METASEDIMENTARY AND METAVOLCANIC ROCKS OF THE AUSABLE SYNCLINE, NORTHEASTERN ADIRONDACKS

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INTRODUCTION

On this trip we will examine two sections of granulite facies metamorphic rocks, exposed in stream cuts in the southern and central Ausable Forks 15' quadrangle (Figs. 1,2). The first section is dominated by calc-silicate rocks, marbles, and quartzites, typical of metasedimentary rocks in the northeastern Adirondacks. The second includes both metasedimentary rocks and the Lyon Mountain Gneiss, an unusual lithologic unit comprising a diverse suite of rocks which we believe are chiefly metavolcanic. Points for discussion on the trip include possible protoliths, the tectonic and sedimentary environment at the time of deposition, the metamorphic environment(s), and contact relationships with olivine metagabbros and anorthositic gneisses.

Both stops on this trip involve moderately long hikes along scenic Adirondack brooks. While the hikes are not particularly arduous, we recommend sturdy boots and the exercise of caution; some of the stream banks are quite steep, and frequent crossings of streams on slippery rocks will be necessary.

Geological Setting

The Ausable Forks quadrangle (Figs. 1,2) in the northeastern Adirondack Mountains, near the border of the Marcy anorthosite massif, contains four major rock units (Fig. 2). Several large bodies of metanorthosite and gabbroic anorthosite gneiss , roughly domical in shape, are the lowermost exposed rocks. Overlying the domical metanorthosites is a complex of layered metamorphic rocks several kilometers thick. These layered rocks dip away from the metanorthosite domes; foliation and layering in them are parallel or subparallel to foliation in the outermost parts of the domes. Individual lithic units within these supracrustal rocks are locally well defined, but exhibit large variations in thickness along strike, and ordinarily cannot be traced for more than a few kilometers. The layered complex includes the metasedimentary rocks which will be described in detail below, as well as diopside-bearing quartzofeldspathic gneisses, granitic gneisses, jotunites (monzodiorite gneisses), and anorthosite and gabbroic anorthosite gneisses.

The third major unit in the quadrangle is a heterogeneous quartzofeldspathic gneiss that crops out over an area of nearly 1000 km^2 in the northeastern Adirondacks. This has been named the Lyon Mountain Granitic Gneiss by Postel (1952); we have shortened this to Lyon Mountain Gneiss (LMG) because it contains substantial amounts of rock that are not of granitic composition. This unit underlies much of

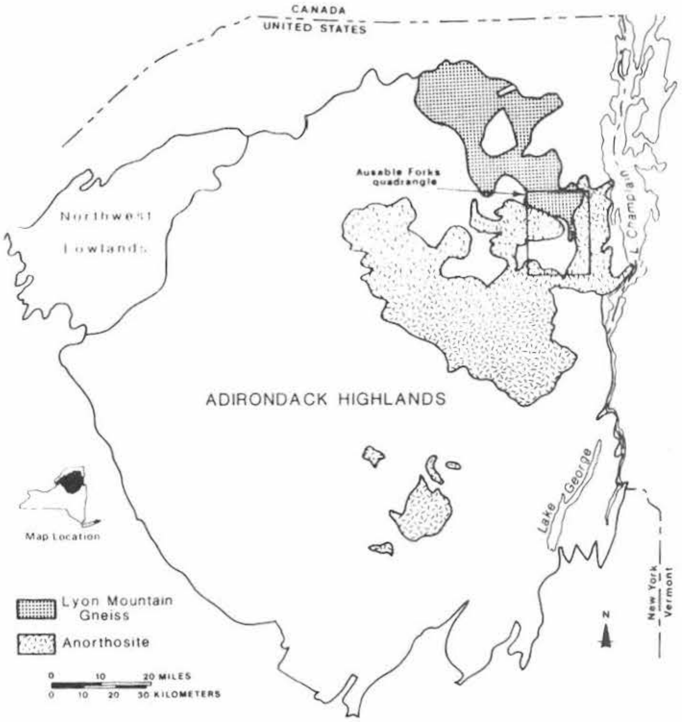

Figure 1 Index map showing location of the Ausable Forks Quadrangle.

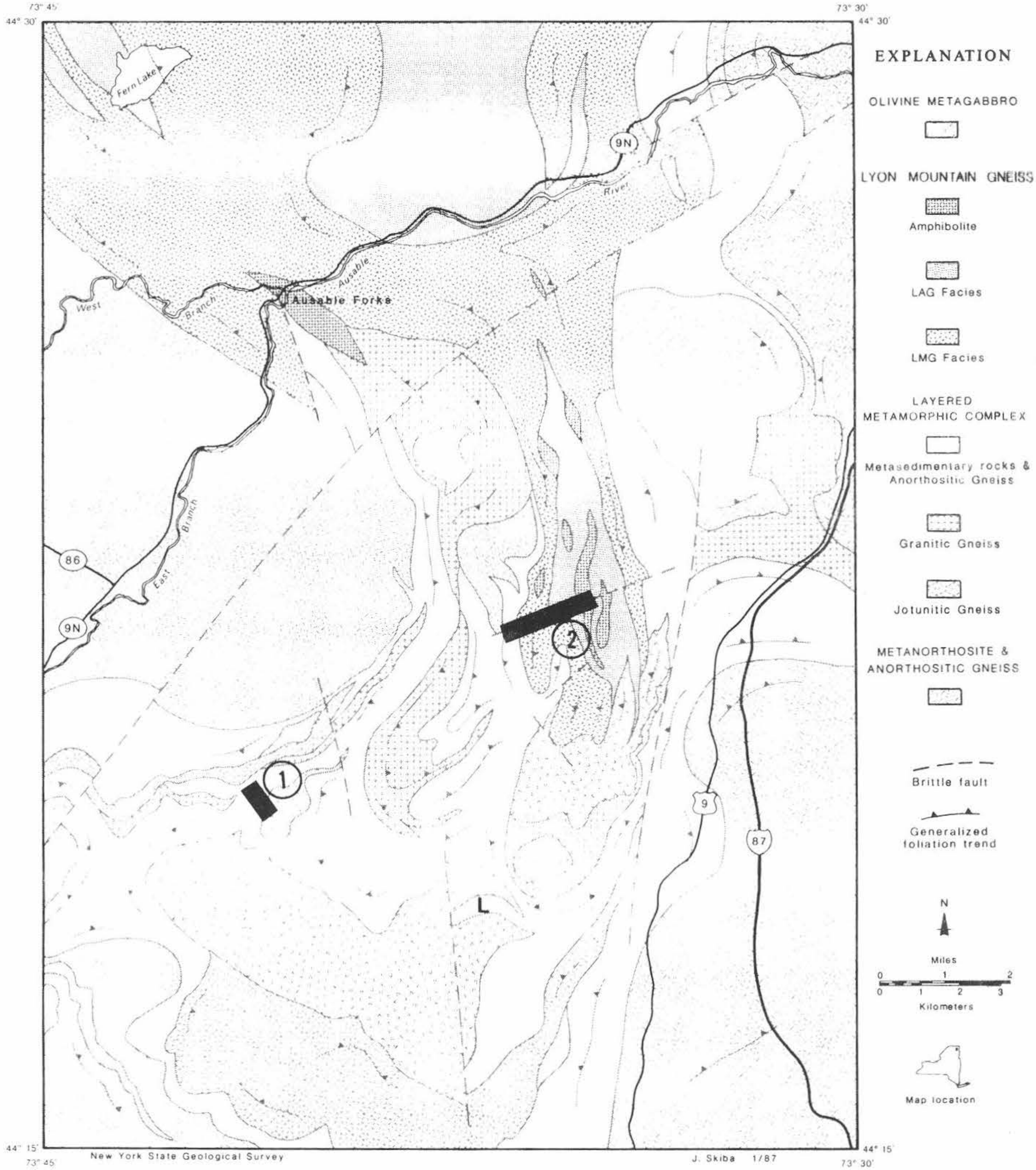

Figure 2 Map showing the general geology of the Ausable Forks Quadrangle, after Whitney and Olmsted, 1988. "1" and "2" show approximate locations of the two traverses. "L" is the Lewis wollastonite mine. "LMG" on the map is the GG facies of the Lyon Mountain Gneiss. After Whitney and Olmsted (1988).

TABLE 1. Partial list of mineral assemblages in metasedimentary rocks of the Ausable Forks quadrangle.

Carbonate-free assemblages	Assemblages with carbonates
Cpx	Cc
Cpx-kf	Cc-cpx
Cpx-kf-qz	Cc-cpx-gt
Cpx-pf	Cc-cpx-sc
Cpx-pf-qz	Cc-cpx-sc-kf
Cpx-pf-tn	Cc-cpx-sn-gt
Cpx-pf-gt	Cc-sn
Cpx-sc	Cc-sn-ph
Cpx-sc-tn	Cc-wo
Cpx-wo	Cc-wo-cpx
Cpx-wo-qz	Cc-wo-gt
Cpx-wo-gt	Cc-cpx-wo-gt
Cpx-ph	Cc-ch-sp
Qz-ph	Cc-cpx-wo-gt-id
Qz-ph-opx	Do
Qz-tr	
Qz-opx-cpx	
Qz-opx-cpx-tr	
Qz-opx-cpx-tr-ph	
Pf-cpx-wo-gt-qz	
Pf-cpx-opx-ph	
Gt	
Gt-wo	
Gt-cpx	

cpx	clinopyroxene (Di-Hd ss)
opx	orthopyroxene
qz	quartz
kf	microcline or mesoperthite
pf	plagioclase
gt	garnet (Gr-And ss)
wo	wollastonite
tr	tremolite
bi	biotite
ph	phlogopite
cc	calcite
sc	scapolite
tn	titanite (sphene)
sn	serpentine (after forsterite)
sp	spinel
ch	chondrodite
id	idocrase
do	dolomite

Graphite and pyrite are commonly present in minor amounts. Low-T alteration products include prehnite, chlorite, and sericite.

the northern third of the Ausable Forks Quadrangle, and forms the core of a tight, upright, north-plunging synform (the Ausable Forks Syncline of Balk, 1931) in the central third (Fig. 2). North of the Ausable River, the LMG is host to numerous small, and a few rather large, bodies of low-Ti magnetite iron ore that were worked throughout much of the nineteenth century and the first half of the twentieth (Gallagher, 1937; Postel, 1952). The first three units are intruded by a fourth, coronitic olivine metagabbro, which occurs as several large bodies in the southern half of the quadrangle, and as smaller pods and lenses in the layered rocks throughout the area. The metagabbro ordinarily retains primary igneous textures in the interiors of all but the smallest bodies, and is metamorphosed to garnet amphibolite or mafic granulite near the contacts. All four units display mineral assemblages consistent with granulite facies metamorphism, except for local retrograde assemblages in the vicinity of late, brittle faults.

Locations of the field trip stops are shown on a generalized geologic map (Fig. 2). The first stop is a traverse along a stream that drains a cirque on the north flank of Jay Mountain, crossing a section of metasedimentary rocks of the layered complex. The second, along Doyle Brook in the central part of the quadrangle, begins in the core of the Ausable Forks Syncline where sevaral variants of the Lyon Mountain Gneiss are exposed, and continues into some of the underlying metasedimentary rocks.

Metasedimentary Rocks

The metasedimentary rocks in the layered complex consist principally of diopside-rich calcsilicate granulites, together with impure quartzites and calcite marbles. Phlogopite and biotite schists are less common, and there is one occurrence of dolomite marble. At the top of the layered complex, directly underlying the Lyon Mountain Gneiss, is a thin, graphitic, sillimanite-garnet-quartz-microcline metapelite. Substantial amounts of quartzofeldspathic gneiss of granitic composition, and lesser amounts of amphibolite and biotite-rich mafic granulite are interlayered with the metasedimentary rocks; these rocks probably are the metamorphic equivalents of felsic and mafic volcanics, respectively.

Most individual layers within the metasedimentary sequence are relatively thin (less than a few tens of meters). Accurate measurement of thicknesses is prohibited by scarcity of outcrop. Layers are commonly discontnuous along strike, possibly due in part to tectonic disruption. Because of these factors, and the common presence of interlayered gabbroic and anorthositic rocks, it has not been possible to recognize a coherent stratigraphy. It is concievable that there is repetition due to folding or faulting.

Table 1 lists observed mineral assemblages in the calcsilicate granulites, quartzites, and marbles. The dominant mineral in most of the calcsilicate rocks is diopsidic clinopyroxene, ranging from nearly colorless to dark green. The color, which depends largely on ferrous iron content, may vary widely within a few cm. With the clinopyroxene are variable amounts of alkali feldspar, quartz, plagioclase, calcite, scapolite, phlogopite, wollastonite, and titanite. Rocks with over 90% diopside ("diopsidites") are common, as are diopside-microcline rocks. Wollastonite-rich rocks occur locally in economic quantities. At the Lewis wollastonite mine (Fig. 2), the ore is a wollastonite-diopside-

TABLE 2. MODES OF LYON MOUNTAIN GNEISS

	A LMG FACIES (12)			B LAG FACIES (6)			C MAG FACIES (11)#		
	Mean	Min	Max	Mean	Min	Max	Mean	Min	Max
PLAGIOCLASE (includes Antiperthite)	11.7	0	46	64.1	51	74	65.6	33	83
K FELDSPAR	53.5	11	78	0.7	0	2.6	0.6	*	*
QUARTZ	27.5	10	38	27.2	18	43	8.9	0	45
CLINOPYROXENE	1.5	0	6.1	2.7	0	13	16.7	0.3	34
AMBHIBOLE	1.6	0	8.3	1.0	0	3.2	3.8	0	17
OXIDES	1.9	0.3	4.7	2.9	0.7	4.4	1.2	0	4.6
TITANITE	0.2	0	1.3	0.5	0	1.3	1.7	0	2.7
OTHER+	2.0	0	6.7	0.8	0	2.9	1.5	0	13

All modes based on at least 1000 points counted.

* Present in one sample only.

Excludes one sample with 30% scapolite.

\+ Includes biotite, zircon, apatite, garnet (in two samples), fayalite (in one sample), fluorite, chlorite and low-temperature alteration products.

garnet rock, with numerous nearly monomineralic zones. The high-variance mineral assemblages, as well as the common absence of either quartz or calcite with the wollastonite, suggest that this ore, like that at Willsboro in the next quadrangle east, is partly metasomatic in origin (Buddington, 1939; DeRudder, 1962).

With the addition of quartz, the calcsilicate rocks grade into impure quartzites that are commonly tremolite-bearing. The magnesium-rich assemblage tremolite-enstatite-diopside-(phlogopite)-quartz is locally present. Calcite marbles, usually with abundant calcsilicate minerals, tend to occur in lenses and irregular layers. In the central part of the quadrangle west of Black Mountain, prominent marble "dikes" crosscut a stratiform metanorthosite body, illustrating the ductile behavior of the marble relative to that of anorthosite during deformation. Graphite and pyrite are common accessory minerals in all asssemblages, with the exception of wollastonite- and garnet-rich rocks, which tend to be relatively oxidized.

Several features of these metasedimentary rocks suggest the former presence of evaporites. The preponderance of diopside-rich calcsilicate rocks, the metamorphic equivalent of silicious dolostones, is significant in that dolomite is commonly a product of hypersaline depositional environments (Friedman, 1980). The diopside-rich rocks locally contain major amounts of microcline, possibly the metamorphic equivalent of low temperature, authigenic or diagenetic microcline. The latter, in part pseudomorphous after evaporite minerals, has been reported from late Proterozoic, evaporite-bearing dolomitic rocks in South Australia (Rowlands and others, 1980) and in the Damara Orogen of Namibia (Behr and others, 1983). Magnesium-rich metasedimentary rocks, in particular phlogopite schists and enstatite-diopside-tremolite-phlogopite-quartz rocks, are likely granulite facies equivalents of evaporite-related talc-tremolite-quartz schists, such as those found near Balmat in the northwest Adirondacks (Brown and Engel, 1956), in stratigraphic association with diopside-rich rocks and bedded anhydrite. Magnesite-dolomite-chlorite-quartz rocks are a possible sedimentary protolith. The common presence of scapolite in both marbles and calcsilicate rocks is another possible indicator of former evaporites (Serdyuchenko, 1975). Granulite facies metasedimentary rocks similar to those of the Ausable Forks quadrangle occur in the Caraiba mining district of Brazil (Leake and others, 1979), and in the Oaxacan Complex of southern Mexico (Ortega-Gutierrez, 1984); in both localities anhydrite is present in the subsurface.

Lyon Mountain Gneiss

The Lyon Mountain Gneiss (LMG) comprises three distinct facies. Granitic (sensu lato) gneisses (GG facies) consist chiefly of quartz and mesoperthite with minor amounts of biotite, hornblende, clinopyroxene, or garnet and up to 5 percent magnetite. Locally present is a potassium-rich variety with microcline as the principal feldspar. Modal compositions are widely variable, both with respect to proportions of quartz and feldspar present, but also with respect to the amount and identity of the mafic minerals (Table 2). These heterogeneous rocks are common throughout the outcrop area of the LMG. A second facies, leucocratic albite gneiss (LAG), is composed of quartz and albitic plagioclase (Ab_{95}-Ab_{98}), minor clinopyroxene with up to 40 percent acmite component, and as much as 4 percent magnetite. Both the

TABLE 3. CHEMICAL ANALYSES OF LYON MOUNTAIN GNEISS

	LAG FACIES (6)			MAG FACIES (9)		
Element	Mean	Maximum	Minimum	Mean	Maximum	Minimum
SiO2	71.63 ± 2.63	75.07	68.45	64.39 ± 5.78	78.24	59.24
TiO2	.48 ± .08	.62	.38	.94 ± .16	1.16	.63
Al2O3	12.71 ± .81	13.49	11.47	13.17 ± 2.22	16.46	8.01
Fe2O3	4.13 ± .85	5.48	2.91	2.85 ± 1.18	4.72	1.36
FeO	2.11 ± .46	2.86	1.65	2.15 ± .58	3.09	1.25
MnO	.02 ± .01	.03	.01	.04 ± .02	.08	.02
MgO	.31 ± .11	.45	.17	3.05 ± .69	3.79	1.71
CaO	1.28 ± .71	2.57	.43	5.21 ± 1.92	7.66	2.69
Na2O	6.81 ± .91	7.76	5.54	6.98 ± 1.92	8.69	3.24
K2O	.48 ± .29	.99	.11	.68 ± .95	2.99	.15
P2O5	.07 ± .04	.13	.02	.16 ± .07	.22	.01
Rb	7 ± 4	12	2	19 ± 31	80	2
Sr	31 ± 9	42	18	61 ± 43	153	25
Ba	55 ± 28	101	27	121 ± 174	501	10
Zr	1015 ± 228	1320	653	290 ± 54	385	195
Y	137 ± 50	210	75	55 ± 19	85	34
Nb	40 ± 11	48	18	18 ± 5	23	10
Ce	223 ± 106	342	75	68 ± 19	103	47
Ga	29 ± 4	33	24	18 ± 5	25	10

TABLE 3. (CONTINUED)

	GG FACIES (9)			MICROCLINE GG (3)		
Element	Mean	Maximum	Minimum	Mean	Maximum	Minimum
SiO2	70.04 ± 3.98	74.41	62.75	69.49 ± 1.04	70.66	68.67
TiO2	.56 ± .26	1.04	.33	.52 ± .09	.59	.42
Al2O3	12.96 ± 1.16	15.44	11.88	12.89 ± .81	13.66	12.04
Fe2O3	2.61 ± 1.49	5.06	.17	3.69 ± .76	4.51	3.03
FeO	2.92 ± 1.02	4.45	1.24	1.98 ± .25	2.22	1.72
MnO	.08 ± .04	.13	.04	.01 ± .01	.02	.01
MgO	.22 ± .24	.77	.01	.24 ± .11	.37	.16
CaO	1.41 ± .35	2.02	.95	.45 ± .26	.71	.19
Na2O	4.27 ± .87	5.36	2.46	1.34 ± .56	1.98	.97
K2O	4.44 ± 1.25	5.73	2.23	8.79 ± .98	9.71	7.75
P2O5	.11 ± .09	.27	.03	.11 ± .06	.17	.06
Rb	114 ± 50	215	61	237 ± 31	272	212
Sr	64 ± 36	138	28	42 ± 22	65	21
Ba	441 ± 285	866	88	1188 ± 550	1822	837
Zr	844 ± 351	1229	388	532 ± 164	641	343
Y	120 ± 66	228	58	59 ± 6	64	53
Nb	35 ± 16	59	17	19 ± 1	20	18
Ce	183 ± 84	375	108	113 ± 10	120	101
Ga	29 ± 6	38	22	18 ± 1	19	17

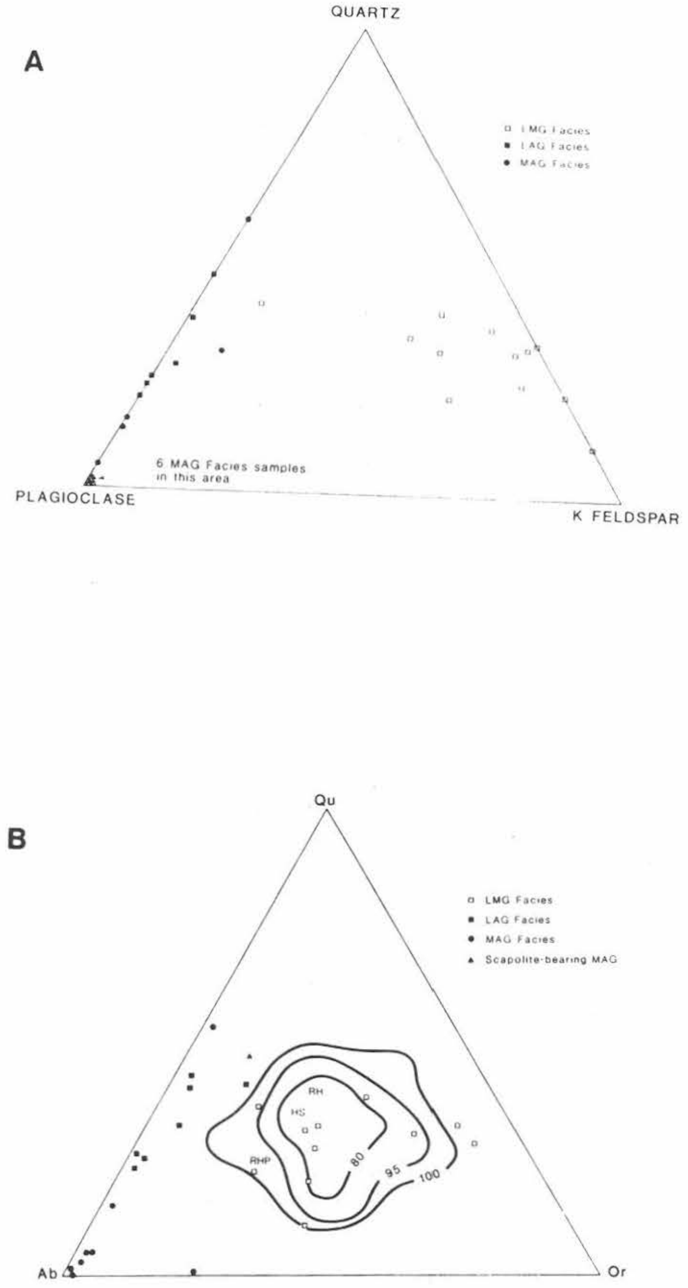

Figure 3 A. Modal quartz, plagioclase, and K feldspar (microcline or perthite) in rocks of the Lyon Mountain Gneiss.

B. Normative quartz, albite and orthoclase in the Lyon Mountain Gneiss. Contours show percentages of 137 analyses of Adirondack granitic rocks. After Whitney and Olmsted (1988).

GG and LAG facies commonly appear as fine- to medium- grained granoblastic rocks, massive to weakly foliated but with locally strong compositional layering. Colors range from white to pink or buff; mafic varieties are locally gray. Table 2 shows modal data for these rocks, and figures 3A and 3B illustrate the variability of both modal and normative quartz and feldspar.

These quartzofeldspathic gneisses are interlayered with lesser amounts of a third facies, mafic albite gneiss (MAG). The latter is a distinctive albite-pyroxene rock, with varying amounts of quartz and a blue-gray sodic amphibole, plus minor titanite. The pyroxenes are dark green and acmite-rich (up to 35%). Oxide minerals are uncommon; where they do occur they consist of laminar intergrowths of hematite and ilmenite or rutile, in contrast to the ubiquitous magnetite of the GG and LAG facies. These MAG rocks are commonly pink to gray, fine-grained, with a sugary granoblastic texture. In some outcrops, they display a prominent pinstripe layering, with alternating mm-scale pyroxene-rich and albite-rich layers. More commonly the MAG facies is massive. Both banded and massive varieties locally contain pink megacrysts of nearly pure albite, up to 5 cm across. Quartz content is commonly under 5 percent, but one sample contains 45 percent, suggesting admixture of a quartz-rich sedimentary component. Scapolite is locally present.

Table 3 shows the average chemical composition of several facies of the Lyon Mountain Gneiss. Notice in particular the high Na_2O, low K_2O nature of the LAG and MAG facies. In contrast, the microcline-bearing variant of the GG facies (not exposed on Doyle Brook) is K_2O-rich. Whitney and Olmsted (1988) attribute the heterogeneity of these rocks and the extreme alkali metal ratios to diagenetic alteration of felsic volcaniclastics in a hypersaline environment such as a playa lake. Possible unmetamorphosed analogs of these rocks are found in several areas in the southwestern United States, where rhyolitic tuffs of Pliocene to recent age have been altered in a playa setting to produce rocks with diagenetic analcite (Na-rich), zeolites, or K feldspar (Surdam, 1981). A weakly metamorphosed analog of the MAG facies is present in the Damara orogen of Namibia, in the form of albite-dolomite-quartz rocks, locally with albite porphyroblasts. These late Proterozoic metasedimentary rocks also originated in a playa environment (Behr and others, 1983).

In the section we will see, in the southernmost, tightly folded part of the Ausable Forks Syncline, all three facies of the LMG are interlayered with amphibolite, at least some of which has been derived from intrusive olivine metagabbro.

ROAD LOG

Mileage	Cumulative	Remarks
0	0	This trip will assemble in the parking lot at the west end of Hudson Hall. As you leave, turn R (west) into Broad Street and continue west about two miles to the entrance to I-87 south.
1.8	1.8	Turn L into entrance to I-87. Keep right after you make this turn so as to elect I-87 south.

14.6	16.4	Take exit 34 to NY 9N.
0.2	16.6	Turn L onto NY 9N south toward Whiteface Mountain.
4.5	21.1	Clintonville. This hamlet is a former iron mining town said to have had a population of over 10,000.
4.7	25.8	Outcrops in roadcut on right are an unusual ferrohedenbergite-fayalite granite, first described by Buddington (1939). This may be a reduced facies of the Lyon Mountain Gneiss, or a subsequent intrusive rock.
0.4	26.2	Village of Ausable Forks.
1.0	27.2	Turn L at red blinker onto Main St.
0.2	27.4	Route 9N turns R at bridge. We will leave 9N briefly to examine a spectacular exposure of metasedimentary rocks in a roadside outcrop.
0.1	27.5	Turn R at other end of bridge onto Sheldrake Road.
1.3	28.8	Stop at several small outcrops in a bank on the L (east) side of the road, directly downslope from a house. Cameras are a must at this stop, but no hammers, please. This informal stop illustrates the differing mechanical properties of various rock types, including marble, diopsidite, amphibolite, and granitic gneiss. This exposure has been called "The Snake", for obvious reasons.
1.3	30.1	Turn R on Stickney Bridge Road.
1.1	31.2	Cross bridge and turn L on 9N.
3.1	34.3	Village of Jay.
0.8	35.1	Turn L at intersection with route 86, toward the "Old Covered Bridge".
0.2	35.3	Covered bridge. Drive across bridge and bear R up hill. Exposures on R in the bed of the Ausable River are metanorthosite of the Jay Dome, cut by several unmetamorphosed mafic dikes.
0.7	36.0	Y intersection; continue on L fork.
0.7	36.7	Bear R at yellowish house.

0.1 36.8 Turn L on Nugent Road (unpaved).

1.75 38.55 STOP 1. Gelina Basin.

The road forks at this point, with the R fork leading steeply uphill. There may be a gate across the L fork. This is private property, owned by Ward Lumber Co. in Jay. If you come here on your own, get permission. We will park here and proceed on foot up the R fork. If you have an altimeter, set it for 1280 feet. After about a half mile, the road ends at a hunting cabin in a clearing. Walk to the R of the cabin past the john, where you will find a trail that follows the top of a steep bank. Follow the trail S to about 1800 feet altitude, and work your way down the bank to the stream at the bottom. This unnamed, north-flowing stream drains a cirque (Gelina Basin on the 15' quadrangle map) on the north flank of Jay Mountain. We will attempt to hit the stream at about 1700 feet and traverse upstream over a well-exposed section of NNE-striking metasedimentary rocks.

1730-1750' (altitudes approximate) Calcsilicate rocks with diopside and wollastonite, locally rusty weathered, with quartzite layers.

1750-1760' Strongly foliated amphibolite, overlain by coarse, rusty calcite-diopside-phlogopite-graphite marble.

1780-1820' First of three waterfalls. At the base of this falls, layered diopside-wollastonite calcsilicates (WoDi) and quartzite are exposed. The caprock is tremolite-bearing quartzite; just above this is Mg-rich enstatite-diopside-tremolite-quartz rock.

1830' 5' cascade over diopsidite and diopsidic marble with thin quartzite layers.

1840-1870' Interlayered metasedimentary rocks (diopsidites and WoDi) and thin amphibolites.

1880-1900' Amphibolite, overlain by metasedimentary rocks, including a calcite-diopside-wollastonite-grossular-idocrase marble at the base of a second waterfall. The cap of this falls is a dark, feldspathic diopsidite with locally abundant sphene. The amphibolite here may be a sill or dike of olivine metagabbro satellitic to the larger body exposed just upstream.

1910-1960' Third falls. The lower part of the falls is a cascade over banded WoDi rock; the upper part is olivine metagabbro locally mixed with granitic gneiss. The gabbro contact here appears to have a steep easterly dip, truncating the more gently dipping metasedimentary layers. Thin sections of the WoDi rock here show thin rims of grossularitic garnet around wollastonite, possibly a result of the reaction wollastonite + plagioclase = grossular + quartz.

0.0 38.55 Turn around and retrace route on Nugent Road.

1.75 40.3 Turn R on The Glen Road.

0.1	40.4	Fork in road, bear L toward Village of Jay.
1.3	41.7	Turn R just before covered bridge.
0.5	42.2	Turn L on North Jay Road.
4.2	46.4	Turn R on Green Street.
5.4	51.8	Turn R on Trout Pond Road.
5.0	56.8	Stop 2. Clear Pond Park and Doyle Brook Gorge.

Park on R side of road. To reach the traverse up Doyle Brook we will walk along a private logging road (permission needed) that runs SW from Trout Pond Road. [Note: the 1953 USGS topographic map (1:62,500) is accurate in this area; the 1980 1:25,000 version is not]. Proceeding SW along the logging road, we will pass Copper Pond, which occupies a small basin in albite gneisses of the LAG and MAG facies. Just S of Nesbitt Pond, a short trail leads S to Doyle Brook. From here, we will traverse upstream. The stream gradient is small, so altitudes are not listed. The first rocks encountered in the streambed are amphibolites. A short distance upstream, Doyle Brook emerges from a slot formed at an ENE-trending fault here occupied by an unmetamorphosed mafic dike of indeterminate age that shows evidence of multiple episodes of intrusion. The walls of the gorge are MAG facies albite gneisses, with massive, banded, and megacrystic variants all present. Notice the complex folding in the banded gneisses.

After leaving this first slot, continue upstream along a flat stretch with occasional outcrops of the GG and LAG facies, some quite magnetite-rich. Then enter a second gorge, walled by heterogeneous, intensely fractured LMG, mostly of the GG facies. Shortly beyond the SW end of this gorge, the stream crosses a concealed contact between the LMG and the underlying metasedimentary rocks. The first outcrop of the latter is a rusty-weathered, graphitic, sillimanite-garnet metapelite. Continuing upstream, the course of the stream swings around to a nearly NS direction, with outcrops of garnetiferous granitic gneiss. At the S (upstream) end of this segment are several marble outcrops, including a coarse white calcite marble with serpentine and graphite, and a nearly pure, gray, tan-weathering dolomite marble. A large spring marks the underground outlet of Lawson Pond, located just to the south and about 80' higher in elevation. The surface outlet shown on the map does not exist. The rocks here strike NNE and dip east; the marble overlies the granitic gneiss seen in the previous outcrop. Another bend in the stream leads first SW and then W (downsection) over outcrops of amphibolite and rusty calcsilicate rocks, back into garnetiferous granitic gneiss, followed by gabbroic anorthosite gneiss. The latter is part of a large, irregular lens of metanorthosite within the layered metamorphic rocks. At this point we will leave the stream and walk back to the access road, following the N rim of Doyle Brook gorge.

To return to Plattsburgh, follow the Trout Pond Road south about three and one half miles to Route 9. A left turn here will take you north toward Plattsburgh. You may get on I87 (north) at exit 33, located at the intersection of routes 9 and 22 about one mile north of Poko-Moonshine Park.

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