ZOISITE AND OTHER MINERALS INCLUDED IN MICA FROM SPRUCE PINE, NORTH CAROLINA

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Spruce Pine, North Carolina, is the center of a region containing a large number of pegmatite dikes which cut the old crystalline rocks. They range in size from small stringers to huge dikes several hundred feet in width and several miles or more in length. The most abundant minerals in these dikes are feldspar, mica and quartz. The district is an important feldspar producing center. In places the feldspar is altered to kaolin, and large quantities of kaolin are mined, washed and shipped to potteries and other users.

The material upon which this paper is based was collected during the early part of April, 1931, by H. C. Amick, a colleague at the University of Tennessee and the writer, in company with Mr. J. C. Pittman, owner of the Chestnut Flat Mine. The mine consists of a number of openings on the hillside high above the creek valley, and is operated for feldspar, which is chiefly microcline, the only sodic feldspar present occurring as perthitic lenses in it, but the dike contains quartz, mica, garnets, pitchblende and other minerals. Pure feldspar is desired and the other minerals are carefully sorted out. The amount of pitchblende is very small. Locally associated with the pitchblende are hydrated uranium minerals of brilliant shades of red, yellow, and green. The mica, muscovite, occurs in "books" or masses of different sizes. They vary from 1 to 30 inches in diameter and from two or three inches to 15 or 20 inches in thickness. The mica masses occur sparingly in most places, but locally they become more numerous. In general, the mica is not first grade and most of it is of such poor quality that it must be rejected and thrown on the dump. By careful sorting and trimming some saleable mica can be obtained. The major portion of the mica is reported to be sold to the electrical trade. Associated with the muscovite are several minerals, biotite, in small amounts; garnet; magnetite; branching groups of zoisite crystals; quartz; and small tufts of crystals that are probably zoisite. While the occurrence of minerals as inclusions in mica is well known, it is believed that the occurrence of zoisite in muscovite is new, as is also garnets with inclusions.

Zoisite ordinarily occurs in masses of small threads and needles as a product of metamorphism. However, large, coarsely crystalline masses of this mineral were once obtained at Ducktown, Tennessee. At the Chestnut Flat Mine in April, 1931, a mineral was discovered which was new to the workmen. Superficially, it resembled enstatite or tremolite, but later optical examination showed it to be zoisite. It occurs in extremely flat elongated crystals which radiate from common centers. Moreover, the needles from

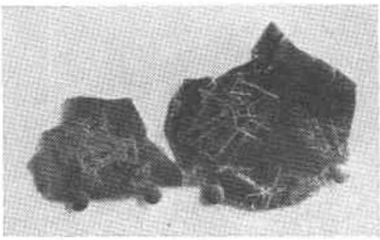

FIG. 1. Zoisite on cleavage plates of mica.

adjacent centers intersect, yielding patterns like that shown in fig. 1. The crystals in these specimens are more than 50 cm. in length, but in others they are much smaller. In some cases the growth of the needles seems to have been entirely between the "leaves" or cleavage plates of the "books" of mica while in other instances, as in fig. 1, the crystals are several millimeters thick,

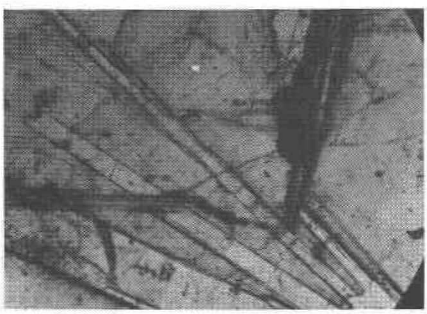

FIG. 2. Fine needles of zoisite in muscovite. Magnification 13×.

and the casts of the crystals with the impression of the striations are conspicuous when the zoisite crystals are removed from the mica host. The cleavage sheets of muscovite frequently have grooves, caused by impressions of the included crystals in them, when torn from the mass. The fine needles of zoisite are shown in fig. 2 as they appear under the microscope. Another type of zoisite forms fibrous, spherical masses which have a decided tendency to grow by penetrating through the mica rather than by developing along the cleavage planes. This type appears to have formed during the crystallization of the muscovite, as is shown in fig. 3.

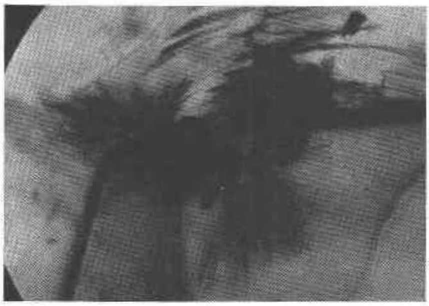

FIG. 3. Fibrous, spherical masses of zoisite penetrating muscovite. Magnification 30×.

Associated with the muscovite is some biotite. Hand specimens of the latter mineral can be obtained from the waste dump. Under the microscope, the biotite occurs in small, extremely thin crystals in the muscovite. Due to their dark color they photograph black under the microscope. Other small lens-like masses of similar size and shape are opaque and prove to be magnetite. These magnetite masses are cracked, as shown in fig. 4, in a manner resembling

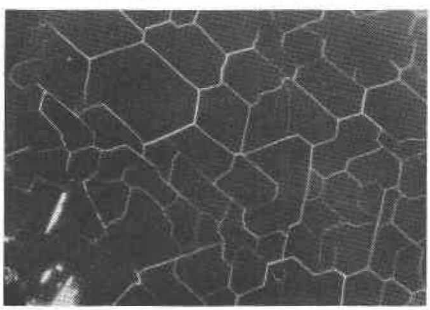

Fig. 4. Cracked magnetite in muscovite. Magnification 13×.

the pattern of a basal section of columnar basalt. It suggests that the biotite was altered and the iron oxide portion of the mineral was changed to magnetite but that the area was too great to permit the formation of a continuous film, or that the film was continuous originally but broke up in cooling in order to afford relief from strain.

Hematite occurs in minute scales which are blood red in transmitted light.

The garnets included in the muscovite from this locality are well known. They are chiefly rhombic dodecahedrons and trapezohedrons with two parallel and relatively large faces and the others greatly reduced in size. The garnets resemble the variety pyrope, but contain sufficient amounts of iron and calcium to give definite reactions for these elements. Garnets richer in iron and calcium occur in the pegmatite in association with microcline feldspar. The garnets associated with feldspar are much larger and the faces are approximately equally developed. However, they are so well attached that it is difficult, if not impossible, to obtain crystals free from feldspar. The feldspar and garnet weather with almost equal rapidity and good crystals cannot be obtained from the weathered masses. The garnets in the muscovite are shown in fig. 5. The largest of these garnets is less than a centimeter in

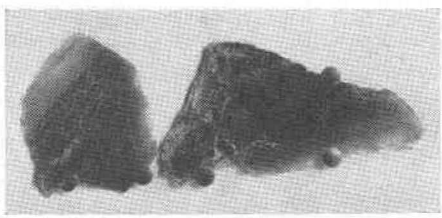

FIG. 5. Flattened garnets in muscovite.

diameter. On account of the size of some of the garnets workmen often examine the garnetiferous books of mica, before they are thrown on the waste heap, for garnets sufficiently large for cutting, but they report that they find few suitable for this purpose. The garnet shown in fig. 6 is a relatively clear one, but it shows a distinct zonal structure as shown by variations in both color and birefringence. The black specks are magnetite grains that show prominently in the mica and lie either above or below the garnet. Fig. 7

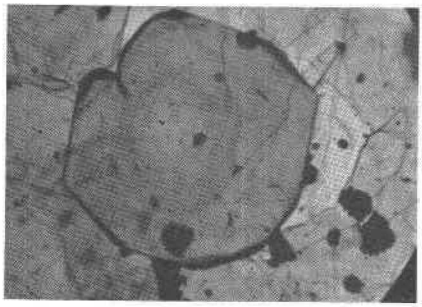

FIG. 6. Flattened garnet showing zonal structure. Magnification 13×.

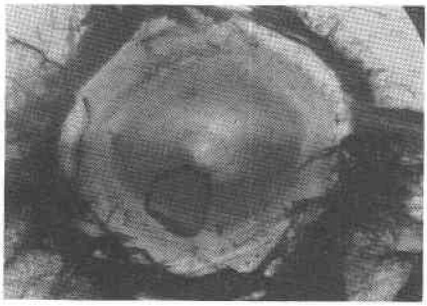

FIG. 7. Garnet included in a garnet in muscovite. Magnification 13×.

shows a garnet with another garnet included within it. The included garnet appears to be oriented approximately 180 degrees with reference to its host.

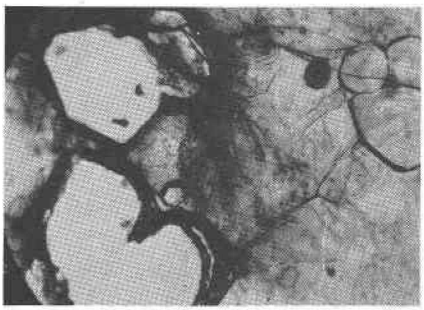

FIG. 8. Flattened quartz and garnet in muscovite. Magnification 13×.

The quartz crystals shown in fig. 8 are distinctly flattened. The difference in indices of refraction of garnet, muscovite and quartz are clearly shown in this figure.