DEVITRIFIED FELSITE DIKES FROM ASCUTNEY MOUNTAIN, VERMONT

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Introduction

The stock of gabbro and nordmarkite penetrating the ancient gneisses and phyllites of Ascutney mountain, Vermont, is associated with various dike rocks. Among the leucocratic types, and probably connected with the nordmarkite, Daly[1] describes paisanitic dikes which strikingly resemble fine-grained phases of the main stock. During a brief visit to the region in 1933, a few glass-bearing dikes were observed that contain spherulites. They have not been previously mentioned, and appear to have some bearing on the depth at which the stock consolidated. The field relations were studied by Balk and the petrographic examination made by Krieger.

Field Relations

Fine grained, aphanitic dikes, cutting the gneiss as well as the gabbro and nordmarkite porphyry, were found at four localities. (1) Near the top of hill 980 feet, one mile northeast of Ascutney Notch, (Claremont quadrangle, Vermont-New Hampshire), the hornblende gneiss is traversed by a group of splintery, grayish-white, aphanitic dikes striking north-south and dipping in various directions. The dikes vary in thickness from three to 27 feet and can be followed along their strike for approximately 600 feet. At this locality they do not appear to reach the intrusive stock. (2) At the crest of Little Ascutney mountain (Ludlow quadrangle, Vermont) the nordmarkite porphyry is cut by another dike. The contact of the dike and nordmarkite at this locality is well defined. This dike strikes northwest-southeast and dips 75 degrees northeast. Where best exposed, the dike is one foot thick but attains somewhat greater thickness at other places along the strike. Loose blocks of the dike were also found in the paisanite area as mapped by Daly.[2] (3) About 15 dikes outcrop in the hornblende gneiss of hill 1040 feet, one and one-half miles northwest of Pierson Peak (five millimeters south of letter "o" of "Robinson Hill," Ludlow quadrangle). Some of these dikes are perfectly straight whereas others curve with the strike of the gneiss, which here forms a northward pitching syncline. All of these dikes are short and rarely traceable for more than 30 feet, although some resemble rows of lenses which appear to be connected below the surface. Although rudely parallel to the foliation of the gneiss, the

[1] Daly, R. A., The geology of Ascutney mountain, Vermont: *U. S. Geol. Survey, Bull.* **209**, 1903.

[2] *Op. cit.*

contact planes, nevertheless, cut the folia at acute angles. These dikes vary in thickness from one-half inch to five feet or more. A few additional dikes outcrop some 1200 feet southeast of this locality along the southwest slope of hill 1060 feet. (4) The largest dike was observed along a brook just south of the private road one-half mile west of Pierson Peak (Ludlow quadrangle). This dike strikes east-west and attains a thickness of over 100 feet. The brook follows the strike of the dike for approximately 600 feet and exposures along it are continuous and fresh. Both the gneiss and the gabbro are cut by the dike.

A laminated structure due to the alignment of flow layers is present in all of the dikes and is especially intense in the thinner ones. The flow layers follow the contacts and abut sharply against the foliation of the gneiss and also of the gabbro when the latter rock is foliated. At locality (1) flow layers of the largest dike display well developed isoclinal folds, the limbs of which join the contacts (Fig. 1).

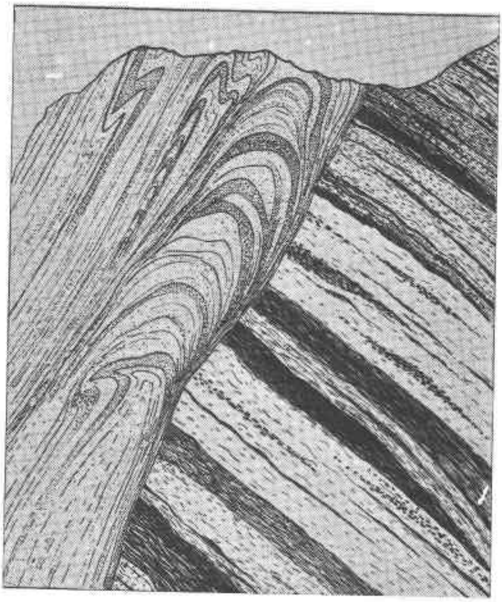

Fig. 1. Field sketch of devitrified felsite dike, cutting foliation of hornblende gneiss, near top of hill 980′, 1 mile NE of Ascutney Notch, Claremont quadr., Vt.,-N.H. Area 9 by 7 feet. Looking north. Note isoclinal folds of spherulite-bearing layers (dark stippled). The dike dips west at an angle of 70°.

Most of the dikes are aphanitic in texture, although the interior of the thick dike at locality (4) is slightly porphyritic and shows small phenocrysts of feldspar and an occasional grain of biotite or hornblende. In addition, porphyritic facies appear locally in the form of irregular, bale-shaped masses, ranging in width from a fraction of an inch to about four inches, with aphanitic facies filling spaces between these areas. At locality (1) the rock exhibits fine linear streaks on the flow layers which share trend and pitch with the axes of the folds in the dikes. The streaks appear to be composed of rows of minute sericite flakes.

The most noteworthy feature of the dikes is the occurrence of small spherulitic nodules which are aligned in directions parallel to the flow layers and participate in their contortions and bends (Fig. 1). A petrographic examination of several spherulitic specimens was made.

The geologic relations suggest that the dikes are related to the paisanitic dikes described by Daly. They resemble these rocks in the field and analysis of the interior portion of the thick dike at locality (4) shows an alkali content not greatly different from those of Daly's[3] analyses of the paisanitic rocks (Table 2). The aphanitic dikes, however, show a distinct prevalence of potash over soda (Table 1), and it would seem as if the last residues differed somewhat from a true nordmarkitic magma. The spherulitic nodules, with their devitrified shells, suggest that the stock of Mt. Ascutney had arrived at a fairly shallow level in the crust when the last dikes consolidated.

TABLE 1. CHEMICAL ANALYSIS OF DEVITRIFIED FELSITE DIKE, NEAR TOP OF HILL 980 FEET, 1 MILE NE OF ASCUTNEY NOTCH, CLAREMONT QUADRANGLE, VT.-N.H.

R. B. ELLESTAD, *analyst*.

	SiO_2	67.61
	Al_2O_3	16.78
	Fe_2O_3	0.42
	FeO	1.52
	MgO	0.75
	CaO	0.85
	Na_2O	0.96
	K_2O	9.36
	H_2O+	0.72
	H_2O-	0.08
	CO_2	0.44
	TiO_2	0.11
Spec. gravity	2.644	99.60

TABLE 2. ANALYSIS OF ALKALIES IN CENTRAL PORTION OF THICK FELSITE DIKE, BROOK ONE HALF MILE WEST OF PIERSON PEAK (LUDLOW QUADR., VT.).

E. H. EMENDORFER, *analyst*.

CaO	0.46
Na_2O	4.84
K_2O	3.93
	9.23

[3] *Op. cit.*, p. 75.

Petrography

Megascopic Characteristics. A hand specimen of the felsite is light gray to brown in color, uniformly fine grained or felsitic in texture, with moderately well developed flow structure and a fine incipient jointing. The latter feature is best seen on a polished slab of the rock. Minerals that can be identified megascopically consist of small feldspar phenocrysts up to two or three millimeters in diameter, and a few scattered grains of pyrite. Inspection with a hand lens shows numerous small spherulites, which rarely exceed more than one half millimeter in diameter. The rock weathers to a rusty brown color that is readily distinguishable from the light gray color of the gneiss in which it occurs.

Along the contact of the felsite and the gneiss a narrow band, or selvage, of dark colored ferro-magnesian minerals is usually present. The width of this band is from 10 to 20 millimeters and the color, on a polished slab of the rock, contrasts strongly with the felsite and the gneiss.

Microscopic Features. The microscope reveals a highly devitrified, glassy groundmass enclosing numerous spherulites of feldspathic material. Phenocrysts of feldspar are also fairly abundant in most of the specimens. Some of these show good polysynthetic twinning and have optical properties which would place them in the oligoclase-albite range. Others show good carlsbad twinning with optical properties corre-

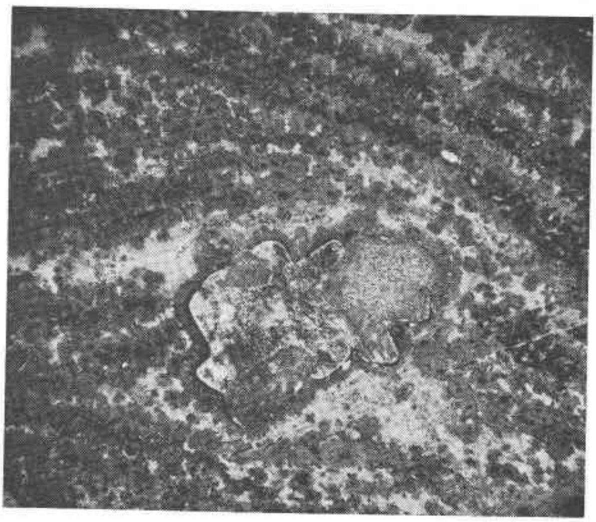

Fig. 2. Photomicrograph of the felsite dike rock showing a cluster of feldspar phenocrysts and spherulites, the latter aligned along the flow layers of the rock. ×22.

sponding to those of orthoclase. Flow structure is well developed in all of the specimens examined.

Feldspar phenocrysts occur as individual crystals and as aggregate groups of crystals distributed throughout the glassy and spherulitic groundmass. Almost invariably they contain numerous liquid or gaseous inclusions which, in most cases, appear to be concentrated in the central portion of the phenocryst. That the magma was still highly fluid after these crystals had formed is evidenced by the well-defined flow structure passing around individual crystals or crystal aggregates (Fig. 2). Some of the feldspar phenocrysts show alteration to flaky sericite. This may have been brought about by the still fluid portion of the magma or by the introduction of deuteric quartz with which the rock appears to have been swamped during the latter stages of its consolidation (Fig. 3).

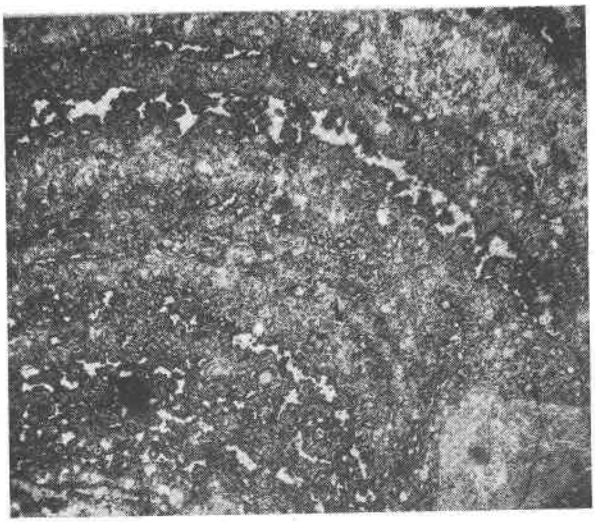

Fig. 3. Photomicrograph showing flow structure of the felsite and the manner in which quartz (clear white areas) occurs along the flow layers. A portion of an altered feldspar phenocryst is also shown. ×22.

Spherulitic growths are abundant in most of the specimens examined. They are usually closely grouped and often coalesce to form numerous clusters which are arranged roughly parallel to the flow structure of the rock. The spherulites consist of numerous small microlites that originally appear to have crystallized in the radiate manner characteristic of such growths. Intense devitrification of the glassy groundmass, however, and the introduction of additional quartz, has modified them to such an extent that good radial extinction is but occasionally observed. The general form of the spherulites, however, is usually well preserved. What the original composition of the spherulites may have been could not be definitely determined. As they frequently show alteration to fine, flaky sericitic material, however, it is judged that they were largely felspathic in composition.

The original glassy groundmass of the rocks has been highly devitrified and, where not affected by other processes, now consists of finely crystalline areas made up of minute interlocking grains which show good polarization effects. Although the individual grains are too small to permit determination of optical properties, it is judged that they consist of quartz and an acid feldspar, the latter showing alteration to sericitic material.

In addition to the devitrified groundmass, the rocks also contain many irregular, blotchy areas consisting of larger interlocking quartz grains (Fig. 4). Individual grains in these areas seem to be too large to

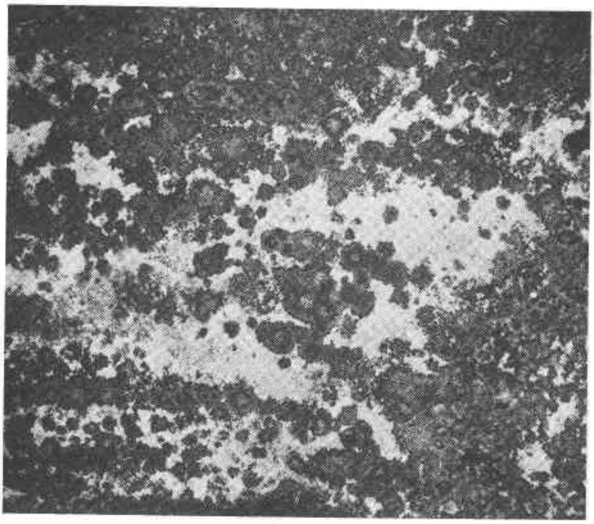

Fig. 4. Photomicrograph showing spherulites and the occurrence of quartz (white areas) which has replaced some of the glassy groundmass. The blotchy habit is typical of the late stage quartz in these rocks. ×22.

have been the result of simple devitrification. The blotchy appearance of these areas, and the manner in which they occur, suggest that they are not the result of devitrification. This material occupies interstitial areas between spherulites and appears to have replaced the groundmass in preference to the spherulitic nodules. Many of these areas extend along flow layers, participating in their contortions and bends. This quartz does not occur in veinlets, but simply as irregular, blotchy areas, nor is there any evidence in the rock to indicate areas of weakness or fracturing along which material may have been introduced. For these reasons it is believed that this material was not introduced from an outside source after complete consolidation of the rock, but that it represents deuteric quartz with which the dike rock was swamped either while still in a slightly viscous state or immediately after being chilled.

An interesting feature of some of the dike rocks is the occurrence of numerous nodules which are made up of exceedingly minute, interlocking grains showing but faint polarization effects. This material occurs as individual nodules, and also as rims surrounding feldspar phenocrysts, in a groundmass of highly devitrified and altered glassy material (Fig. 5). When surrounding phenocrysts of orthoclase, the index of refraction of this material is nearly identical to that of the feldspar, but

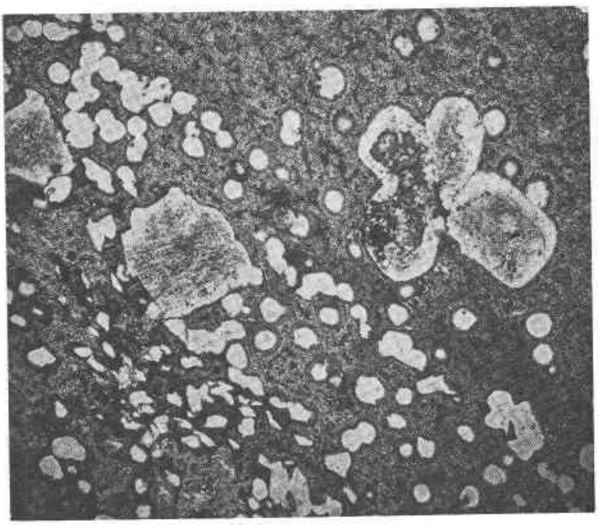

Fig. 5. Photomicrograph showing feldspar crystals and numerous nodules of nearly isotropic material in an altered and devitrified groundmass. The clear, white rim bordering the feldspar crystals is made up of the same material. ×22

it is so nearly isotropic that further optical determinations could not be made. The material making up such rims is later than the feldspar for occasionally it is seen to encroach and penetrate the feldspar in a manner suggesting replacement. These nodular forms do not resemble other spherulites in the rock, nor do they show the development of microlites, but are made up of finely devitrified glassy material.