# NOTES AND NEWS

## PALEOZOIC PEGMATITES IN THE PENNSYLVANIA HIGHLANDS

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ABSTRACT

Quartz-feldspar dikes have been found in the Hardyston sandstone of Cambrian age where it directly overlies the pre-Cambrian rocks in the Pennsylvania Highlands. The occurrence is in the east end of Morgan Hill along the Delaware River, in the eastern part of Northampton County where the roughly parallel ridges of the Highland area strike nearly east and west.

The quartz-feldspar introduced material occurs in the lower few feet of the sandstone in groups of small lenticular dikes only a few feet long and usually not more than a few inches thick. Microcline and apatite were formed first and were later invaded by an abundance of quartz which has replaced the feldspar to a large extent.

The pegmatitic invasion of Lower Paleozoic rocks has long been recognized in the Philadelphia area but the writer is not aware that it has previously been reported in the Pennsylvania Highlands.

With the finding of definite pegmatitic material of Paleozoic age, it may be reasonably assumed that much of the silicification of Paleozoic rocks of the area has been accomplished by magmatic solutions; also it is likely that at least some of the quartz veins in these rocks were formed from solutions of magmatic origin, which in their less aqueous and more siliceous phases formed pegmatites.

### FIELD RELATIONS

Pegmatitic material in the form of microcline-quartz-apatite dikes are found in the basal part of the Paleozoic rocks of the Highlands where they are cut by the Delaware River in Easton Quadrangle (Fig. 1). The dominant ridge west of the Delaware is known as Morgan Hill, and extends away from the river in a direction a little south of west. The main mass of the hill is pre-Cambrian crystalline gneisses and schists. The Hardyston formation flanks the ridge along its northern side and is cut off at the eastern end by a fault which parallels the southern side of the ridge. The Hardyston which varies from a quartzite to a less densely indurated sericitic arkose, for the most part, dips away from the ridge to the north and northeast. The dikes occur in this arkosic sandstone immediately above the contact with the crystalline rocks which have previously been stated to be pre-Cambrian. Inasmuch as some of the underlying crystalline material is pegmatite there is a possibility that some of it likewise may be Paleozoic in age. The nature of the contact with the Hardyston however lacks the characteristics of intrusion and more nearly resembles a contact of deposition along which recrystallization has occurred. The amount of intruded material of Paleozoic age found in the Hardyston is small, and in all probability, it is not abundant in the underlying crystallines close to their contact with the Paleozoic sediments.

Pegmatites are very common in the pre-Cambrian rocks of the region. They range from those types approaching coarse textured granites to very coarse, truly pegmatitic masses of feldspar, quartz and mica and (or) tourmaline. Other types vary considerably in their texture and composition, some containing andesine and hornblende as neocrystallization products of materials assimilated from basic gneisses, some

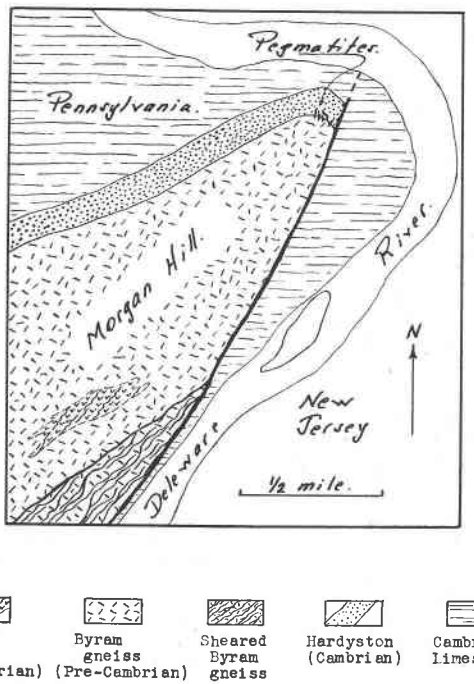


FIG. 1. East end of Morgan Hill showing the areal geology and the location of the pegmatite dikes. Limestone by B. L. Miller. Hardyston by P. B. Myers.

locally being hornblende pegmatites, and others contain only quartz and tourmaline. Dikes having clean-cut borders are uncommon and the gradation, through several inches or several feet, from pegmatitic material to country rock is the rule.

It is apparent that pegmatites of Paleozoic age would be distinguished with difficulty in the areas of pre-Cambrian rocks and only where one is fortunate enough to find them actually cutting Paleozoic sediments may their later age be recognized.

The pegmatitic material observed in the Hardyston varies from subhorizontal irregular lenses, changing in a horizontal distance of less than ten feet from a maximum of five or six inches to less than an inch in

thickness, to small dikes extending vertically and sending off small spur-like apophyses that have filled what were apparently gash joints.

The proportional amounts of feldspar and quartz vary considerably. In hand specimens feldspar appears in some places relatively free from other minerals, and in others it is intimately mixed with quartz which may, and often does, make up a large percentage of the dike.

The dikes occur in only the first few feet of the Hardyston above its contact with the pre-Cambrian. The Hardyston itself is only a few feet thick in the outcrop where the dikes appear. There is, therefore, no evidence of a very extensive invasion of pegmatitic material into Paleozoic formations altho further discoveries may extend the upper limit considerably.

Pegmatite dikes[1] and evidence of pegmatitic emanations into Paleozoic


FIG. 2. Microcline (M), apatite (A) and quartz (Q). Note the replacement of the feldspar by quartz. The feldspar is partially kaolinized. Mag. 45 diameters.

rocks of the Philadelphia region are not uncommon, but the evidence of a similar activity in the Pennsylvania Highlands is not so abundant and to the writer's knowledge has not been previously reported. Igneous rocks of Paleozoic age in areas near the Highlands are found north of Beemerville,[2] New Jersey, and near Jonestown,[3] Pennsylvania. The former is a nepheline syenite illustrated in the Folio as an elliptical area lying between the areas of Martinsburg shale and Shawangunk con-

[1] Bascom, F., and others., *U. S. Geol. Survey, Folio* **162,** Philadelphia, Pa.

[2] Spencer, A. C., and others, *U. S. Geol. Survey, Folio* **161,** Franklin Furnace, N. J. Wolff, J. E., described the nepheline syenite.

[3] Gordon, S. E., *Proc. Acad. Nat. Sci., Philadelphia,* vol. **72,** pp. 354–357, 1921. Stose, G. W., Jonas, A. I., *Bull. Geol. Soc. Am.*, vol. **38,** pp. 505–536, 1927.

glomerate. The latter is an occurrence of basaltic material as lava flows interbedded with rocks of Ordovician age.

## Petrography

In thin section, microcline is found lining the dike walls and extending into the dike proper in irregular masses. It contains occasional grains, or aggregates of grains, of apatite and is extensively replaced in places by quartz (Fig. 2). The quartz may occupy the entire dike except for small amounts of ragged microcline remaining along the walls. In other places it has encroached upon microcline and has penetrated this mineral as arms and irregular areas (Fig. 3). The edges of some microcline grains contain abundant small circular areas of quartz and have numerous concave encroachments of quartz.

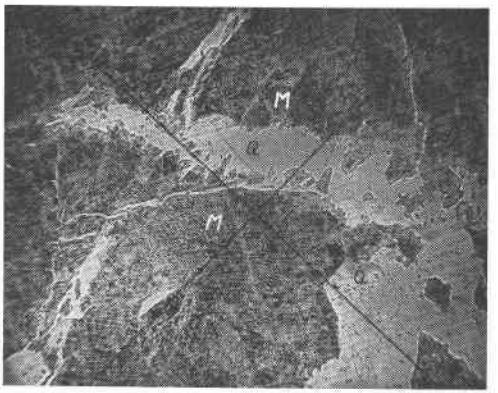


Fig. 3. Quartz (Q) veinlet replacing microcline (M). Note the smaller areas of quartz at the upper center and lower left and the small remnants of feldspar along the margins of the veinlet. Mag. 45 diameters.

Along the walls of the dike, which are much more distinct than the contacts of pre-Cambrian dikes with their wall rocks, grains of feldspar in the sandstone show extended growth, as do also occasional grains of tourmaline.

It is concluded from these features that at first microcline and apatite entered and filled the fractures. At this time some feldspar grains, and probably the tourmaline also, suffered extended growth in the wall rock. Quartz then entered, permeated the vein material and extensively replaced the microcline.

It is likely that the dikes where now found indicate the upper limit reached by the pegmatitic juices beyond which the filling more and more closely approached vein formation. Their igneous affiliations, however,

are fairly definite and hence the presence of a granite magma in the proximity of the Highland area, in Paleozoic time, is indicated.

If we now consider the abundance of quartz veins found in the region and the extensive silicification of the Hardyston and the pre-Cambrian rocks, it is apparent that the entire Highlands, and the limestone and shale areas adjacent, have been subjected to an extensive permeation by silica bearing solutions. Much of this material which has previously been tentatively assumed to be of meteoric origin, may well be of magmatic origin as is indicated by the finding of pegmatitic material in the district.

In addition, it should be pointed out that there is now a source for magmatic solutions which may have formed the zinc deposits at Friedensville, as well as other zinc and lead deposits of eastern Pennsylvania, which have been thought to lie outside the areas invaded by such solutions.