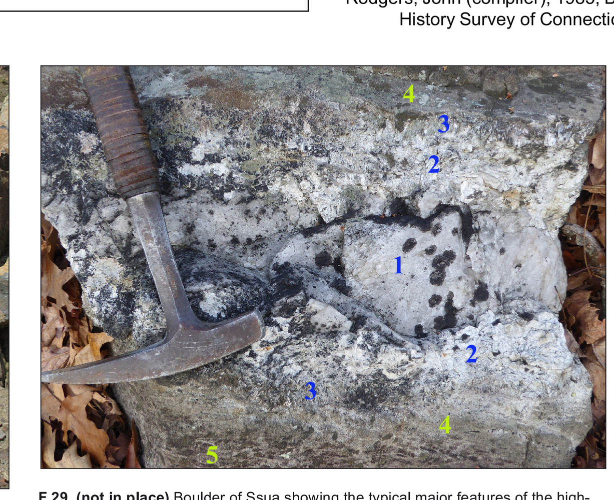
The cross-section shows the gently folded stratigraphic section exposed in the Old Mine Park area. The amphibolites and marbles are collectively referred to as the Saganawamps Section in the map area, and regionally equate to the "basal member" of The Straits Schist in Connecticut and the Russell Mountain Formation in southern Massachusetts (Rodgers, 1985). Saganawamps Section (Ss) members comprise a well exposed, generally consistent stratigraphic package that is overlain by The Straits Schist (DSt). Ductile deformation of the section during the Acadian Orogeny is expressed at a range of scales, but is best displayed on the section by outcrop-scale boudinage in the amphibolites (oval pattern on section) above and below the lower marble member with concomitant ductile thickness changes in the marble. On the E end of the section The Straits Schist occurs below the lower amphibolite member indicating thrusting of the whole stratigraphic package over DSt along the intervening Pequonnock River migmatite zone (Dprmz). Inclusions of amphibolite and schist within the Dprmz exhibit a high degree of localized deformation. Devonian pegmatite diapirs cut the metamorphic rocks, as do Permian high-temperature mineral veins.

Selected Photographs from Guidebook No. 11 - Moritz et al. 2022

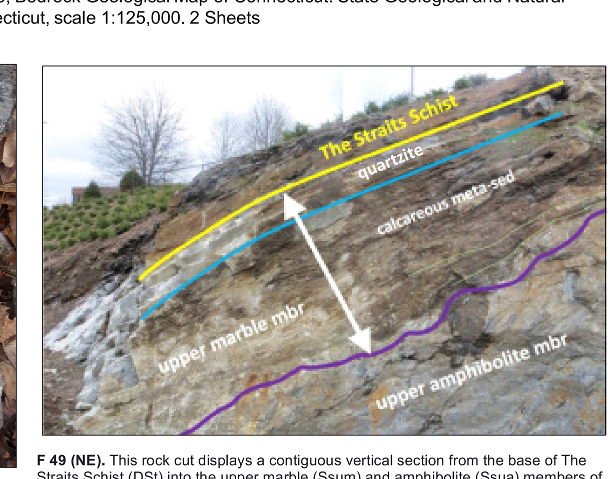
F 12. Wall of the marble quarry SW side of Saganawamps Hill showing nearly the full 8-meter thickness of the lower marble member of the Saganawamps section (Sslm). Multiple packages of white albite-quartz layers can be traced along much of the hill's adjacent outcrops. The impure marble appears grayish from the presence of calcsilicate minerals such as diopside, grossular, actinolite and phlogopite. At lower right is a cavity excavated by the tungsten miners in search of the ferberite-rich layer at the top of the underlying amphibolite. The mill complex was located opposite this approximately 15 m wide view. (H. Moritz photo).

F 18. Ductile deformation in lower marble member (Sslm) situated in the neck region between two very large upper marble member (Ssua) amphibolite boudins. Location is north (right) of the view in Figure 17. 18-cm hammer head in moss at bottom for scale. (H. Moritz photo).

F 27. (off map) Excellent exposure of about 1 m wide high-temperature mineral vein oriented N22°W, 74°SW cross-cutting amphibolite foliation oriented N65°W,74°E. It is located in a cut into amphibolite outside the study area behind 41 Monroe Turnpike west of Route 111. This vein is mostly quartz with albite, chlorophane, and muscovite along the contact and is similar to what the vein in the mined-out Champion Lode in the park would have looked like. (H. Moritz photo).



F 29. (not in place) Boulder of Ssua showing the typical major features of the high-temperature mineral veins. From the center are:
1.) Core zone of massive milky quartz.
2.) Outer core zone of chalky white, very coarse-grained albite crystals (in others mostly topaz and fluorite).
3.) Muscovite wall zone (with some marialite, hard to see here).
4.) Altered amphibolite contact zone of fine-grained marialite and phlogopite.
5.) Unaltered amphibolite.
At a minimum, a high-temperature vein can consist of just the muscovite wall zone and the altered, host amphibolite contact zone. Besides the planar geometry,these features distinguish the veins from the many granitic pegmatites, which do not show them. Hammer head is 18 cm. (H. Moritz photo).



F 49 (NE). This rock cut displays a contiguous vertical section from the base of The Straits Schist (DSt) into the upper marble (Ssum) and amphibolite (Ssua) members of the Saganawamps section. This is the best exposure of the upper marble unit, which is a quartz-rich, calcareous metasediment overlain by a 30 cm quartzite at this locality, best examined at the NE corner of the cut. Along the NW-facing wall The Straits Schist is observed to cut down into the underlying stratigraphy, truncating the quartzite and upper marble layers until the schist directly overlies the upper amphibolite member. The latter exhibits local metasomatic alteration and variable scheelite content beneath the truncation. (W. Devlin photo)