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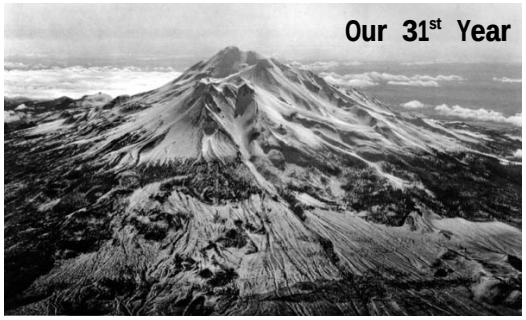

Client Sample No. Boring MR-4, Run 5C, Depth 37.4'	**Dukelabs Sample No**. N751	**Classification:** Plagioclase-quartz-muscovite-biotite-garnet migmatitic gneiss

Color Index (% mafic phases): 20

Megascopic Sample Description: Massive, crudely foliated coarse-textured biotite-muscovite-garnet migmatitic gneiss consisting of mica gneiss injected by cm-scale felsic segregations consisting of quartz and feldspar. Gneissic portion was sampled for thin section as to not skew results. As such total mica content of entire core is somewhat less than reported below. Gneissic foliation is subvertical.

Brief Petrographic Description: Gneissic rock consisting of intergrown plagioclase and quartz with subordinate muscovite, biotite, and accessory garnet, zircon, apatite, ilmenite, sphene, and pyrite scattered throughout. Micaceous phases are concentrated in zones and show significant recrystallization in various episodes resulting in crosscutting mica fabrics and non-continuous foliation. Feldspar and quartz phases predominate.

Mineral Phase	Crystal Size (mm)	Volume %	Mohs Scale	Comments
Plagioclase	0.5-5.0	40	6.0	Twinned and untwinned euhedral to subhedral crystals intergrown with quartz
Quartz	0.3-5.0	20	7.0	Clear to smoky anhedral to subhedral crystals with undulose extinction
Muscovite	0.5-3.0	20	2.0-2.5	Clear to pinkish pleochroic laths that replace relict kyanite, variable orientations
Biotite	0.5-3.0	15	2.5-3.0	Brown to greenish tan pleochroic lath-like crystals at various orientations
Garnet	1.0-4.0	3	6.0-7.5	Subhedral poikiloblastic crystals that overgrown quartz and feldspar relicts
Accessories	0.1-2.0	2	~5.0	Disseminated euhedral to anhedral zircon, apatite, ilmenite, sphene, and pyrite

Core and Petrographic Images

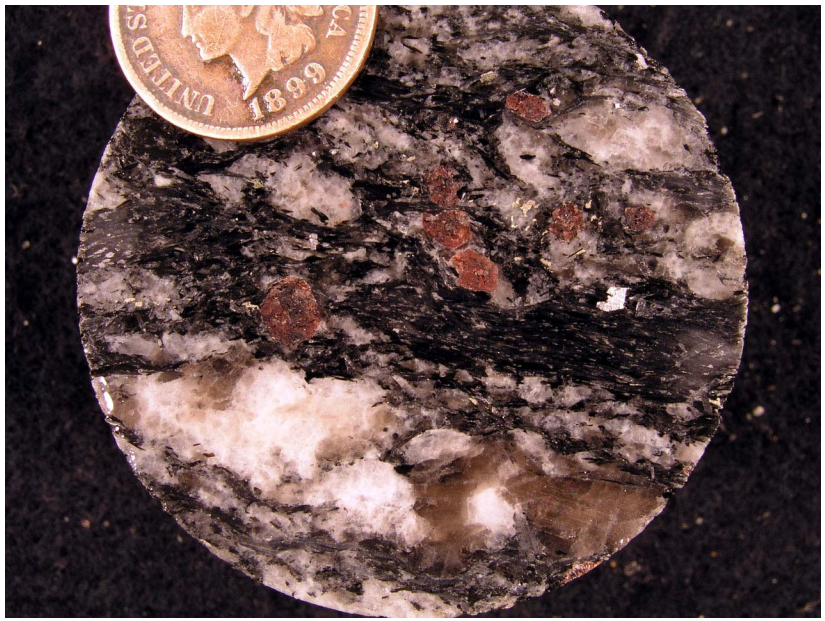

Figure 1 – Macrophotograph of sawn core of sample **N751** showing vertical gneissic fabric consisting of recrystallized light-colored quartzofeldspathic layers separating contorted mica-rich layers that are injected by quartzofeldspathic segregations. Garnet porphyroblasts up to 4 mm in size overgrow the predominant metamorphic layering, indicating a younger phase of metamorphic overprinting and recrystallization.

The foliation is non-continuous and stitched together by the quartz, feldspar, and garnet creating a massive gneissic texture.

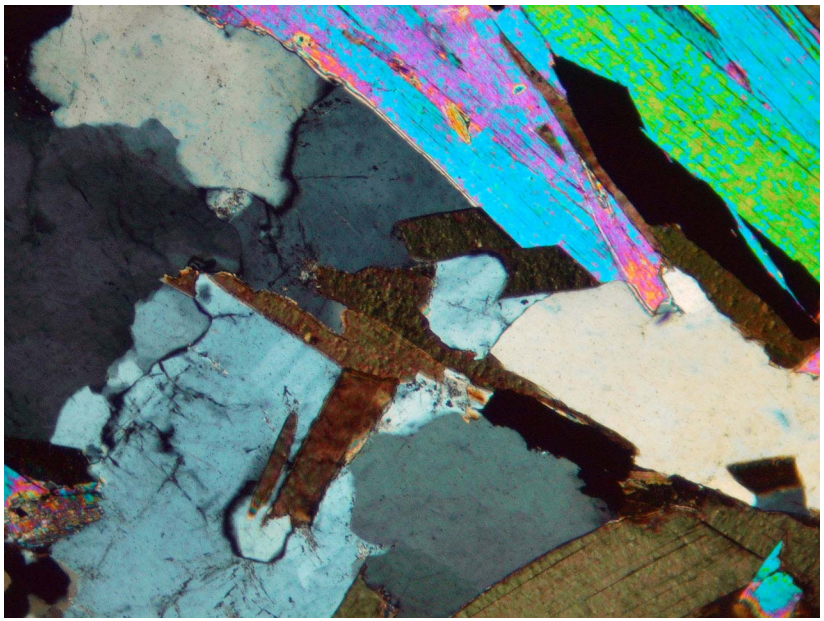

Figure 2 - Photomicrograph in cross-polarized light showing interlocking texture discontinuous euhedral to subhedral micas set in a matrix of subhedral to anhedral sodic plagioclase and quartz (gray to colorless crystals). The micas include the brightly colored muscovite (upper right corner and lower left edge) and the greenish brown biotite (center and lower right edge). Note that the micas form a discontinuous foliation with crystals grown at various angles.

Note: Petrographic Image Width of Field = 1.6 mm

Petrographic Description and Rock Mass Properties

Thin section sample **N751** was taken from the top half of the core pictured in Figure 1 in order to eliminate the quartz+feldspar segregation that cuts through the core. Petrographic analysis and sodium cobaltinitrate staining indicates that the rock predominately consists of plagioclase and quartz (~60%) with subordinate muscovite and biotite (35%) and accessory phases (5%) including red garnet porphyroblasts that overgrow the predominately gneissic fabric. Quartz and plagioclase feldspar have co-crystallized along with micaceous phases to produce a crudely foliated gneissic fabric consisting of interlocking subhedral to euhedral twinned and untwinned sodic plagioclase feldspar and anhedral quartz. The plagioclase shows some strain in the form of distorted twin lamellae and exhibits minor internal alteration to fine-textured sericite and clay minerals, typical of metamorphic rocks of this type. The quartz shows undulose extinction and is basically inclusion free. Together, the intergrown quartz and feldspar predominate producing the overall hardness and toughness of the rock mass.

The micaceous phases (muscovite and biotite ~35% combined) show recrystallization as a result of polymetamorphism with high-angle and cross-cutting relationships between the mica laths (Figure 2). Minor kyanite, a high-pressure metamorphic phase common in NYC, occurs as relicts, replaced in the interiors of late idioblastic muscovite. Muscovite is more abundant than biotite, reflecting the original bulk chemistry of the parent material, probably clay-rich feldspathic sandstone, a parent lithotype typical of the Hartland Formation of NYC. The micas do not show strong preferential alignment as is commonly found in schistose rocks. Rather, the micas occur in thin zones separated by interlayers of quartzofeldspathic material. Garnets are typically found associated with the micaceous layers since they grow at the expense of biotite with progressive regional metamorphism.

The garnet occurs as porphyroblasts that overgrow relict and rounded plagioclase, quartz, biotite, and opaques. The garnet crystal boundaries truncate muscovite laths and the porphyroblasts overgrow aligned opaque minerals indicating that garnet growth is the result of metamorphic reheating. The mineralogy and texture of sample N751 are indicative of amphibolite facies regional metamorphism, a common metamorphic grade found in NYC.

Petrographer: Charles Merguerian, Ph.D.

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