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

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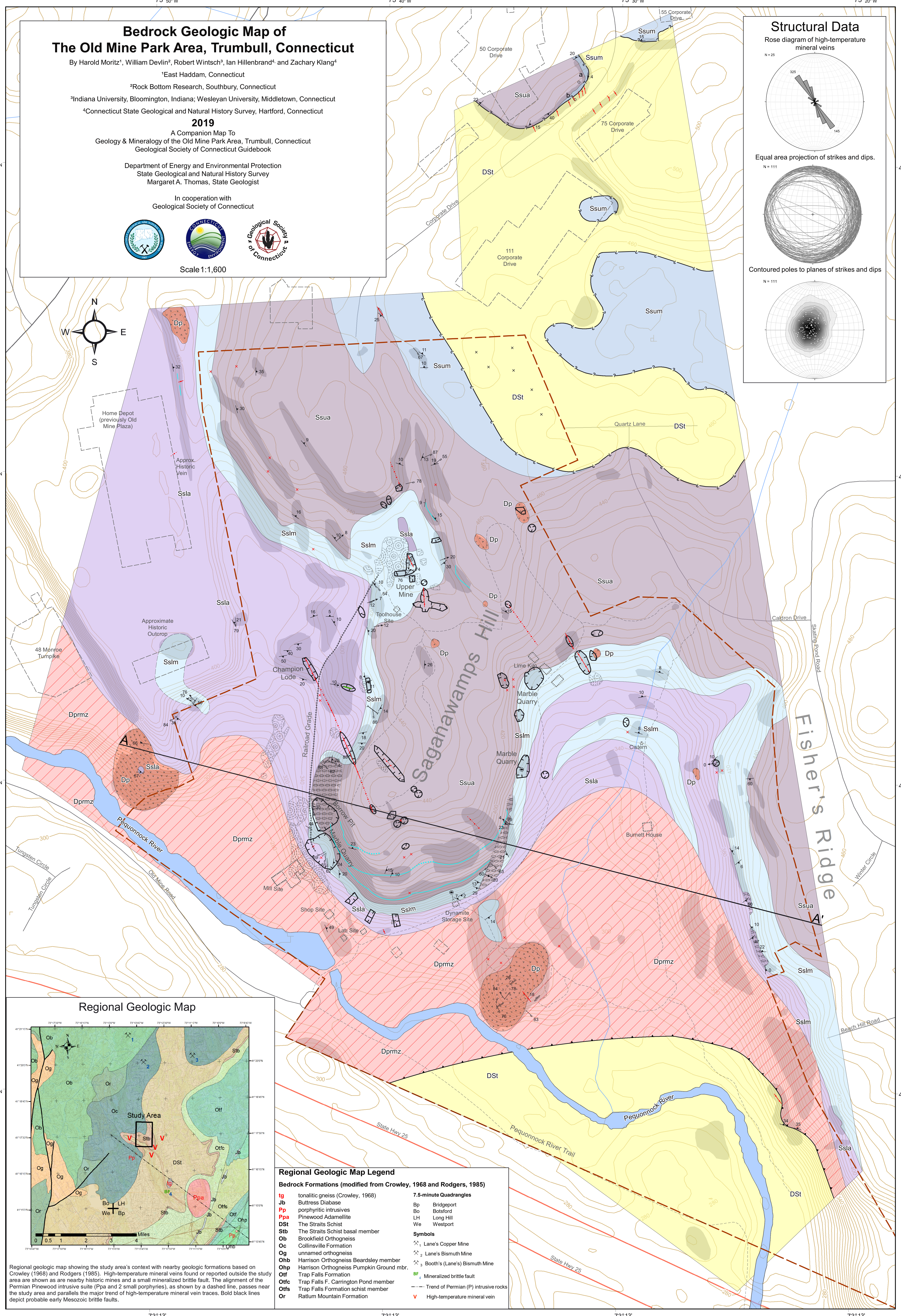
A Companion Map To
Geology & Mineralogy of the Old Mine Park Area, Trumbull, Connecticut
Geological Society of Connecticut Guidebook

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

In cooperation with
Geological Society of Connecticut

Scale 1:1,600



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

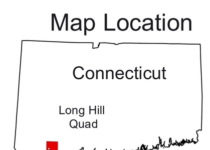
Bp	Bridgeport
Bo	Botsford
LH	Long Hill
We	Westport

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

Map Location



Approximate Mean Declination, 2019
13.5°
MAGNETIC NORTH
TRUE NORTH

0 200 400 600 800 1,000 Feet
0 50 100 150 200 250 Meters

DIGITAL COMPILATION AND CARTOGRAPHY
Connecticut Geological Survey, Office of Information Management
Department of Energy and Environmental Protection
Melissa Luna, 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 (Silliman, 1822a, b). Long before prospecting by European settlers, the term Saganawamps, after the Paugusetts' term for "on the side of the hill" (Sullivan, 1985), 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 Western 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. 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. 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 associated with 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 (see *Fundian* **Geochronology of Western Connecticut**). 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 and grading 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, actinolite, 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 isocinal 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.

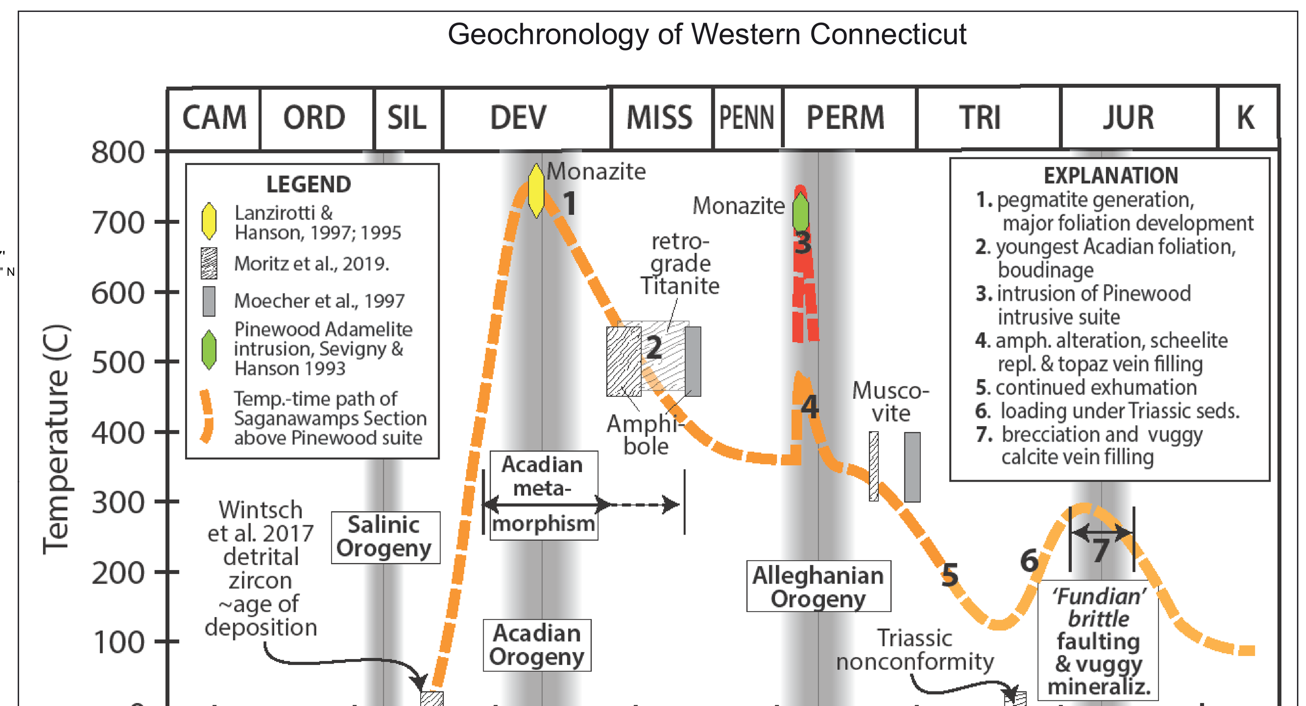
Permian High-Temperature Mineral Veins

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 the Jurassic *Fundian* low-temperature hydrothermal event may also be present. Amphibolite host rock typically shows metasomatic alteration zone 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
- Horizontal foliation and layering
- Joint
- Silicified Fault Breccia
- Contact
- Amphibole Lineation
- Trench
- Float
- Mineral Vein float
- Cataclastic Foliation
- Foliation in Schlieren
- Joint filled with Chlorite
- Axial Plane
- Fold Axis
- L-Tectonite Penetrative Lineation
- Adit
- Thermochronology locality (Moritz et al. 2019)
- High-temperature Mineral Vein
- High-temperature Mineral Vein (Concealed)
- Brittle Fault (quartz,clinochlore)
- Marble Interlayer
- Marble Interlayer (Concealed)
- Contact
- Contact (Location approx.)
- Thrust Fault
- Line of Section
- Old Mine Park Boundary
- Trails
- Inferred Fault
- Pits and Quarry Walls
- Historic Structure
- Modern Structure
- Outcrop
- Mining Dump

Geochronology of Western Connecticut



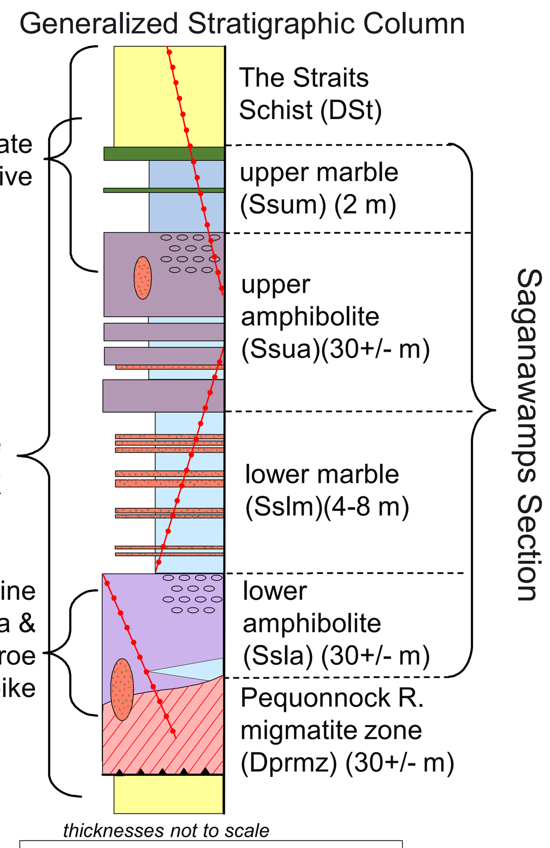
The temperature - time (T-t) path (orange dashed curve) for the metamorphic history of the rocks of the Long Hill area. It is established by joining the geochronological and thermochronological data from this study with data available in the literature (see text). Time ranges for three well-known orogenies are indicated with the shaded bars. The name "Fundian orogeny" for the loading by Mesozoic sediments on these rocks was coined by Wintsch et al. (2003). Peak temperature for the Acadian orogeny (1) is established by a monazite age. Cooling from the high temperature Acadian orogeny (path 1-2-5) was interrupted (path 3-4) by heat from the Permian (age of crystallization of monazite) intrusion of the nearby Pinewood Adamelite and related smaller bodies (see inset). References in Moritz et al. (2019).

Geochronology and Thermochronology

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

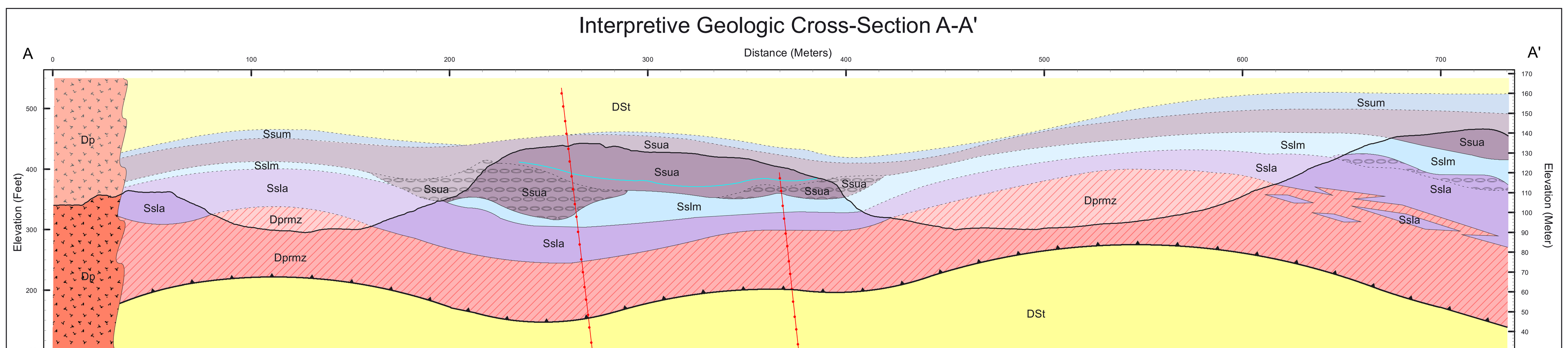
*Moritz et al. 2019

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.

Acknowledgements

Scientific contributions from Shinae Lee, SookJu Kim, and Keewook Yi for U-Pb SHRIMP analyses of titanite grains, and Ryan McAleer for 40Ar/39Ar 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.

Map References

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Fisher, Joseph O., 1942, Structure and origin of the old tungsten mine near Trumbull, Conn.: Unpub. MA thesis, Columbia U.

Hobbs, W. H., 1901, The old tungsten mine in Trumbull, Conn.: U.S. Geological Survey Annual Report 22, Part II, Plate 1.

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

Figure 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 calc-silicate 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).

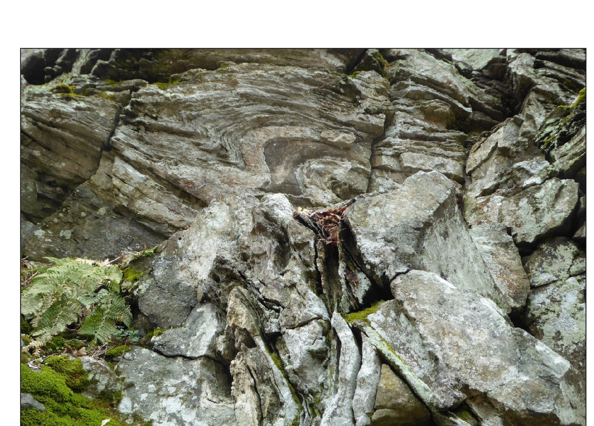

Figure 18. Ductile deformation in Sslm marble situated in the neck region between two very large amphibolite boudins. Location is along the contact of Sslm and Ssla on the east side of Saganawamps Hill. Hammer head in moss at bottom for scale. (H. Moritz photo).

Figure 27. 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. Located outside the study area behind 41 Monroe Turnpike (Edge Fitness) 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).

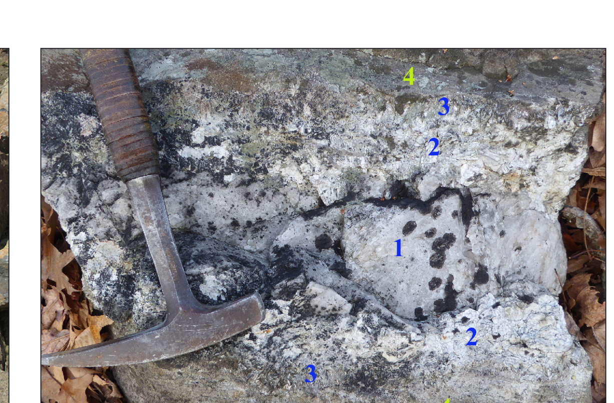

Figure 29. Boulder of Ssua showing the typical major features of the high-temperature mineral veins. From the center are:

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 vein can consist of just the muscovite wall zone and the altered, host amphibolite contact zone. These features distinguish these veins from the many granitic pegmatites, which do not show them. (H. Moritz photo).

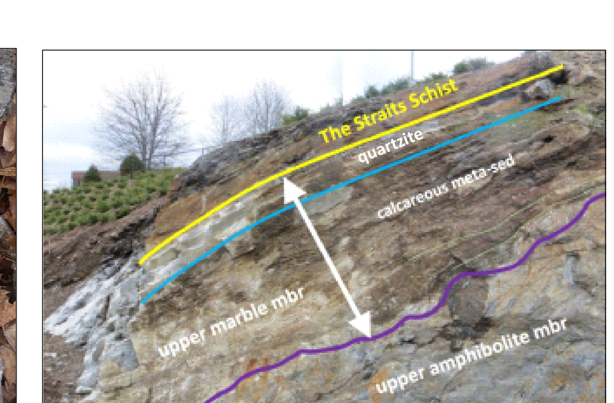

Figure 49 (NE). This rock cut displays a contiguous vertical section from the base of The Straits Schist (DSt) into the upper marble (Ssum) and amphibolite (Ssua) members of the Saganawamps Section. This is the best exposure of the Ssum which is a quartz-rich, calcareous metasediment overlain by a 30 cm quartzite at this locality, best examined at the NE corner of the cut. (W. Devlin photo)