

found in regarding such samples as composed of smaltite-chloanthite and skutterudite. The general distribution of the last named mineral in what has often been regarded as smaltite-chloanthite can scarcely be doubted.

Analyses of massive or nodular smaltite-chloanthite from the veins of Cobalt usually conform to the general formula  $RS_2$ , as brought out by the analyses reported by Miller,<sup>1</sup> which show: Co 16.7–19.8, Ni 4.5–7.0, Fe 6.2–8.9, As 60.3–63.5, S 4.1–7.0, insoluble, etc. 0–4.4%. The present case thus represents the peculiar situation of massive material having a composition nearer to the theoretical than crystallized material.

The results here brought forward confirm those of Volkhardt and of Beutell, that skutterudite and smaltite-chloanthite are capable of forming isomorphous intergrowths in all proportions, and the theoretically pure individual minerals are almost unknown. These minerals resemble one another so closely in physical properties as to be nearly indistinguishable, while crystallographically they show the same dominant forms,  $a(100)$ ,  $o(111)$ ,  $d(110)$ , and  $n(211)$ . They are probably all pyritohedral, altho in the case of skutterudite the hemihedral character is not so well established. The isomorphism of smaltite-chloanthite and skutterudite, minerals which do not possess similar chemical formulas, suggests in some respects the striking isomorphism of the minerals of the feldspar group.

## THE MINERALS OF ROCKPORT, MASSACHUSETTS

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More than fifty years ago attention was called to the unusual mineral occurrences at Rockport, on Cape Ann, by J. P. Cooke's description of danalite, a new beryllium mineral, and subsequently of cryophyllite, a new lithium mica. Besides being the type locality for these species, the Rockport quarries have afforded an interesting list of rare-earth minerals, and, perhaps most unusual of all, large tabular crystals of fayalite, normally an utter stranger to granitic rocks.

*Geology.*—The country rock of Cape Ann is an alkali granite which forms a batholith having an exposure of some 25 kilometers in greatest diameter, and is cut by numerous dikes of diabase

<sup>1</sup> Miller, W. G., *Report, Bureau of Mines*, 19, pt. II, 17, 1913.

and of various types of porphyry. To the mineralogist, however, its most interesting features are the pegmatites which it encloses.

The granite is very similar to the famous commercial stone of the Quincy quarries, and like it, has been extensively quarried for building purposes. Chemically it is low in magnesium and calcium, and relatively high in sodium and potassium. It therefore falls near the syenite end of the granite series and is usually described as an alkali granite.

In composition the pegmatite is analogous to the granite, and is far from being an orthodox granite pegmatite. It lacks entirely the common tourmaline, garnet, muscovite, beryl and biotite. On the other hand, nephelite and sodalite, so characteristic of the alkali pegmatites, are also absent.

Not only is the pegmatite unusual in its mineralogical composition, but its mode of occurrence is also unique. Instead of appearing in dikes and sills as a well-behaved pegmatite should, it is found in irregular masses, roughly lens-like in form, and entirely surrounded by granite, so that when exposed on any face the pegmatite has the shape of a rounded or perhaps jagged patch framed in a border of granite, finer grained than the normal country rock. The "patches" are small, rarely over 4 or 5 dm. in diameter, and many show a rough zonal structure with feldspar near the periphery and quartz at the core. Large plates of black mica (lepidomelane) occur in the outer feldspar and marginal fine-granite zones.

Aside from these lens-shaped pockets, a less common mode of occurrence of the pegmatite is in narrow seams, few more than 2 or 3 cm. wide, and these seams show the same zonal arrangement as do the irregular pegmatite masses.

*Location and Present Condition.*—Rockport is best reached via the Boston and Maine R. R. from North Station, Boston. The principal localities are (1) the Flatledge quarry on the east or seaward side of the Cape, about fifteen minutes walk northward from the railway station on the road to Pigeon Cove; and (2) the Babson Farm quarry at the northern point of Cape Ann.

Unfortunately for collectors, no pegmatite is at present visible in place at either of these localities. The best collecting ground is a rock dump on the south crest of the Flatledge quarry, where large blocks of rejected granite show remnants of the pegmatite bodies. During last spring, when the locality was visited by the writer in company with Professor Palache, lepidomelane

was collected in plates up to 7 cm. in diameter, as well as cyrtolite, danalite, thorite, fluorite and molybdenite.

#### MINERALS REPORTED

*Albite.* See Feldspar.

*Amphiboles:* *Hornblende* occurs as a narrow black rim surrounding crystals of pyroxene and fayalite.

*Actinolite.* Occurs in radiating black crystals resembling the hornblende in color and luster.

*Anthophyllite.* Fibrous iron amphibole is found along the contact between fayalite crystals and the enclosing quartz and feldspar, where Warren<sup>1</sup> has shown it to be a reaction product between the basic fayalite and the siliceous minerals of the pegmatite.

*Astrophyllite.* Reported by Sears.<sup>2</sup>

*Calcite.* Film-like plates along cleavage planes of decomposed pyroxene.

*Chlorite.* A fine-grained black micaceous mineral forming stringers filling fractures in the feldspar and irregular cavities.

*Cryophyllite.* A variety of zinnwaldite containing lithium and fluorine was described by Cooke<sup>3</sup> from type material obtained at this locality.

*Cyrtolite.* "Hydrous zircon" in groups of brown, curved-faced tetragonal crystals, usually associated with shattered white quartz and granular black mica.

*Danalite.* Rockport is the type locality for this mineral, which, like cryophyllite was described by Cooke.<sup>4</sup> It occurs in small grains to large masses embedded in the pegmatite, and rarely showing crystal faces suggesting octahedral forms.

*Fayalite.* Large crystals of fayalite, the iron olivine, up to 20 cm. long and more than 3 cm. thick have been found in the pegmatite. The crystals are tabular in shape but with faces only roughly developed. Along their margins are radiating fibers of anthophyllite which form the reaction rim above alluded to. Grains of magnetite are segregated near the borders of the fayalite, frequently forming a nucleus for the anthophyllite fibers.

*Feldspars.* The feldspar of the pegmatite is chiefly microperthite,—microcline and albite intergrown in varying proportions. In places the feldspars have the green color of amazon-stone and show prism and dome faces, particularly where surrounded by quartz. More commonly the feldspar is gray and somewhat platy with curved cleavage faces.

*Fergusonite.* This rare-earth mineral is found in irregular grains and narrow lens-like plates in the feldspar of curved-plate cleavage, and in graphic granite.

*Fluorite.* Anhedronal crystals of sea-green fluorite about 2 cm. in diameter are occasionally found embedded in the feldspar of the pegmatites. Purple

<sup>1</sup> Anthophyllite with fayalite from Rockport. *Am. J. Sci.* [4], 16, 339, 1903.

<sup>2</sup> Sears, J. H. *Phys. Geog., Geol., Mineralogy and Paleontology of Essex Co., Mass.*, 1905.

<sup>3</sup> Cryophyllite and Assoc. Minerals from Rockport. *Am. J. Sci.* [2], 43, 217, 230, 1867.

<sup>4</sup> Danalite, a new mineral from Rockport, *Am. J. Sci.*, [2], 42, 73, 1866.

fluorite is common in small grains and is usually associated with granular chlorite and metallic sulfides.

*Gadolinite.* A prismatic crystal 1 x 2 cm. imbedded in a "strained zone" of quartz, collected recently by Prof. Palache, corresponds closely to the description of gadolinite from Llano County, Texas, altho the careful qualitative analysis necessary for its positive identification has not yet been made. It is dark, lustrous and glassy, with conchoidal fracture, black in ordinary light, but green in thin fragments by transmitted light. The crystal is rounded in outline, with no well-developed faces, and is coated with a brick-red alteration product.

*Galenite.* Grains and small masses associated with sphalerite and danalite.

*Hedenbergite.* See Pyroxene.

*Hematite.* As small lustrous scales associated with phenacite and sphalerite in cavities resulting from decomposition of danalite.

*Hornblende.* See Amphibole.

*Lepidomelane.* The large plates of black mica that occur in the fine-granite zone and marginal feldspar have already been alluded to. The most striking occurrence, however, is in tabular masses with basal cleavage-plates up to 8 cm. in diameter and 4 cm. thick. These crystals are automorphic in feldspar and quartz, and have rather rounded edges. In another modification the lepidomelane occurs in compact masses of long, narrow pseudo-hexagonal crystals a few millimeters in diameter. Cyrtolite crystals are frequently embedded in this variety.

*Microcline.* See Feldspars.

*Molybdenite.* In flakes up to five centimeters in diameter, altho usually only a few millimeters. It seems to seek the marginal zones of the pegmatite bodies, where its characteristic occurrence is in the feldspar containing large lepidomelane crystals. It is commonly found in the so-called xenoliths of fine granite, which may or may not be associated with the pegmatite.

*Muscovite.* Small quantities of muscovite have been found, but it is distinctly a rarity and its primary origin has not been established.

*Orthite.* Reported by Sears.

*Phenacite.* In small crystals up to 5 mm. in diameter lining cavities resulting from the decomposition of danalite. This unusual paragenesis for phenacite has been described by Palache<sup>1</sup> in material from an abandoned quarry along the railroad track between Rockport and Gloucester.

*Pyrite.* Found occasionally in small grains with hornblende along the periphery of pyroxene and fayalite crystals.

*Pyroxene.* Hedenbergite occurs, in tabular brown crystals, flattened parallel to the front pinacoid. One twin crystal was noted which showed the basal cleavages meeting at an angle along the pinacoidal plane.

*Pyrrhotite.* Occurs sparingly with pyrite as described above.

*Quartz.* In graphic intergrowth with feldspar or in large smoky masses at the core of pegmatite bodies. Large masses from the Babson Farm Quarry show delicate bluish opalescence. Small, flattened crystals showing prismatic and terminal planes are found in earthy decomposed pyroxene.

<sup>1</sup> *Am. J. Sci.* [4], 24, 252, 1907.

Also in small crystals with the phenacite resulting from decomposition of danalite.

*Siderite.* Pale-brown anhedral crystals as decomposition product of danalite.

*Sphalerite.* Associated with galenite in intergrown masses, and as stringers with chlorite penetrating feldspar along fractures. Also in the quarry between Rockport and Gloucester as a decomposition product of danalite.

*Tantalite.* There is in the Harvard collection a prismatic crystal of tantalite 25 mm. long imbedded in feldspar of the graphic-granite zone. Front and side pinacoids are well-developed and it is terminated with domes and basal pinacoid.

*Thorite.* Var. Orangite in orange-yellow grains is associated with cyrtolite.

*Ytrocercite.* Reported by Sears as occurring on massive quartz at Rockport.

## NOTES AND NEWS

SUPPLEMENTARY NOTE ON CRISTOBALITE. AUSTIN F. ROGERS. *Stanford University.*—Since the manuscript of the writer's note on Cristobalite from Yellowstone National Park<sup>1</sup> was sent in for publication in the AMERICAN MINERALOGIST, this mineral has been recognized in a new locality in California. The statements made in that paper as to the probable frequent occurrence of cristobalite in medio-silicic rocks can therefore be emphasized by the addition, on page 6, of one each to the number of occurrences in California, in America, and in rhyolitic obsidian.

The following additional notes may be of interest. Iddings in the paper cited (p. 264, and Pl. 12, fig. 3) referred to certain minute pellets in the rock of Obsidian Cliff, which may well have been cristobalite. The thin sections of the specimens studied by the writer show in spots an intimate intergrowth of orthoclase and cristobalite. In addition to the mosaic structure and polysynthetic twinning of this mineral, it exhibits in section a peculiar curved fracture which seems to be characteristic of it, thus giving a further means for its recognition.

A METHOD OF OBSERVING AIRY'S SPIRALS. FRANK J. KEELEY. *Academy of Natural Sciences of Philadelphia.*—It may not be generally known that Airy's spirals may be exhibited with a *single* plate of quartz cut normal to the axis, by employing a vertical illuminator and a plane mirror just beneath the quartz plate. The objective used should have sufficient working distance to focus on the reflecting surface of the mirror and the vertical illuminator must be of the disc type. Under these conditions the optical figure may be seen in the back focal plane of the objective by merely looking down the tube through a Nicol prism, or it may be magnified by a secondary microscope in the tube. No polarizer is necessary, for the light reflected by the disc of the illuminator, even at the usual angle of 45°, is sufficiently polarized to show the figure fairly well; and, by tilting the disc more obliquely until it approaches the angle of maximum polarization, and raising the source of illumination correspondingly, the effect is quite as perfect as when a polarizer is interposed in front of the light.

<sup>1</sup> Published in *Am. Min.*, 6 (1), 4-6, 1921.