TRIP B-6

GEOLOGY OF THE CONCORD QUADRANGLE

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Introduction

The Concord quadrangle in south-central New Hampshire is located on the southeast limb of the Merrimack synclinorium. It is underlain by metasedimentary rocks of the Littleton formation of Devonian age and igneous rocks of the New Hampshire plutonic series of late Devonian age (Billings, 1955). The entire area is in the sillimanite zone of regional metamorphism.

Geologic mapping of the quadrangle by the author is in progress and about three-quarters completed. Reports have been published for several of the adjacent quadrangles (Heald, 1955), (Sriramadas, 1966), and (Greene, 1971).

The Littleton formation has a very complex lithology which has led to some inconsistencies in subdivisions in surrounding quadrangles. Tentative identification of lower, middle, and upper units has been made in the Concord quadrangle. The typical rock is a gray quartz-oligoclase-mica schist, often having one or more of the following minerals in varying amounts: garnet sillimanite, orthoclase, chlorite, pyrrhotite, pyrite, graphite, tourmaline. Much of the rock is more appropriately termed a gneiss with numerous varieties represented. Quartzites and lime-silicate granulites are locally conspicuous. Weathering of iron-bearing minerals in some units has made them distinctive marker horizons. Evidence of retrograde metamorphism is widespread and biotite and garnet in particular have been replaced by chlorite, and sillimanite by muscovite.

The two largest igneous rock bodies consist of the earlier Kinsman quartz monzonite and the later Concord granite. The Kinsman quartz monzonite occurs as the Weare pluton trending north-south in the western half of the quadrangle and as other small isolated bodies throughout the quadrangle. It is generally a coarse-grained, porphyritic, strongly foliated rock consisting mainly of quartz, oligoclase-andesine, biotite, and orthoclase

phenocrysts which may reach 8-10 cm. in length. The Kinsman is intricately mixed with the Littleton throughout much of the quadrangle.

The Concord pluton is the main body of Concord granite and located in the northeast section of the quadrangle. The granite is a light-gray, fine-to-coarse-grained to subporphyritic rock composed of quartz, microcline, oligoclase-andesine, biotite and muscovite. A faint to strong planar structure in the granite is interpreted as a primary flow structure and can be related to a primary fracture system. This evidence, along with petrographic considerations, suggests a mode of emplacement by multiple forceful intrusions (Virgin, 1964).

Muscovite granite occurs as small bodies and dikes in the Concord granite and as larger masses in the surrounding schists, often associated with pegmatite and aplite. Pegmatite of several generations is present but most appears to be genetically related to the Concord granite. Lamprophyre dikes are common and cross-cut all other rock types in the area.

The dominant structure in the schist is a foliation which has a variable strike to the northeast and dips moderately to the northwest. Mineral lineations on the schistosity are common and strike northwest with a gentle plunge to the northwest. Small scale faulting has been extensive but one large silicified zone, which may be a fault zone, cuts diagonally across the lower part of the quadrangle.

References Cited

Billings, M. P. (1956) Geology of New Hampshire: Part II -- Bedrock Geology: New Hampshire State Planning and Development Commission, 203 pp.

Balk, R. (1937) Structural behavior of igneous rocks: Geol. Soc. America Mem. 5, 177 p.

Heald, M. T. (1955) The geology of the Gilmanton quadrangle, New Hampshire: New Hampshire State Planning and Development Commission, 31 p.

Sriramadas, A. (1966) The geology of the Manchester quadrangle, New Hampshire: Bulletin No. 2: New Hampshire Department of Resources and Economic Development, 78 p.

Greene, R. C. (1971) The geology of the Peterborough quadrangle, New Hampshire: Bulletin No. 4: New Hampshire Department of Resources and Economic Development, 88 p.

Virgin, W. W. Jr. (1964) The structure and petrography of the Concord granite in the Concord area, New Hampshire. Lehigh University. Unpublished Ph.D. thesis.

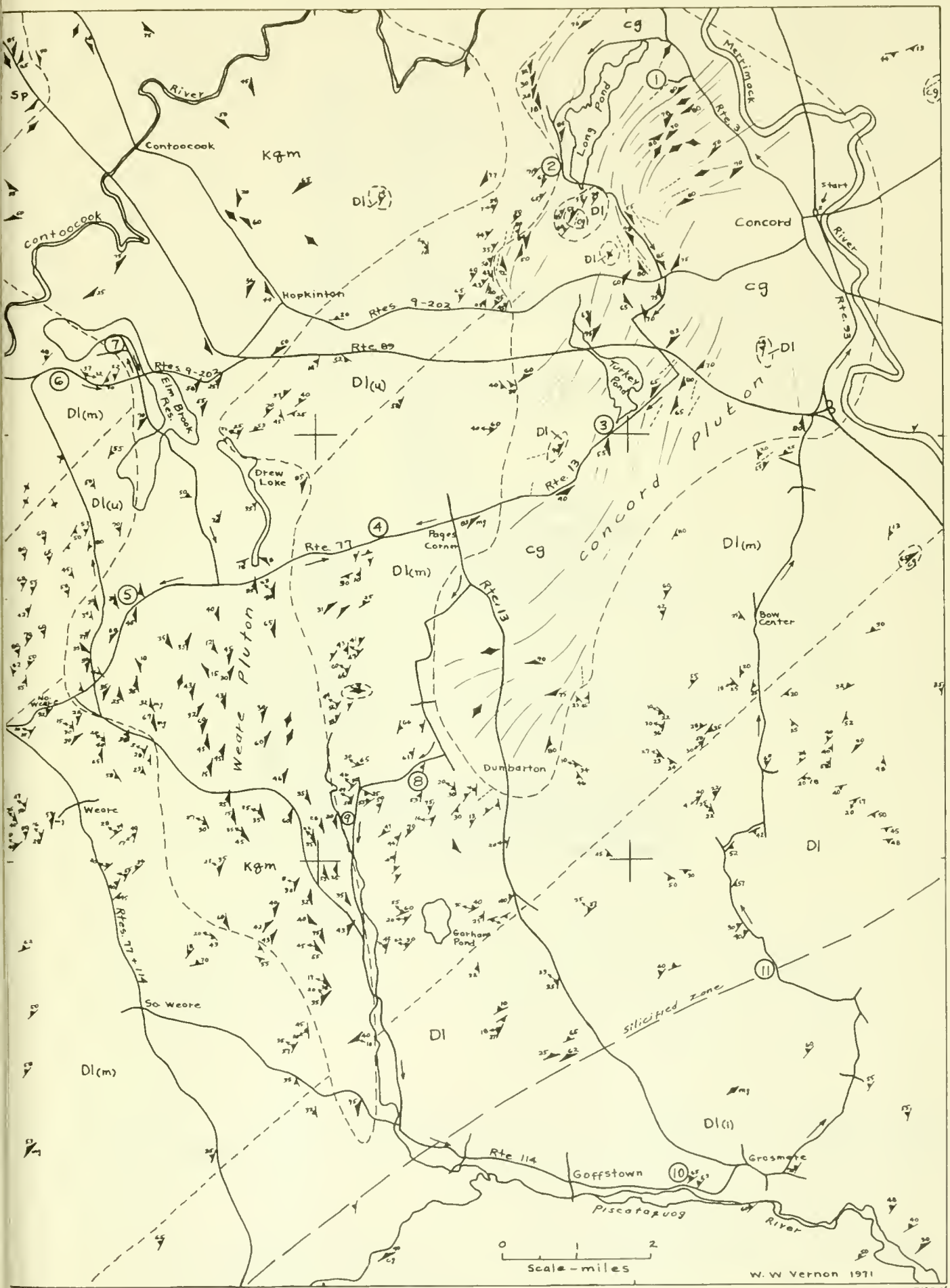

Fig 1. Geologic Sketch Map of the Concord Quadrangle

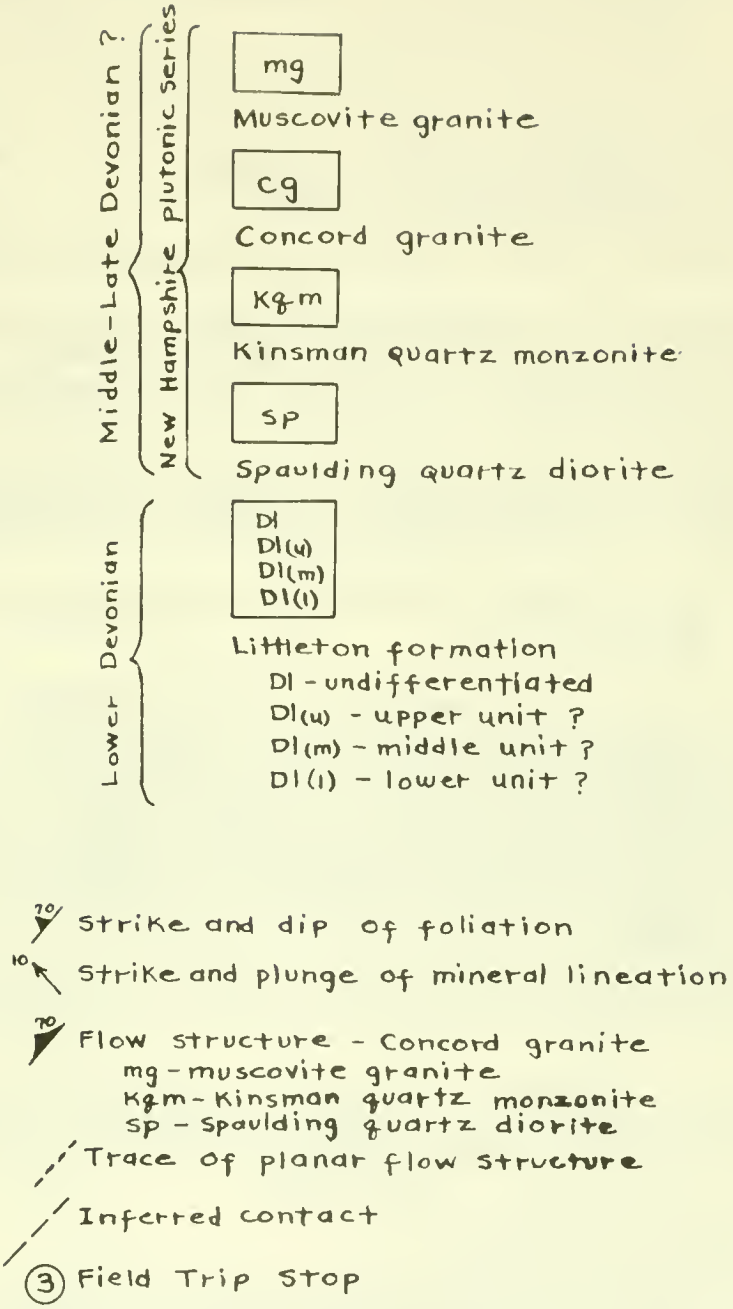

Fig. 2. Legend for geologic map of the Concord quadrangle

ROAD LOG FOR TRIP B-6

Assembly: 8:30 A.M., Sunday, October 3, at Highway Motel.
Topographic map: Concord, 15'.

Mileage

0.0 New Hampshire Highway Motel, Concord, N. H. Proceed northwest on Route 3 (North Main Street).

3.0 STOP 1 Swenson Granite Works in the Concord granite.

Brief explanation of quarry operations by Mr. David Swenson. Note joints and planar structure in the granite. Is this a primary flow-fracture system similar to examples cited by Balk (1937)?

Follow Route 3 to West Concord. Turn left on Hutchins Street (0.65 mi. from quarry). Follow to Lake View Drive and go south onto Long Pond Road.

6.5 STOP 2 Contact between Concord granite and Littleton formation (middle unit?).

This is the only known exposed contact between the pluton proper and the Littleton formation. The granite is essentially concordant with the schistosity here which strikes approximately N 45°E and dips 55°NW. A strong planar structure in the granite can be seen along the road several hundred feet south of this point. Faint grooves across the top of the outcrop trend S 18° E. Glacial striae?

Proceed southeast along Long Pond Road and turn south on Fisk Road.

7.7 Hopkinton Road (Routes 9 and 202). Turn left for a few hundred feet and then turn right through St. Pauls School grounds to Silk Farm Road. Turn left and follow to Clinton St. (Rte. 13). Turn right.

11.8 STOP 3 Concord granite.

Joint sets and flow structures are well-displayed in this outcrop. Pegmatite and aplite dikes are numerous and show preferred directions. Are they related to a primary fracture system?

Proceed southwest on Route 13.

14.6 Pages Corner. Intersection of Routes 13 and 77. Follow Route 77 southwest.

15.5 STOP 4 Littleton formation.

Schists and gneisses of the middle unit (?) cut by biotite granite, pegmatite, aplite and lamprophyre. The rusty weathering quartz-pyrrhotite-rich gneiss is a key unit in the quadrangle. It is identifiable with a

"rusty quartzite" unit found in other quadrangles and placed at a lower-middle to upper-middle horizon. It is placed in the latter horizon here. Discussion of correlation problems.

The garnetiferous biotite-muscovite-sillimanite schists are usually associated with the rusty weathering unit.

Mineral lineations here strike approximately N 60° W and plunge 10-20° to the N.W. Significance?

Proceed southwest on Route 77.

18.9 STOP 5 Kinsman quartz monzonite.

This is the typical coarse-grained porphyritic Kinsman of the quadrangle although local variations are widespread. Toward the west end of the outcrop the amphibole content increases significantly. Are all the rock variations here phases of the Kinsman?

20.4 Turn right on Shaker Hill Road. Proceed north and then east on Route 9 and 202.

25.9 STOP 6 Quartz diorite.

This is the oldest member of the New Hampshire plutonic series in the quadrangle. The author equates it with the Spaulding Quartz diorite in the Monadnock quadrangle although other names have been used for a similar rock in other quadrangles. The rock is generally foliated and has a characteristic mottled effect because of the uneven distribution of biotite. An interesting problem is the explanation of the mixed light and dark colored units in the outcrop.

Follow Routes 9-202 east.

27.0 Turn left on Stumpfield Road.

STOP 7 Lunch

Go back to Routes 9-202. Cross and go south on Stumpfield Road to Sugar Hill Road North (resume mileage at crossing).

30.2 Turn left on Route 77 and return to Pages Corner. Turn south on Route 13.

31.0 Turn right.

32.5 Bear left.

33.9 Turn right on Everett Dam Road.

34.5 STOP 8 Littleton formation (lower part of middle unit?)

The unit is primarily a garnetiferous biotite-sillimanite schist and gneiss striking northeast and dipping to the northwest. Minor flexures have fold axes trending to the northwest.

Proceed westerly and bear left past entrance to dam.

35.9 STOP 9 Littleton formation (lower part of middle unit?)

This large cut in the spillway of Everett Dam shows the complex relationships between the Littleton and a variety of intrusives. Raymond Cliffs, directly west of here, is near the southern end of the Weare Pluton (Kinsman quartz monzonite).

Proceed south.

37.4 Turn south on Route 77 and proceed to Route 114.

40.1 Turn left on Route 114.

42.6 Go straight through Goffstown. Stay north of river.

44.1 STOP 10 Littleton formation (lower unit?)

This unit is a coarse-grained garnetiferous mica-sillimanite schist commonly with quartzo-feldspathic layers and pods. Large sillimanite knots on some foliation surfaces largely have been altered to muscovite. Drag folds and ptygmatic folds in quartz are common in this unit. Tourmalinization of the schist is also more widespread here than in other parts of the quadrangle.

45.8 Proceed west through Grasmere. Turn left on Tirrell Road.

47.5 Intersection. Go straight.

48.4 Turn left.

49.9 STOP 11 Silicified zone.

This is typical of the many silicified zones in this part of the State and may be the largest in the quadrangle. It is approximately 100 feet wide at this point and may be followed in a southwesterly direction, varying greatly in width. Faulting is common along these zones, but to what extent this area has been affected, if any, has not been determined.

END OF TRIP

Proceed north through Bow Center and back to Concord.