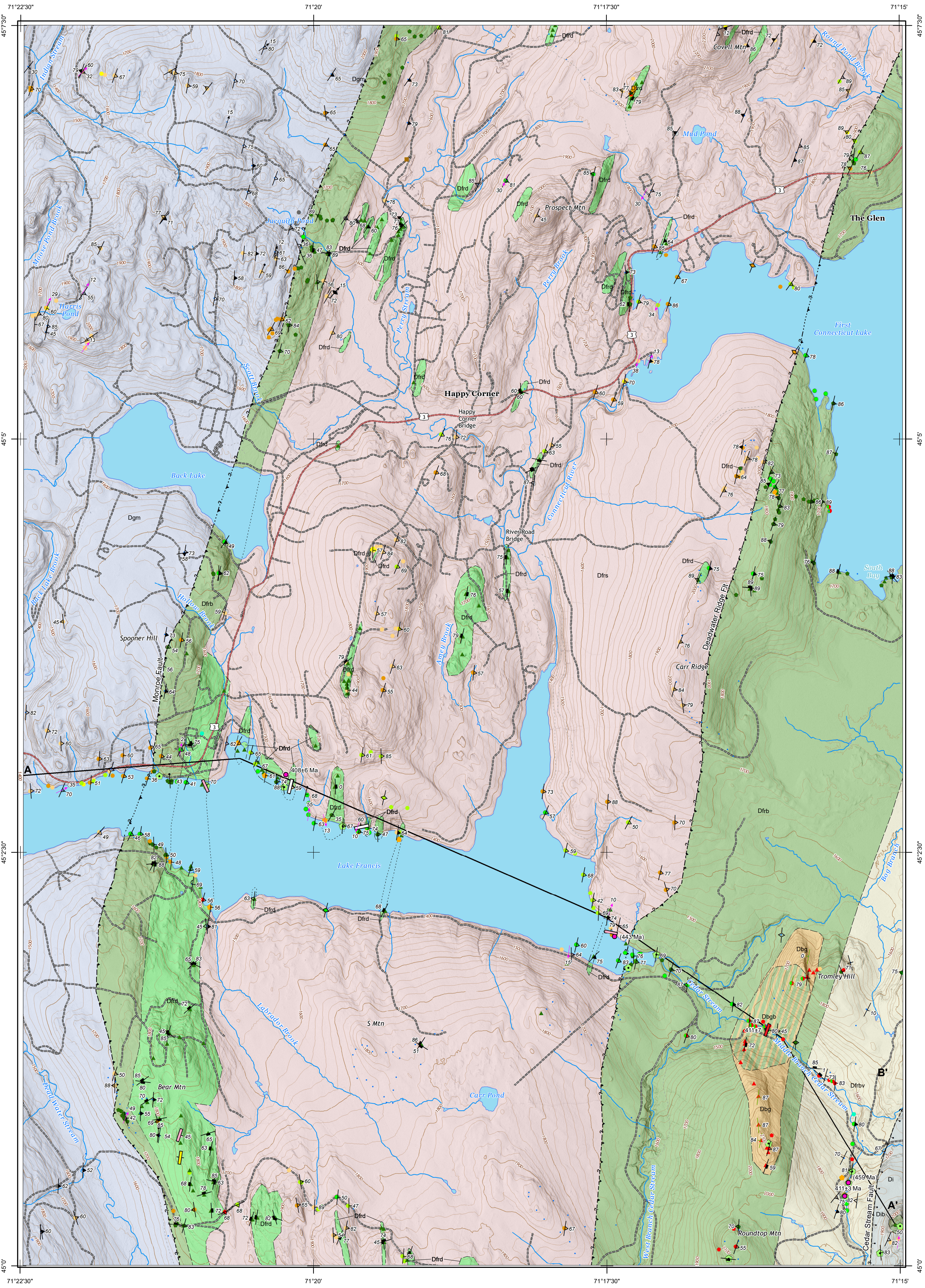
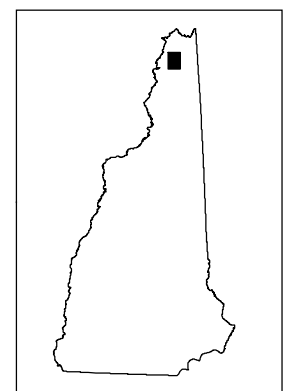


Bedrock Geologic Map of the Lake Francis 7.5' Quadrangle, New Hampshire, 2021

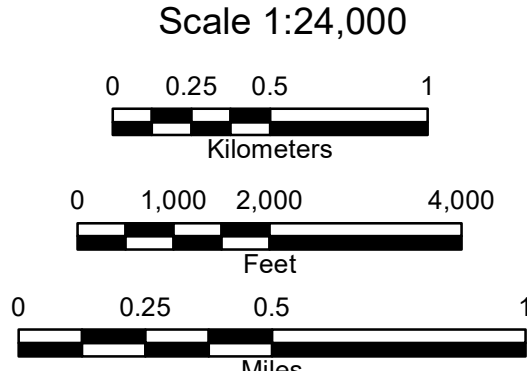


Monadnock Mountain	Coverly Hill	Second Connecticut Lake
Pittsburg	Lake Francis	Magalloway Mountain
Lowering Mountain	Diamond Pond	Mount Pisgah

ADJOINING QUADRANGLES



QUADRANGLE LOCATION



Topographic basemap from The National Map (USGS) vector base data, Lake Francis 7.5' quadrangle
Projection: North American Datum 1983 New Hampshire State Plane Feet.
Contour Interval 20 ft
Hillshade produced from high resolution (1 meter) LIDAR data

DESCRIPTION OF MAP UNITS

IGNEOUS AND META-IGNEOUS UNITS Mesozoic White Mountain Plutonic-Volcanic Suite

Basalt dikes — One-meter-thick dike of dark, fine-grained unmetamorphosed alkali basalt composed of plagioclase, dark brown hornblende, a fine-grained dark groundmass, opaques, augite, carbonate, and apatite. Located on northeast shore of Lake Francis northwest of the Cedar Stream Bay. Two additional unmetamorphosed dikes crop out along Cedar Stream along the western edge of the biotite granite.

Devonian?

Felsite Dike — One narrow (ca. 10-15 cm wide) broadly folded aphanitic felsite dike was located on the northwestern shore of Lake Francis. This unit predates the last folding event.

Early Devonian?

Ironbound Mountain Formation Metabasalt (?) — Fine- to medium-grained metabasalt forms ~40-50 m cliff in the southeastern corner of the Lake Francis Quadrangle. It contains possible pillows, flow structures, mineralized vesicles, and epidote knots as well as meter-scale folds. The volcanics are associated with a gray black phyllite and metasilstone unit that is visually similar to the Ironbound Mountain Formation. An attempt in 2021 to date these rocks failed due to a lack of zircon grains in the sample. Preliminary geochemical analysis suggests that this unit is more akin to the metabasalts near the Monroe Line than near the Deadwater Ridge Fault, but more analysis is required.

Early Devonian

Metamorphosed Biotite Granite — "Graphic" granite with spectacular exsolution of quartz in plagioclase (myrmekite) in thin section. Occurs as abundant sills in the metabasalt along Cedar Stream (as indicated by the green and orange striped pattern on the map and orange lines in the cross-section) and as less frequent, smaller sills on the southern shore of First Connecticut Lake. Occurs as larger granitic body on Tromley Hill where there are massive cliffs of 30-40 meters and to a lesser extent on Roundtop Mt. U-Pb age dating of zircon grains indicate an age of 411 ± 7 Ma, which is very similar to the age of the meta-igneimbrite described below. Along strike to the northeast (ca. 20 km) is the East Inlet Pluton (similar biotite granite) also associated as sills within metabasalt, which was dated at 430 ± 4 Ma (Lyons et al., 1986) using a whole rock U-Th-Pb method. We plan to analyze zircon grains from the East Inlet Pluton samples for U-Pb age dates to verify this date in the Spring.

Zone of abundant metamorphosed biotite granite sills intruding Frontenac Formation metabasalt — Represented as orange lines in the cross section.

Early Devonian Frontenac Formation metagneous units

The relationships between intrusive and extrusive metagneous rocks can be complex and subtle. An outcrop with abundant pillow metabasalts or meta-hyaloclastites or lapilli tuffs or ignimbrites that define extrusive activity, can also include coarse-grained metabasalt. Contacts between coarse-grained and finer-grained units often do not have an obvious chill zone. Three metagneous Frontenac members were defined:

Bimodal Metavolcanic Rocks — A bimodal unit with metabasalts, metadiorites, metadacites, metarhyolites and metaignimbrites all in close proximity, along the eastern edge of Cedar Stream. The source of the meta-ignimbrites (411 ± 7 Ma Zircon age-date) also is likely the biotite granite (411 ± 3 Ma) which intruded the underlying metabasalt sequence to west along Cedar Stream. The ignimbrite is indicated by a special symbol in the cross-section. A schematic feeder zone between the biotite granite and the ignimbrite is shown on the cross-section. As shown on the map, we attempted to date a mafic metavolcanic sample along Cedar Stream, but the zircon recovery was poor and the discordance high, so the 459 ± 16 Ma age is not reliable. To the northeast apparently along strike in the Second Connecticut

Meta-igneimbrite — Exposed in Cedar Stream. A schematic feeder zone between the biotite granite and the ignimbrite is shown on the cross-section.

Metadiabase — Dominantly coarser grained metadiabases to metabasalts that are sometimes associated with meta-lapilli tuffs, pillow basalts, metavolcaniclastic sediments and other extrusive features. Compositions are similar to the metabasalt unit (Dfrb). Outcrops range from thin sills to very large 30-40 m cliffs with lengths of kilometers. It was not possible to map all occurrences, particularly due to challenges in accessing private property. An adjacent lapilli meta-tuffaceous sediment (Dfrs) yielded an age date of 408 ± 6 Ma.

Metabasalt — Dominantly metabasalts with common pillows, meta-hyaloclastites (and more rare exhalative horizons) in thicker units just east of the Monroe Line and just east of the Deadwater Ridge Fault. The pillows range from less than 30 cm to 2-3 m in length; tops can often be determined. The meta-hyaloclastites are best exposed on the south shore of First Connecticut Lake. Compositions range from basalts and trachybasalts to basaltic andesites and basaltic trachyandesites. It seems likely that the metabasalt sequence is not much older than the metavolcaniclastic tuffaceous sediments of 408 ± 6 Ma.

METASEDIMENTARY ROCKS

Early Devonian

Ironbound Mountain Formation(?) — Gray black phyllite plus metasilstones that appear similar to the Ironbound Mountain Formation occur along the southeastern corner of the quadrangle. This lithologic correlation made over the years but is not yet supported by any age data. What is different from the typical Ironbound Mountain Formation in this area is the close association of the phyllites with a metabasalt unit described above. Outcrops are sparse, but about 4 kilometers northeast of the Lake Francis Quadrangle, there is well-exposed outcrop of similar lithology in an old gravel pit. The eastern side of the outcrop appears to be limited by a fault containing mineralized gouge.

Gile Mountain Formation — Gray to light brown weathering, variably calcareous feldspathic metasandstone in beds that are 0.5 - 3 m thick, meta-siltstone and dark gray phyllite. These units often carry ankerite and/or pyrite cubes up to 1 cm across, alteration of both minerals produces a reddish-brown weathering surface. Graded bedding is rarely preserved; brown weathering carbonate-rich lenses are present locally. Detrital zircons from the calcareous metasandstone at Murphy Dam yielded multiple U/Pb age date clusters with the youngest being 413 ± 18 Ma (maximum depositional age - not high quality) and a second maximum depositional age from the intersection of Route 3 and Tabor Notch Road of 411 ± 10 Ma. This unit is correlated with the Lac Drolet member (maximum depositional age of 413 ± 7 Ma along the Quebec-NH border - Perrot, 2019) of the Compton Formation and the Gile Mountain Formation (Dggs) in nearby Vermont.

Metasediments of the Frontenac Formation — Metasediments consist of metasilstones, metasandstones (sparse), phyllites and a wide range of volcaniclastic metasediments. Homogeneous metasilstone bed thicknesses can exceed 1-2 m thick. In some places, there are graded beds that preserve Bouma complets, which occasionally provide top directions, and rare calcareous lenses up to a meter in length. A distinct characteristic of much of the Frontenac metasediments is the presence of sufficient chlorite to provide a green color that is uncommon in the Gile Mountain metasediments. U-Pb zircon age dates from a metavolcaniclastic sediment / lapilli tuff on the north shore of Lake Francis indicate a maximum depositional age of ca. 408 ± 6 Ma. Age analysis of a sample from the northeast shore of Lake Francis near the Deadwater Ridge Fault with limited zircon recovery (very fine-grained metasediment) yielded a maximum depositional age of 443 ± 16 Ma that is likely significantly older than the depositional age. Comparison of the age distributions of zircon grains in the Frontenac and the Gile Mountain metasediments shows that the Frontenac metasediments have a unique peak around 382 Ma, suggesting a different sediment source at that time.

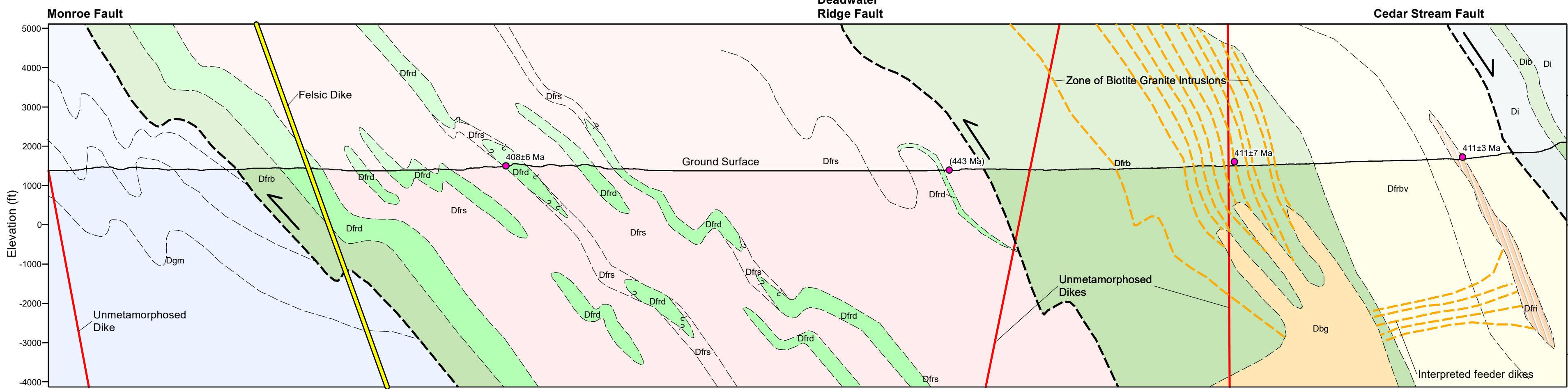
EXPLANATION OF MAP SYMBOLS

Planar features	Bedding	Foliation	Points
— Contact, certain	— Contact	S1	• Observation
- - - Contact, approximate	— Contact between biotite granite dike and metabasalt	S1, vertical	✕ Gravel pit
..... Contact, concealed	Bedding, inclined	S2	• Samples
- - - - - Questionable thrust fault, approximately located	Bedding, vertical	S2, vertical	• Geochemistry
..... Questionable thrust fault, concealed	Inclined graded bed, showing topping direction	Joint	• Preliminary Zircon U/Pb date (this study)
- - - - - Questionable normal fault, approximately located	Vertical, ball indicates topping direction	Joint, vertical	• Basemap features
— Massive (bull) quartz, inclined	Bedding, overturned	F2 fold axis	— US Route
— Dike, inclined	Indeterminate bedding and/or S1 foliation	Lineation	— Local Road
— Felsic dike, vertical			— Not Maintained
— Diabase dike, inclined			— Railroad
			— Lidar Contours (20-foot intervals)
			— Stream
			— Trail

EXPLANATION OF LITHOLOGY POINT SYMBOLS

• Black Phyllite	• Gray-brown Phyllite	• Meta-exhalative Horizon	• Meta-tuff and Pyroclastics
• Bimodal Igneous	• Green-gray Phyllite	• Meta-felsic Volcanic	• Meta-volcaniclastics
• Biotite Granite	• Halls Stream Grits	• Meta-felsic Intrusive	• Felsic Dike
• Bull (massive) Quartz	• Mafic Intrusive	• Meta-graywacke	• Quartz Breccia
• Gossan(?)	• Meta-basalt	• Meta-sandstone	• Mafic Dike
• Carbonate-rich rocks	• Meta-basaltic Andesite	• Meta-siltstone and Phyllite	

Interpretive Cross Section A - A' (No Vertical Exaggeration)



Bedrock Geologic Map of the Lake Francis 7.5' Quadrangle, New Hampshire

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Maps can be found at <https://www.des.nh.gov/land/geology>

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