Note on the occurrence of piedmontite in quartz-muscovite-schist from Shotover valley, western Otago, New Zealand.

By F. J. Turner, D.Sc., F.G.S.
Lecturer in Geology, University of Otago.

[Communicated by the General Secretary, read March 23, 1933.]

SPECIMENS of quartz-muscovite-schist obtained from boulders in the Shotover river, western Otago, New Zealand, were recently examined by the writer and found to contain abundant piedmontite, a mineral not previously recorded from New Zealand. The specimens had been collected twenty years before and were labelled ' micaceous quartz schist coloured with haematite ' in the geological collections of the Otago University. The following description is submitted pending further field investigations.

Macroscopically the rock (no. 1489) is a strongly foliated, finely laminated quartzose schist of a distinctive purplish-red colour. In section the essential minerals are quartz, piedmontite, muscovite, and a little garnet, accompanied by accessory iron-ore and apatite. The quartz greatly predominates over the other constituents and occurs as xenoblastic grains about 0·3 mm. in diameter, showing marked undulose extinction, and everywhere traversed by minutely spaced strings of dusty inclusions trending parallel to the foliation. Oriented flakes of muscovite are concentrated, together with needles and prisms of piedmontite, in narrow bands from 0·5 to 1 mm. apart. The garnet is a colourless variety occurring as small, irregular, sporadically distributed porphyroblasts which usually enclose minute inclusions of iron-ore, piedmontite, and quartz. Slender prismatic crystals of piedmontite ranging up to 0·5 mm. in length are abundant and always show marked parallelism, thus imparting a linear foliation and sometimes an almost nematoblastic microstructure to laminae in which the mineral is especially conspicuous.

The optical properties of this mineral are somewhat abnormal and merit detailed description. The most striking feature is intense pleochroism according to the following scheme:

α clear canary-yellow, β very pale amethyst, γ deep purplish-red;
Absorption $\gamma > \alpha > \beta$.

Since β is parallel to the b crystallographic axis (the direction of elongation), those sections which are pleochroic from yellow to pale amethyst have positive elongation, while sections in which the deep purplish-red γ tint appears are negatively elongated; in both cases the direction of maximum absorption is normal to the length of the section. The birefringence is moderately high, and the axial dispersion is very strong. The optic axial angle appears to be very nearly 90°, but could not be actually measured, and the optic sign could not be determined.

The pleochroic colours shown by the mineral in thin section closely resemble those of piedmontite from Japan and from South Mountain, Pennsylvania, as determined by G. H. Williams,[1] and of piedmontite from Ghogara, Central Provinces, India, described by L. L. Fermor.[2] As regards the absorption, the intensity for β seems to be abnormally low, appearing less than for α, and markedly less than for γ, thus $\gamma > \alpha > \beta$. Williams[1] gives $\gamma > \beta > \alpha$ or $\gamma > \beta = \alpha$, and this seems to be the usual scheme, though J. Suzuki[3] finds for Japanese material $\gamma < \beta > \alpha$, and A. N. Winchell[4] gives $\alpha > \beta > \gamma$ for the same colour scheme.

The piedmontite-schist described above resembles closely some of the Japanese piedmontite-sericite-quartz-schists which Suzuki[5] considers to have originated by dynamic metamorphism of siliceous or slightly calcareous sedimentary rocks, under conditions intermediate between those of the epi- and meso-zones of U. Grubenmann. Though the New Zealand rocks have not yet been found in situ, they no doubt occur in association with the quartz-albite-chlorite-schists and quartz-albite-muscovite-chlorite-schists of the Maniototo Series, which make up the whole of the mountainous region drained by the Shotover and its tributaries. The piedmontite-bearing schists of the Shotover valley appear therefore to have attained only a low grade of metamorphism within the epi-zone of Grubenmann. The presence of garnet in such rocks is no doubt attributable, as demonstrated by Tilley[6] in similar cases, to the relatively high manganese content of the rock itself, as indicated by qualitative chemical tests upon the powdered schist.

[1] G. H. Williams, Amer. Journ. Sci., 1893, ser. 3, vol. 46, p. 52.

[2] L. L. Fermor, Mem. Geol. Surv. India, 1909, vol. 37, pt. 1, p. 191.

[3] J. Suzuki, Japanese Journ. Geol. Geogr., 1924, vol. 3, no. 3–4, p. 138. [Min. Abstr., vol. 3, p. 198.]

[4] A. N. Winchell, Elements of optical mineralogy, 2nd edit., 1927, pt. 2, p. 358.

[5] J. Suzuki, loc. cit., p. 149; and Min. Abstr., vol. 4, p. 402.

[6] C. E. Tilley, Quart. Journ. Geol. Soc. London, 1923, vol. 79, p. 198.

Boulders of similar quartz-muscovite-piedmontite-schist (nos. 1915, 1916, 1917), the ultimate source of which probably lies somewhere in the Shotover valley, have also been obtained from Clyde, central Otago.[1] Specimens of piedmont-bearing erratics have since been found in other districts.

In conclusion the writer wishes to extend his thanks to Professor J. Park of Dunedin, who collected the specimens which form the subject of the present paper.

[1] Specimens from both these localities have been deposited in the rock collection of the British Museum.