Notes on some Minerals from the Lizard.

By J. J. H. Teall, M.A., F.G.S.

[Read May 8th, 1888.]

Chrome-diopside.

THIS mineral is found as a constituent of a variety of gabbro occurring on the shore at the village of Coverak, Cornwall. The rock is an aggregate of allotriomorphic grains of chrome-diopside, labradorite and olivine. The olivine is, in general, perfectly fresh, but it is traversed by a network of veins in which magnetite has been deposited. The whole of the iron-ore present in the rock occurs in these veins in the olivine; so that in this, as in other respects, the rock bears a close resemblance to some of the gabbros described by Prof. Judd[1] from the Western Isles of Scotland.

The chrome-diopside is green when viewed macroscopically, but colourless or nearly so in thin sections. The characteristic prismatic cleavages are well developed, and there is, in places, a fine diallagic striation. When this striation is recognisable in sections in which the prismatic cleavages intersect at right angles, it is seen to be perpendicular to the optic axial plane. There is no doubt, therefore, that it corresponds to a separation parallel to the orthopinacoid. The maximum extinction in the prismatic zone is about 40°.

The chrome-diopside was isolated from the felspar by means of a solution of boro-tungstate of cadmium, and from the olivine by means of the magnet. Its specific gravity lies between 3·2 and 3·23. Its composition, as determined by Mr. Player in the author's laboratory, is as follows:—

SiO_2	...	...	49·9
Al_2O_3	...	...	6·2
Fe_2O_3	...	...	1·7
Cr_2O_3	...	...	·6
FeO	...	...	3·9
MnO	...	...	·4
CaO	...	...	20·4
MgO	...	...	16·1
Ignition	...	...	·9
			100·1

[1] *Quart. Journ. Geol Soc* Vol. XLII. p. 49.

Labradorite.

The felspar which is associated with the chrome-diopside and olivine in the above-mentioned rock is wonderfully fresh. It occurs in grains which show twinning on the albite- and sometimes also on the pericline-plan. The lamellæ are generally broad, and somewhat irregular in their distribution.

The specific gravity of the felspar lies between 2·69 and 2·71. The composition of a sample, freed as far as possible from the other constituents, was determined by Mr. Player.

SiO_2	49·4
Al_2O_3	29·8
Fe_2O_3	1·2
CaO	12·6
MgO	1·7
Na_2O	3·3
K_2O	·4
Ignition	1·7
	100·1

Hornblende.

As the hornblende of the Lizard gabbros is believed, in most cases, to be a secondary mineral arising from the alteration of pyroxene, it becomes of importance to determine the relations between the pyroxenes and the hornblendes so far as composition is concerned. A very pale-coloured variety of hornblende occurring in a gabbro-schist at Pen Voose was analysed by Mr. Player, with the following result :—

SiO_2	48·8
Al_2O_3	10·6
Fe_2O_3	1·7
Cr_2O_3	trace
FeO	4·7
CaO	12·2
MgO	18·6
Ignition	1·8
	98·4
Specific gravity ...	3·05

This hornblende is aggregated in bands in the gabbro-schist. In thin sections rays vibrating parallel to a are colourless, those vibrating parallel

to β and γ are a pale brown. The individuals rarely show any definite crystallographic outlines. If this hornblende be secondary, then its composition does not bear out the view that secondary hornblende is derived from pyroxene by a paramorphic change. Too much stress, however, must not be laid on one or two analyses, especially as there are several varieties of hornblende in the Lizard gabbros.

Malacolite.

An extremely hard and finely crystalline rock is associated with the mass of gabbro which is exposed near the headland of Karakclews. The rock in question weathers almost white. Thin splinters are translucent at the edges. In thin section it is seen to be a very fine-grained aggregate of malacolite, labradorite, sphene and an unknown substance which appears brown by transmitted and white by reflected light. The malacolite occurs mostly in the form of minute rounded grains, and, as the optical characters were insufficient for a satisfactory determination, the mineral was isolated and analysed by the author.

SiO_2	...	...	52·8
Al_2O_3	...	...	2·8
Fe_2O_3	...	...	1·8
CaO	...	...	25·2
MgO	...	...	16·6
Ignition	...	...	·5
			99·7

The mineral is perfectly colourless in thin section, and exhibits, of course, the refraction and double refraction of a pyroxene. Owing to the small size of the grains the cleavages are generally unrecognisable. The felspar which is associated with the malacolite occurs in grains of uniform size (about 1 mm.). Certain portions of a slide are occupied almost entirely by these felspar-grains, which then form a kind of mosaic. Most of the individual grains show multiple twinning. Flakes parallel to M (010) give an extinction of about 25°, referred to the trace of the P (001) cleavage; those parallel to P give an extinction of about 12°, referred to the M cleavage.

The specific gravity of the felspar lies between 2·69 and 2·71. The optical characters and the specific gravity both point to the conclusion that the felspar is labradorite. The sphene only occurs in very minute granules.

Much of the so-called saussurite of the Lizard is similar to the above-mentioned rock in composition. In thin sections malacolite may frequently

be recognised as one of the constituents, as, for example, in the saussurite of Pen Voose.

Anthophyllite.

In some varieties of the Lizard gabbros the altered olivines are seen to be surrounded by two zones. The inner zone is formed of a colourless mineral with which iron oxides are usually associated; the outer zone is formed of green actinolitic hornblende, and is free from iron oxides. The needles of actinolite, composing the outer zone, are often arranged in a radial manner with reference to the nucleus. This zoning is developed between olivine and felspar.

Longitudinal sections of the colourless mineral are lath-shaped in form and somewhat fibrous in appearance. Under crossed nicols they frequently show the colours of the second order, even in very thin sections. They give straight extinction, and the minor axis of depolarisation is invariably coincident with the length of the section. Cross-sections are somewhat rare in the slides which have been examined. A few, however, have been observed, and they give indications of four prismatic faces meeting in the angles characteristic of hornblende. The minor axis of depolarisation bisects the acute angles of the prism, and there is a cleavage also bisecting this angle.

Considerable masses of the colourless mineral were observed at a disturbed junction between gabbro and serpentine (Pen Voose, near Landewednack). In this case the mineral did not occur as a zone round altered olivine, but formed ellipsoidal aggregates in a mass of green hornblende. The aggregates are radially fibrous in structure. The axes of the fibres converge towards the centre, where they meet along a suture. A section through one of these aggregates measures 5 cms. by 1 cm. The mineral possesses a silky lustre. Narrow flakes may be readily detached with a penknife, and they are seen, in convergent polarised light, to be at right angles to a negative bisectrix.

From the above facts we conclude that we are here dealing with a rhombic hornblende having a cleavage at right angles to the negative bisectrix; and, further, that the a axis of elasticity is coincident with the brachy-diagonal, the β axis with the macro-diagonal, and the γ axis with the vertical (crystallographic) axis. The mineral is therefore anthophyllite.

Mr. T. Davies, on seeing the specimen in which it occurs in ellipsoidal aggregates, at once recognised its resemblance to the anthophyllite from Hermannschlag, in Bavaria, which forms radially fibrous zones round kernels of biotite.

A portion of one of the large aggregates was analysed by Mr. Player.

SiO_2	50·8
Al_2O_3	3·6
Cr_2O_3	trace
Fe_2O_3	3·7
FeO	6·8
CaO	1·2
MgO	26·1
Na_2O (K_2O) ...	·2
Loss on Ignition ...	5·8
	98·2

The analysis shows that the mineral is closely allied to the hydrous anthophyllites from Scouric and Glen Urquhart, which have been analysed by Dr. Heddle.[1]

Prof. Becke[2] has described the occurrence of zones of hornblende and anthophyllite round the olivines of the gabbro of Rosswein in Saxony.

There can be little doubt that the anthophyllite is a secondary mineral resulting from the alteration of olivine. It may be interesting to record that in one case where the olivine was perfectly fresh it was separated from the felspar by a narrow zone of pyroxene ; both anthophyllite and actinolite being absent.

In conclusion, the author has to express his thanks to Mr. Player for most of the analyses published in this paper.

---

[1] *Trans. Roy. Soc. Edin.* Vol. XXVIII. p. 536.

[2] *Min. Mitth. Neue Folge.* Vol. IV. p. 450.