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GEOLOGY OF THE EASTERN PORTION OF THE WHITE MOUNTAIN BATHOLITH, NEW HAMPSHIRE

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INTRODUCTION

The Jurassic White Mountain batholith is located in northern Grafton and Carroll Counties, New Hampshire. It is a composite of several overlapping centers of felsic magmatism. Individual centers are strikingly defined by ring dikes and can include plutonic, hypabyssal, and volcanic rock types. Pyroclastic rocks, chiefly rhyolitic tuffs and breccias, are preserved within ring dikes as large subsided blocks. Numerous plutons of subaluminous to peralkaline granites provide an areal continuity to the batholith. The geology of the White Mountain batholith has been mapped by Billings (1928), Billings and Williams (1935), Creasy (1974), Henderson and others (1977), Moke (1946), Osberg and others (1978), Smith and others (1939), and Wilson (1969).

The spatial and temporal geometry of the magmatic centers provides a convenient basis for dividing the batholith into an eastern and a western portion. The eastern portion of the White Mountain batholith (Figure 1) as exposed in the North Conway 15' quadrangle has at least four magmatic centers developed about 175 m.y. ago (Creasy and Eby, 1983). Hitchcock (1878) provided the first outline of the geology of the North Conway quadrangle and certain of his formational names are still in use, e.g. the Conway Granite. However, the work of Billings (1928) remains the chief geological reference for the North Conway quadrangle. Creasy (1974; unpublished maps), Davie (1975), Osberg and others (1978), and Parnell (1975) have provided greater detail to Billings' pioneering work.

GEOLOGY OF THE NORTH CONWAY QUADRANGLE

The geology of the North Conway quadrangle (Figure 1) is summarized in terms of the major magmatic and structural units of the White Mountain batholith.

The Mt. Osceola Granite, a green amphibole ± biotite granite, is the oldest member of the White Mountain magma series exposed in the North Conway quadrangle (Osberg and others, 1978). The number and original extent of plutons of the Mt. Osceola Granite within the North Conway quadrangle is not fully certain due to the complexity and abundance of younger rocks. A whole-rock Rb-Sr isochron for samples from both eastern and western portions of the batholith yields an age of 186 m.y. (Eby and Creasy, 1983) and indicates synchronous intrusion over a broad area . [This age places the Mt. Osceola as the youngest member associated with the large magmatic center that forms the western portion of the batholith.]

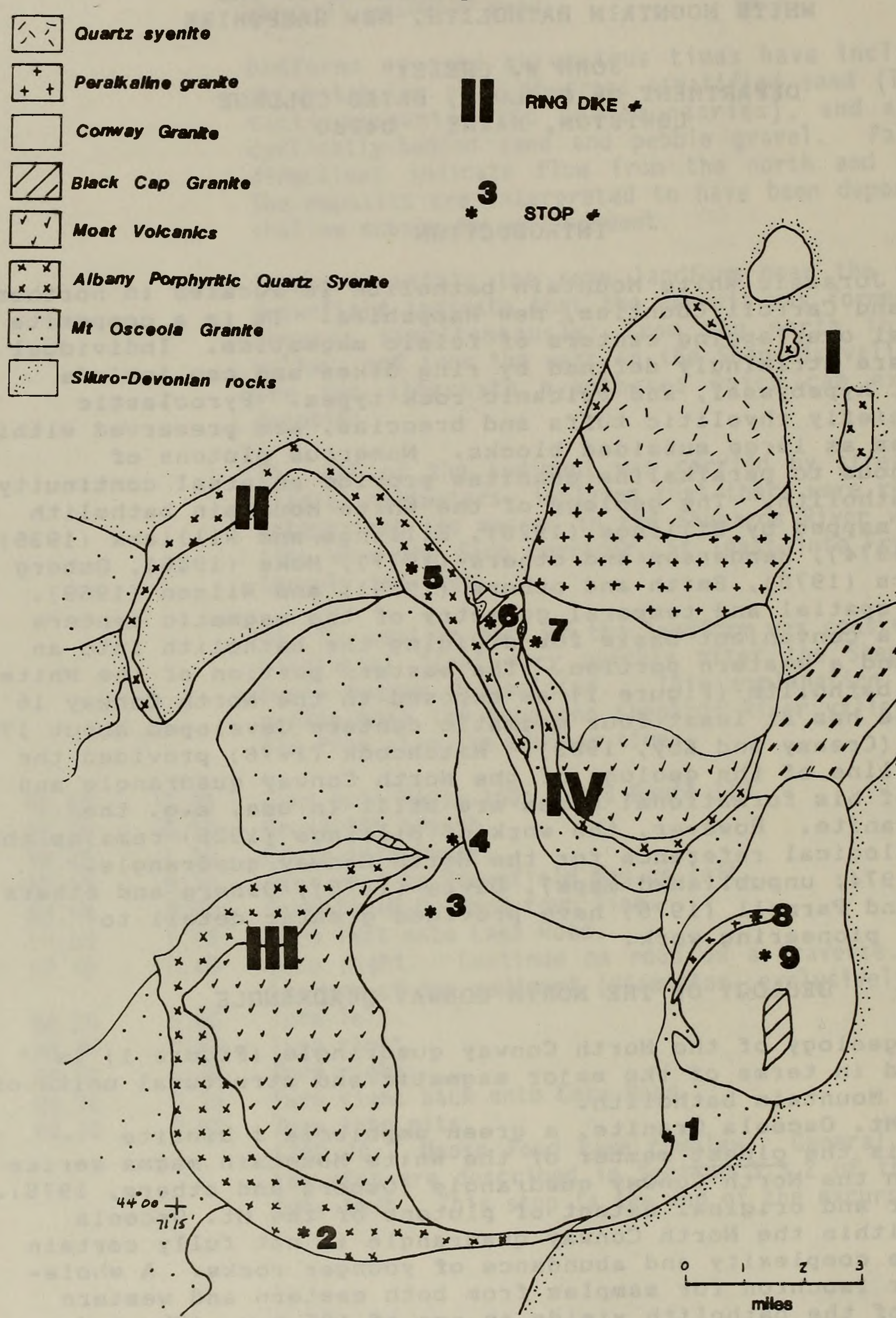

Figure 1. Generalized geologic map of the North Conway quadrangle, NH (after Billings, 1928; Osberg and others, 1978).

At least four magmatic centers are defined by ring dikes of the **Albany Porphyritic Quartz Syenite** (Figure 1). A whole rock Rb-Sr isochron for samples from three ring dikes yields an age of 175 m.y. (Eby and Creasy, 1983). The ring dikes are not seen to cut each other but relationships to other units indicate their emplacement was not simultaneous. These ring dikes are outwardly dipping at 40°-80° with well developed chill margins adjacent to older rocks. In fine structure these ring dikes are themselves multiple intrusions. At least four separate and petrologically distinctive intrusions of Albany occur in ring III (Figure 1 and e.g. STOP 2). Inclusions present in ring II document a similar structural relationship (e.g. STOP 5).

The **Moat Volcanics** (Billings, 1928) are exposed in the Moat Range to the west of North Conway; a second major occurrence is on Mount Kearsarge to the northeast. About 3 km of volcanic stratigraphy are exposed in the Moat Range. This section of comendite tuffs and subordinate breccia and trachyte shows pronounced and laterally persistent layering (Billings, 1928; Noble and Billings, 1967) striking northwest and dipping 30°-40° to the northeast. The eutaxitic structure of tuffs yields similar orientations. On geochemical grounds Creasy and Eby (1981) recognize at least four alkali rhyolites in the Moat Range. A whole-rock Rb-Sr isochron for the Moat Volcanics yields an age of 175 m.y. (Eby and Creasy, 1983); K-Ar dates of 168-170 m.y. (Eby, 1986, pers. comm.) are in general agreement. On Mount Kearsarge and on South Moat Mtn the volcanic rocks are intruded by the Albany PQS. Hence the Moat Volcanics are considered as structural blocks dropped down along younger arcuate fractures now largely occupied by the Albany PQS (Billings, 1928; Osberg and others, 1978). However, their thickness and distribution would be consistent with syn- or post-subsidence accumulation (Noble and Billings, 1967). The eruptive source and original extent of the volcanics is a major question: the volcanic lithologies preclude close genetic association with the ring dikes.

The **Conway Granite**, most extensive unit in the North Conway quadrangle, is a pink biotite granite. Billings (1928) showed the Conway Granite as a single irregularly shaped pluton and as the youngest of the White Mountain magma series. More detailed mapping (Osberg and others, 1978) has recognized several distinct plutons of biotite granite on the basis of texture and outcrop geometry (Figure 1). Absolute ages for plutons in the North Conway quadrangle are within the range of 175 ± 6 m.y. (Eby and Creasy, 1983). Field relations suggest that emplacement of these plutons was not synchronous across the quadrangle but related to individual magmatic centers. The Birch Hill pluton (Osberg and others, 1978) is the largest pluton. The Conway Granite of this pluton becomes finer grained, porphyritic, and miarolitic where it intrudes the Moat Volcanics (e.g. Stop 3). The Gardiner Brook pluton (Osberg and others, 1978) intrudes Moat Volcanics on Mount Kearsarge and is associated with the magmatic center defined by ring IV (Figure 1). The Conway Granite of this pluton shatters Silurian metasediments along the East Branch of the Saco River (STOP 7). A third pluton underlies most the Green Hills, the

prominent north-south oriented ridge forming the east side of Mt. Washington Valley; this pluton is well exposed on Black Cap mountain (STOP 9).

The Black Cap Granite (Billings, 1928) is a fine-grained pink biotite granite that outcrops in two small areas in the North Conway quadrangle (e.g. Stop 6). It is shattered and intruded by the Conway Granite (Green Hills pluton) on the flanks of Black Cap (Stop 9). Billings (1928) considered this rock an early lithologically distinct `phase' of the Conway Granite. Osberg and others (1978) suggest that the Black Cap granite may be coeval with and a roof facies of the Conway Granite.

Peralkaline granite forms an arcuate dike and small intrusion within the Conway Granite of the Green Hills pluton (Stop 8). A K-Ar date of 177 ± 7 m.y. (Eby, 1984, pers. comm.) is obtained from this locality. Riebeckite granite forms large areas of outcrop (e.g. on North Doublehead) that are seemingly young plutons spatially associated with hastingsite granite (Mt. Osceola Granite ?). The lack of clear contact relations and the presence of riebeckite + hastingsite granites suggest a genetic association as well.

DESCRIPTION OF UNITS (Table 1 and Figure 1)

The Mt. Osceola Granite is a medium- to coarse-grained hypersolvus granite that is dark green where fresh. It consists of an interlocking network of anhedral to subhedral microperthite 3-10 mm in diameter enclosing rounded grains of smokey quartz. Ferrohastingsite and locally annite are interstitial late crystallized minerals. Fayalite and ferrohedenbergite are frequently present in minor amounts and encased by reaction rims of ferrohastingsite. Characteristic accessories include allanite, sphene, zircon, fluorite, and monazite. Locally the Mt. Osceola is peralkaline with ferrorichterite or riebeckite present rimming ferrohastingsite.

The Moat Volcanics consist of comendite, trachyte, and tuff-breccia. The comendites are crystal-rich lithic tuffs; eutaxitic texture typical of welded ash flow tuffs is present within the section exposed in the Moat Range. These blue-gray to pink rocks contain variably abundant phenocrysts (1-3 mm) of quartz and sanidine (now microperthite) and rare phenocrysts of biotite, ferrohastingsite, ferrohedenbergite, and riebeckite set in a matrix of quartz and alkali feldspar. Accessories include apatite, fluorite, zircon, and magnetite. Lithic fragments constitute 1-5% of the comendite and range from a few cm to a few mm in size. Lithic types include hornfels, cogenetic volcanic rocks, porphyritic quartz syenite, and rarely cogenetic plutonic rocks. The trachyte consists of phenocrysts (2-3 mm) of pink alkali feldspar set in a dense (<0.1 mm) groundmass of alkali feldspar. Accessories include abundant hematite and minor zircon, magnetite, epidote and clinozoisite. The tuff-breccia contains angular to subrounded blocks ranging from a few cm to a m in size. These are generally polymict breccias but locally may be dominated by a single lithology. Lithic fragments include a

variety of metamorphic rock lithologies, Paleozoic intrusive rocks, and cogenetic volcanic and hypabyssal rocks. The red to gray matrix is generally sub-microscopic; where resolved it is quartz and alkali feldspar with chlorite, sericite, biotite, magnetite, and hematite.

The Albany Porphyritic Quartz Syenite contains phenocrysts of microperthite (5-10 mm) and quartz (2-4 mm) in all occurrences the abundance of phenocrysts and of quartz:feldspar varies. This variation is noted both within a ring dike (e.g. #2a,b,c of Table 1) and among different ring dikes. Minor phenocryst phases include ferrohedenbergite, fayalite, and ilmenite. The groundmass consists of anhedral quartz, alkali feldspar, and ferrohastingsite; the latter also forms poikilitic reaction rims on the phenocrysts of mafic minerals. The groundmass is relatively uniform in grain size (<2-3 mm) within an intrusion (except near contacts) but shows variation among different intrusions. Accessories include allanite, sphene, zircon, and fluorite.

The Conway Granite is a medium- to coarse-grained pink biotite two-feldspar granite. Values of microperthite:oligioclase range from 2:1 to 10:1 and average 4-5:1. Biotite forms anhedral interstitial grains up to 5 mm in size. In contrast with other members of the White Mountain magma series, fayalite and ferrohedenbergite are not present. Field definition of the Conway Granite excludes samples containing amphibole in hand sample (Osberg and others, 1978). Zircon, allanite, apatite, and sphene are common accessories. Near contacts the Conway Granite shows a variety of textures that may grade into each other on the outcrop scale: porphyritic, aplitic, miarolitic, and pegmatitic. Weakly developed banding on the cm- to dm-scale resulting from variations in grain size and/or mineral concentrations is developed near some contacts. Lithic fragments of any type are sparse in the Conway Granite.

The Black Cap Granite is a fine-grained (0.1 mm) equigranular rock composed of quartz, microperthite, subordinate oligoclase, and chloritized biotite. Accessories include zircon, magnetite, apatite, and fluorite.

The peralkaline granite is composed of subhedral grains of white microperthite (5-10 mm) and clear quartz (2-6 mm), blocky interstitial grains of riebeckite-arfvedsonite (<10 mm), and flakes and aggregates of interstitial biotite. Characteristic of this rock are abundant radiating arrays of golden colored astrophyllite. Fluorite, ilmenite, sphene, and apatite are common accessory minerals. Near contacts, miarolitic pods and cavities are developed on a cm-scale; here prismatic riebeckite crystals are found upto 5 cm in length.

Table 1. Modes of plutonic rocks from the North Conway quadrangle listed according to stop number [Figure 1] (Billings, 1928; Osberg and others, 1978; and Davie, 1975).

Stop No.	#1a	#1b	#2a	#2b	#2c
Quartz	35	22	10	16	20
Alkali feldspar	49	72	79	70	68
Plagioclase	14	3	0	0	0
Biotite	2	tr	1	0	tr
Amphibole	0	1	8	9	
Ferrohedenbergite	0	tr	8	2	1
Fayalite	0	2	1	tr	tr
Accessories	tr	tr	3	3	3

Stop No.	#5	#6	#7	#8	#9
Quartz	13	29	33	39	28
Alkali feldspar	74	48	49	54	47
Plagioclase	0	17	16	0	18
Biotite	1	6	2	1	7
Amphibole	12	0	0	5	0
Ferrohedenbergite	0	0	0	0	0
Fayalite	0	0	0	0	0
Accessories	tr	tr	tr	1	1

1a Conway Granite, Birch Hill pluton, Hurricane Mtn Road.
1b Mt. Osceola Granite, Rattlesnake Mtn, Redstone area.
2a,b,c Albany Porphyritic Quartz Syenite, three distinct types present within ring dike III, Little Attitash Mtn.
5 Albany Porphyritic Quartz Syenite, Jackson Falls.
6 Black Cap Granite, Thorn Mtn.
7 Conway Granite, Gardiner Brook pluton, Burnt Knoll Brk.
8 Riebeckite granite, North Doublehead.
9 Conway Granite, Green Hills pluton, Black Cap Mtn.

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ITINERARY

Assembly point is the parking lot of Burger King restaurant located at the junction of Routes 16 and 302 between Conway and North Conway villages, NH. Assembly time is 7:45 a.m. Late arrivals: we will pause momentarily at the assembly point <u>following</u> Stop 1 at about 9:15 a.m.; we should be at Stop 2 until about 10:15 a.m.

All stops are located in the North Conway 15' topographic quadrangle and on Figure 1. Access to Stops 2 and 3 is through the Ossipee Lake 15' quadrangle.

Mileage

0.0 exit parking lot using easterly driveway to Route 302; turn right (east) onto Route 302.

(0.6)

0.6 Turn left (north) at Redstone town triangle; Redstone quarry prominently exposed on south end of Green Hills.

(0.1)

0.7 Cross tracks of Maine Central Railroad

(0.1)

0.8 Pass gated dirt road on left (south) and Mason house on right.

(0.1)

0.9 Park where paved road turns left (south) and woods road continues straight and uphill; proceed on foot along woods road about 0.1 mi to <u>Stop 1a</u>.

<u>STOP 1a, b:</u> Redstone Quarry: Conway Granite (1a) and Mt. Osceola Granite (1b). The coarse pink Conway Granite (Table 1, #1a) of the Birch Hill pluton is homogeneous in grain size and texture and was quarried extensively for building stone. Sparse inclusions, chiefly of porphyritic granite, are present locally. A few thin (3 cm) dikes of aplitic granite are seen on the main bench of the quarry. Samples from here have been used in numerous studies related to the high concentrations of U and Th in the Conway Granite (e.g. Adams and others, 1962; Birch and others, 1968; Osberg and others, 1978).

return to cars and walk .1 mi south on paved road to gated dirt road. The dirt road ends in a small clearing (.1 mi); note the capped drill hole. About

3000 ft of core were pulled from this hole to evaluate the geothermal heat potential of the Conway Granite (DOE's hot dry rock program). The site is on the contact between the Mt. Osceola and Conway Granites; both granites (as well as Albany PQS) are present in the core. Exit the clearing adjacent to columnar pieces of granite. Follow path .1 mi to small quarry with derricks (Stop 1b).

The Mt. Osceola Granite (Table 1, #1b) was quarried here. The contact between this green ferrohastingsite granite and the Conway Granite of Stop 1a is reached by traversing around the east and north (top) sides of the quarry along a narrow foot trail. The Conway Granite is distinctly finer grained at the contact.

Retrace route to cars; return to junction of Routes 16 and 302, reset odometers.

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0.0 Junction Routes 16 and 302; turn left (south) and continue to Conway village.

(3.0)

3.0 Turn right (west) on Route 113 and continue through Conway village.

(0.8)

3.8 Turn right (west) on Route 112, the Kancamagus Highway.

(0.8)

4.6 Cross Albany town line.

(1.5)

STOPS 2a, b, c: Swift River: The Kancamagus Highway crosses ring dike III (Figure 1) at a low angle providing excellent outcrops of the Albany Porphyritic Quartz Syenite. At least three Albany-type lithologies (Table 1, #2a,b,c) are present and are distinguished by the abundance and proportion of quartz and feldspar phenocrysts. Davie (1975) demonstrated the composite nature of ring dike III to the north (Attitash Ski Area) but the exposures are less accessible. This trip will stop at three places along the Kancamagus highway to illustrate these differing lithologies. At all three locations, pull cars as far off pavement as possible.

6.1 STOP 2a

(0.4)

6.5 Enter White Mountain National Forest

(2.0)

8.5 Cross Hobb's Brook

(0.9)

9.4 STOP 2b

(0.3)

9.7 STOP 2c

(0.6)

10.3 Turn sharply right (east) on Dugway Road.

(0.2)

10.5 Cross Albany covered bridge; Albany PQS (type locality of Hitchcock?) crops out here.

(4.1)

14.6 Dugway Picnic Area on right (south) side of road.

(0.8)

15.4 South Moat Trail sign on left (north) side of road. South Moat Mtn on skyline to north.

(0.9)

16.5 Red Eagle Pond along left (north) side of road.

(1.6)

18.1 Junction with West Side Road; turn left (north) onto West Side Road; reset odometers.

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0.0 Junction of West Side Road (=Dugway Road) with Still Road, proceed north on West Side Road.

(1.3)

1.3 Cross tracks of Boston and Maine Railroad.

(1.3)

2.6 Unmarked dirt road on left (west) side of road leads to USFS Smokey Quartz Collecting Area. [This is an accumulation of boulders of the miarolitic contact facies of the Conway Granite; bedrock is not exposed]

(1.0)

3.6 Birch Hill Road enters on left (west); the quarry at the summit has provided samples of Conway Granite for geochemical and geochronologic studies.

(1.6)

5.2 Entrance to Echo Lake State Park on the left (west); continue straight ahead.

(0.6)

5.8 Stop sign at T intersection; turn left (north) and continue on West Side Road. [A right turn here will take you to north end of North Conway village]

(0.6)

6.4 Cathedral Ledge Road on left (west); continue on West Side Road. [Side road leads to summit of Cathedral Ledge (3 mi round trip) which provides excellent views of the Saco River and Mt. Washington Valley.]

(0.7)

7.1 Turn left (west) onto dirt road just north of the Lucy farm on right; park here. This locality is reached by a 1.8 mi traverse (3.6 mi round trip) entirely on graded road and trail; there is 400 ft of relief, up going and down returning.

STOP 3: Diana's Baths and Lucy Brook: Moat Volcanics and Conway Granite of the Birch Hill pluton in contact. At Diana's Baths (0.4 mi) the coarse Conway Granite becomes porphyritic and contains large (upto 3 m) segregations of dark material that Billings (1928) interpreted as partially assimilated inclusions. NO HAMMERS PLEASE!

From here, follow the Moat Mtn Trail (1.4 mi) to the first trailside ledges (Moat Volcanics), then cut over to Lucy Brook (100 ft).

The contact between the Moat Volcanics (upstream) and the Conway Granite (downstream) is very well exposed here in Lucy Brook. In the lowest stream exposures, the coarse Conway Granite grades into medium-grained porphyritic contact facies characterized by a heterogeneous and miarolitic texture. Large rounded inclusions of fine-grained biotite granite are included in the Conway Granite (as at Stop 9), perhaps representing an older contact facies. Blue-gray comendite of the Moat Volcanics is bleached and pink where cut by numerous fractures and thin (<2 cm) quartz veins. Eutaxitic texture is not well developed here; the rocks resemble quartz porphyry.

return to vehicles and continue north on the West Side Road.

(1.8)

8.9 Park on wide left shoulder of road.

<u>STOP 4:</u> Humphrey's Ledge: Mt. Osceola Granite is exposed at the north end of Humphrey's Ledge. This is an excellent locality for collecting samples that contain fayalite and ferrohedenbergite.

return to vehicles and continue north on West Side Road.

(2.6)

11.5 Stop sign. Turn right (northeast) on Route 302.

(2.3)

13.8 Turn left onto Route 16 at Glen village; Use caution--this is a very dangerous intersection! reset odometers.

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0.0 Junction of Routes 16 and 302 at Glen village; proceed north on Route 16.

(2.4)

2.4 Bear right on Route 16A crossing Jackson covered bridge; proceed through Jackson village past Yesterday's Restaurant (on right), bear left (west) past small triangular "park" and cross stone bridge. [note location of Thorn <u>Hill</u> Road and Thorn <u>Mtn</u> Road for later reference.]

(0.7)

3.1 Turn right (north) on Route 16B after crossing stone bridge and proceed uphill; Albany PQS exposed to right.

(0.3)

3.4 Park on wide right (east) shoulder at Jackson Falls picnic area. Walk to broad exposures in Wildcat Brook.

NO HAMMERS PLEASE!

STOP 5: Jackson Falls: **Albany Porphyritic Quartz Syenite** in a composite ring dike. This is one of the best localities to examine the Albany PQS--about 2000 ft of continuous exposure is present between here and Jackson along Wildcat Brook. Just downstream of the iron bridge a screen of Siluro-Devonian gneisses and granite 110 ft wide is intruded by the Albany PQS. Downstream from this screen, the Albany is relatively uniform in mineralogy and texture and contains a small proportion of small (2-5 cm) inclusions. Upstream, large (upto 1 m) inclusions of feldspar-poorer Albany-type lithology enclosed by the Albany PQS are an earlier intrusion within ring dike II. A wide (1 m) dike of fine-grained pink biotite granite cuts the Albany PQS and screen of country rocks. This may be related to the Black Cap Granite seen at Stop 6.

return to vehicles and continue North (uphill) on Route 16B.

(0.1)

3.5 Turn right and continue across Wildcat Brook.

(0.3)

3.8 Turn right (south, downhill) on this branch of Route 16B and return to Jackson village.

(0.6)

4.4 Bear left at Route 16A then turn immediate left (north) onto Thorn Mtn Road; continue steeply up passing side roads to left and right.

(1.5)

5.9 Continue straight (uphill) through uncontrolled 4-way intersection.

(0.7)

6.6 T-junction at saddle of Middle Mtn (left) and Thorn Mtn (right); turn left (west) then immediate right onto wide dirt road passing base lodge of defunct Tyrol Ski Area.

(0.1)

6.7 Park left of 2-bay garage. A 1 mi loop at Stop 7 traverses ski trails to and from the summit of Thorn Mtn.

STOP 6: Thorn Mtn: **Black Cap Granite, Albany PQS, and pre-White Mountain igneous and metamorphic rocks.** The ski trails on the north slope of Thorn Mtn expose pavement outcrops of the fine-grained and homogeneous Black Cap biotite granite (Table 1, #6). Just below (north of) the summit, the Black Cap intrudes a screen of country rocks consisting of Siluro-Devonian metamorphic rocks intruded by Devonian (?) granites and pegmatites. The south margin of the screen is shattered and intruded by a chill facies of Albany PQS. The Albany at and south of the summit has coarser grained

groundmass and may be a separate intrusion. The screen is cut out to the east; the Black Cap Granite is in contact with the chilled Albany but age relations are not evident.

return to cars and retrace route to Jackson village.

(2.2)

8.8 Junction with Route 16A; bear left and reset odometers.

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0.0 Junction of Thorn Mtn Road and Route 16A; proceed south on Route 16A.

(0.2)

0.2 Turn left onto Thorn Hill Road.

(3.1)

3.3 Bear left (south) at junction with Route 16A across from Swiss Chalets Motel.

(0.5)

3.8 Turn left (north) onto Town Hall Road at 4-way intersection (no stop sign) and proceed along the East Branch of the Saco River.

(1.9)

5.7 Park on wide right shoulder at south end of bridge; proceed to Stop 7 across the bridge.

STOP 7: Gardiner Brook: Conway Granite of the Gardiner Brook pluton. The coarse-grained Conway (Table 1, #7) exposed at the north end of the long outcrop becomes porphyritic towards the south where Siluro-Devonian gneisses occur. These country rocks are shattered and intruded by a fine-grained biotite granite (Black Cap Granite ?) which is intruded by the porphyritic Conway Granite.

return to cars and retrace route to Route 16A.

(1.9)

7.6 Turn left (south) onto Route 16A; proceed to junction with Route 302.

(1.9)

9.5 Junction with Route 302 at Intervale. Turn left (south) on Route 302.

(0.1)

9.6 Turn left (east) onto Hurricane Mtn Road; reset odometers.

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0.0 Junction Route 302 and Hurricane Mtn Road, Intervale; proceed east on Hurricane Mtn Road.

(1.6)

1.6 Kearsarge Mountain Trail sign on left (north); continue straight.

(2.3)

3.9 Height-of-land on Hurricane Mtn Road; pull off on right side of road; park here for Stops 8 and 9.

About 50 ft east of the height-of-land a woods road leaves the north side of the road; follow this to a point where a trail leaves left (about .25 mi) and ascends to open ledges (.15 mi) of Stop 8.

STOP 8: Hurricane Mtn. Riebeckite ± biotite granite is exposed in the open south-facing ledges at this stop; Conway Granite is exposed around the rest of the mountain. Riebeckite granite (Table 1, #8) intrudes the Conway Granite in the Green Hills to the south. The blast debris and ledges at Stop 8 contain abundant miarolitic pods and cavities notable for their large prismatic crystals of riebeckite-arfvedsonite. This miarolitic contact facies is probably the top or margin of a larger subjacent pluton of peralkaline granite (c.f. South Doublehead Mtn). Exposures near the summit of Hurricane Mtn lack biotite and contain only scattered miarolitic pods and may lie below this contact zone. Astrophyllite is a characteristic accessory mineral in these peralkaline rocks.

return to the Hurricane Mtn Road and walk 50 ft east towards the height-of-land to a sign on the south side of the road marking the beginning of the trail to Black Cap Mtn. Follow trail to the open ledges of Black Cap Mtn (1 mi).

STOP 9: Black Cap Mtn. Conway Granite of the Green Hills pluton is a medium-grained pink biotite granite (Table 1, #9). The granite is well exposed in the ledges as the trail ascends the north slope of Black Cap. Near and south of the summit, the granite locally becomes sub-porphyritic. About .25 mi southeast of the summit (no trail) the fine-grained Black Cap Granite is exposed in a geometry that suggests a sub-horizontal sheet. The Black Cap Granite is shattered and intruded by the Conway Granite of Stop 8. The Black Cap may represent a marginal roof facies of the Green Hills pluton preceding the main intrusive pulse of Conway Granite.

return to the Hurricane Mtn Road and the cars.

END To Lewiston: Continue east on the Hurricane Mtn Road; at the first and only stop sign (T-junction) turn right (south) onto the road to East Conway. This road joins Route 113 in about 3 miles. Continue south on Route 113 to junction with Route 302 in Fryeburg, ME. Follow Route 302 east through Fryeburg, Bridgton, and Naples. Turn north on Route 11 south about 2 mi east of Naples and follow to Auburn. Consult detailed map of Lewiston-Auburn area provided with registration materials for route to Bates College.