

Geologic Site of the Month  
September, 2008

***Ichthyoglypts and other igneous animals, Topsham***



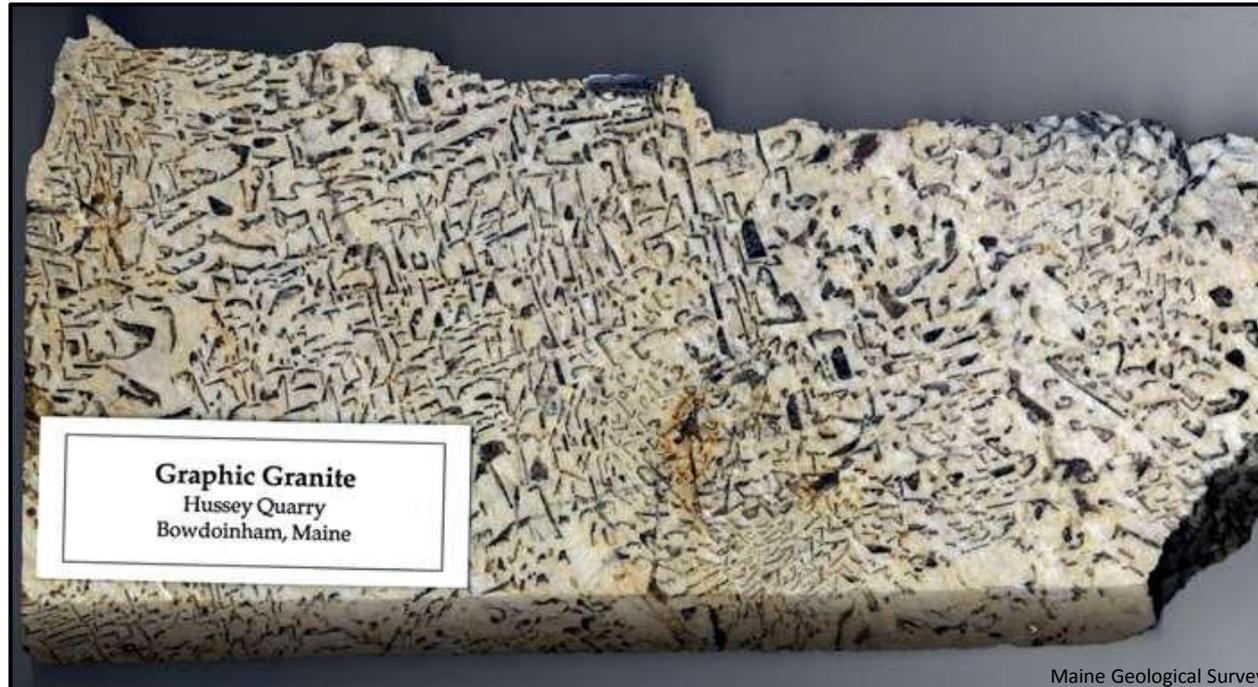
43° 56' 56.26" N, 69° 57' 15.82" W

Text by  
Marc C. Loiselle



Introduction

Last month's Geologic Site of the Month - [Bradbury Mountain, Pownal](#) - made a passing reference to graphic granite - a variety of granite with a peculiar mineral texture - namely, the "...intergrowth of subhedral skeletal quartz prisms in an alkali feldspar or sodic plagioclase host, which occurs in granite pegmatites and rarely as megacrysts in granites" (Barker, 1970). A picture is worth a thousand words, so here is a picture of a slab of graphic granite from the Hussey Quarry in Bowdoinham, Maine



**Figure 1.** Distinctive geometric intergrowth of white feldspar and dark gray quartz.

### Graphic Granite

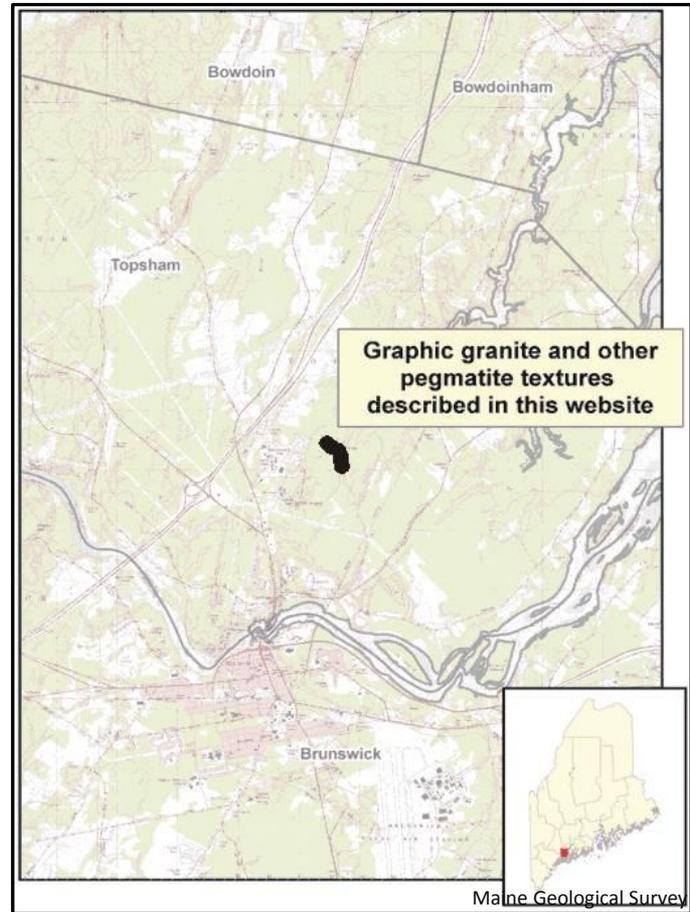
The unusual shapes of the dark quartz crystals prompted earlier workers to propose some striking names for the rock, including "runite" (from the similarity of the quartz crystals to Norse runes), "Hebraic granite," and, my favorite, "ichthyoglypts" because of the fancied resemblance of the quartz rods to tailless fish (Fersmann, 1928, as cited in Whalstrom, 1939). The likeness to crude writing is the origin of the most commonly used term - graphic granite.

Graphic granite is nearly universally associated with pegmatites. The major zone of pegmatites in the Brunswick-Topsham area provides several localities where these textures can be seen in the field. The pegmatite mineral collecting sites in the Midcoast region described in the [Maine Geological Survey's online Collector's Guide to Maine Minerals](#) are good places to start.



Regional Maps

A site not described in the Collector's Guide, several abandoned feldspar quarries adjacent to the [Cathance River Nature Preserve](#), provides an additional and unique opportunity.

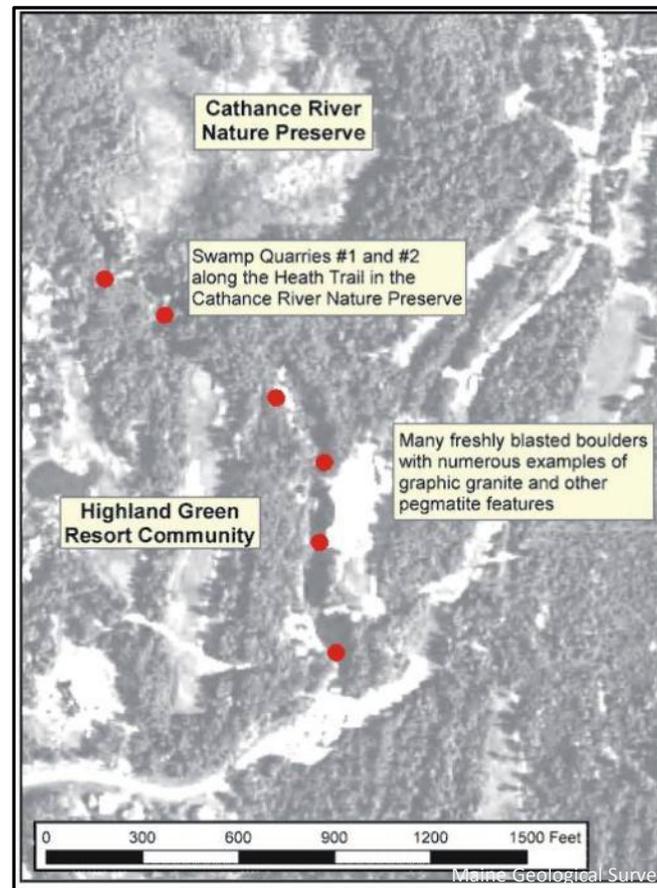
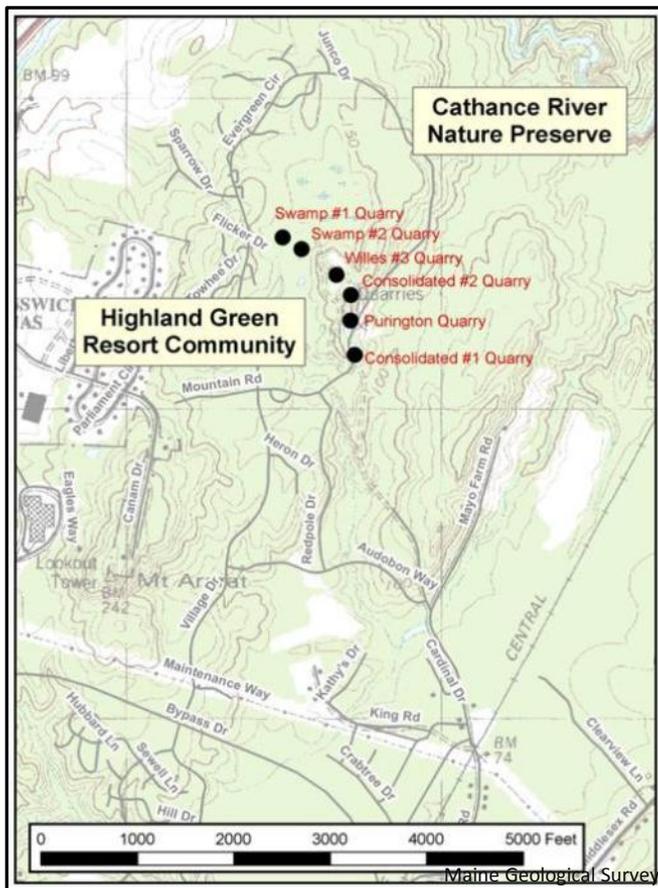


**Figure 2.** Regional location in central Topsham, north of Brunswick; black dots indicate quarries.



Regional Maps

Recent work crushing rock for construction at the nearby Highland Green resort community has left a number of large boulders with many examples of graphic granite exposed on multiple surfaces, allowing a 3-dimensional view of the rock structure.



Maps from USGS

**Figure 3.** Location of Cathance River Nature Preserve and quarries (Left) and aerial photo of site (Right).



### The Heath Trail and Graphic Granite

This locality also has the advantage of being adjacent to the Cathance River Nature Preserve. If your interest in the pegmatites wanes, you can wander onto one of several hiking trails that crisscross the preserve. The following ten pictures were taken adjacent to the Purington and Consolidated #1 quarry pits and along the Heath Trail. The pits themselves are now filled with water, but blasting has left many large boulders with excellent exposures of fresh pegmatite, many showing graphic textures.



Photo by Marc C. Loisel

**Figure 4.** Graphic granite with quartz crystals showing the the characteristic "V" shaped cross-section. The quartz crystals are within an optically continuous alkali feldspar crystal.

The Heath Trail and Graphic Granite



Photo by Marc C. Loisel

Maine Geological Survey

**Figure 5.** The Heath in early morning from the start of the Heath Trail. A parking area for hikers is located just to the north of the area by the Purington Quarry where the photographs of graphic granite were taken.



The Heath Trail and Graphic Granite

**Figure 6.** The optically continuous nature of the enclosing alkali feldspar crystal is demonstrated by the uniform reflection of the cleavage planes of the feldspar. In many cases (but not all - see Whalstrom, 1939) the quartz crystals are also optically continuous. Relationships like this one led to theories that posited the origin of graphic granite by replacement of alkali feldspar along cleavage planes.

The Heath Trail and Graphic Granite

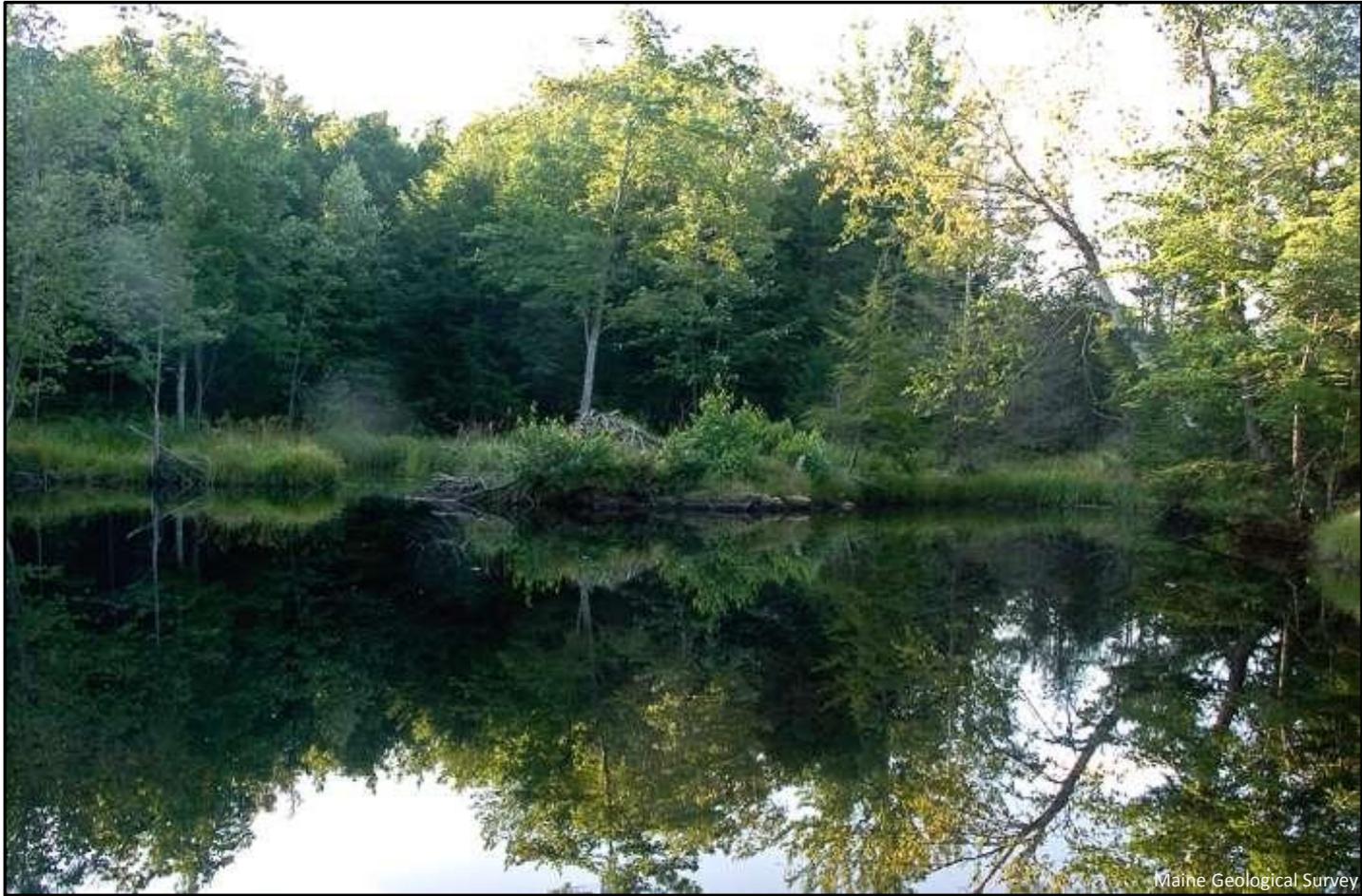


Photo by Marc C. Loiseau

**Figure 7.** A beaver lodge occupies prime real estate - one of the water-filled Swamp Quarries - in the Cathance River Nature Preserve. Viewable along the Heath Trail.



The Heath Trail and Graphic Granite



Photo by Marc C. Loiseau

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**Figure 8.** This graphic granite segregation may be a large megacryst in the pegmatite or it may have crystallized from a pocket of water-saturated magma.



The Heath Trail and Graphic Granite



Photo by Marc C. Loiseau

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**Figure 9.** A quiet pool in the Nature Preserve along the Heath Trail.



The Heath Trail and Graphic Granite



Photo by Marc C. Loiseau

**Figure 10.** The opportunity to view segregations of graphic granite in three dimensions lets you see that the thin rods of visible quartz are actually long, thin, planar crystals.

The Heath Trail and Graphic Granite



**Figure 11.** A miniature world takes shape and evolves on the stump of a tree logged many years ago on the Heath Trail.

The Heath Trail and Graphic Granite



Photo by Marc C. Loiselle

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**Figure 12.** The Purington Quarry.



The Heath Trail and Graphic Granite



Photo by Marc C. Loiseau

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**Figure 13.** The Cathance River along the Rapids Trail. The higher-than-normal rainfall in August, 2008, produced flows much higher than would normally be seen in late August when this picture was taken.



### Graphic Granite

Arguments over the origin of graphic granite mirrored closely the debate on the origin of granite - a metasomatic/replacement origin versus a magmatic origin (see Whalstrom, 1939; Spencer, 1945; Barker, 1970; and Fenn, 1986).

The optical continuity of the enclosing alkali feldspar, the lack of a consistent crystallographic orientation between the quartz and feldspar host, and the cross-cutting nature of late quartz veins in some feldspar crystals provided support for a replacement hypothesis (Whalstrom, 1939).

The similarity of the texture of graphic granite to eutectic structures in metallic systems suggested that graphic granite may have crystallized from a eutectic or cotectic composition - a liquid composition where two or more solid phases are in equilibrium with the liquid and crystallizing simultaneously. This is supported by the relatively narrow range the quartz/feldspar ratio of graphic granite - in the range of 24-percent to 32-percent quartz. A fixed ratio of crystallizing phases is characteristic of a cotectic or eutectic composition. Bulk compositions of some graphic granites do not lie on the quartz-feldspar cotectic at reasonable temperatures and pressures, however.



### Graphic Granite

The general consensus at the present time is that graphic granite does form by the simultaneous crystallization of alkali feldspar and quartz, but not necessarily at equilibrium conditions. Experimental studies (Fenn, 1986; Lentz and Fowler, 1992) suggest that graphic granite textures form under non-equilibrium conditions in rapidly cooling silicate liquids saturated or nearly saturated with a volatile (water-rich?) phase. The unusual texture is the result of oscillation between silica saturated (quartz crystallizing) and silica under-saturated (feldspar crystallizing) conditions.

In the Topsham area, graphic granite is characteristic of the youngest suite of pegmatites, dated from 268 to 275 million years old - of Permian age (Tomascak and others, 1996). Older pegmatites in the region, of Middle to Late Devonian age, do not have the graphic texture. The different pegmatites are shown on the [geologic map of the Bowdoinham quadrangle](#) (West and Cubley, 2006), and summarized in the [Bath 100K bedrock geology report](#) by Hussey and Berry (2002).



References and Additional Information

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- Fenn, P. M., 1986, On the origin of graphic granite: American Mineralogist, v. 71, p. 325-330 ([pdf format - 626Kb](#)).
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