

SHORT COMMUNICATIONS

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Tourmalines from Cuvier Island, New Zealand

THE intrusion of a mid-Tertiary diorite stock into Mesozoic geosynclinal sediments on Cuvier Island was accompanied by considerable tourmalinization and hydrothermal alteration of the country rocks. Tourmalinization postdates the major period of intrusion and metamorphism and coincides with the pneumatolithic phase of plutonism, which also produced tourmaline-rich pegmatites. The strongest tourmalinization is seen in siliceous lithologies and breccias. Tourmalinizing solutions apparently penetrate the country rocks along joints, veins, and shear zones and tourmaline systematically replaces all aluminium and ferromagnesian silicates and locally results in the formation of tourmaline-quartz rocks (luxullianites). Crosscutting tourmaline vein sequences, and the occurrence of large tourmalines showing uncorroded crystal faces overgrown by polar outgrowths of small tourmaline needles while other faces are deeply corroded, suggest that tourmalinization was a complex process that may have extended over a considerable time period.

The object of the study was to investigate the range in composition within a single tourmaline crystal and between tourmalines from a variety of host rocks and to determine whether any elements, other than boron, were introduced into the country rocks during tourmalinization.

All Cuvier tourmalines are uniformly black in hand specimen but in thin section they are pleochroic from blue, golden-brown deep olive-brown, or green to pale lilac or colourless and basal sections frequently show colour zoning. Deep green pleochroic tourmaline is the only species found in country rocks outside the aureole; the more variably coloured and zoned tourmalines are found in pegmatites and high grade hornfelses. Comparison of the succession of colours in zoned tourmalines from a number of different localities showed no consistent colour sequence.

Axinite has been found in metamorphosed limestone bands associated with manganese cherts and variolitic lavas. Analysis of the axinite has shown it to be manganese-rich and according to the nomenclature of Sanero and Gottardi (1968) it should be classified as manganaxinite.

An axinite and a number of homogeneous areas within zoned tourmaline crystals were analysed with an Applied Research Laboratories E.M.X. electron microprobe using natural analysed axinite and tourmaline as standards. The data were corrected for background, atomic number differences, and absorption. Errors are estimated to be 3 % for major and 5 % for minor components. The composition, pleochroic colour, and refractive indices of the analysed minerals are listed together with unit-cell

dimensions calculated from indexed powder diffraction data for two tourmalines in Table I.

ϵ and ω refractive indices, determined for twenty-five tourmalines, were within the range $\epsilon = 1.620-1.635$, $\omega = 1.650-1.668$ indicating a variation from 0.50 to 2.00 ($\text{Fe}^{2+} + \text{Fe}^{3+} + \text{Mn}$) ions on the basis of 31 (OH, F) (Deer *et al.*, 1962, p. 311).

TABLE I. *Electron microprobe analyses of Cuvier Island axinite and tourmalines*

	10272	10204A	10204B	10181	10203A	10203B	10206A	10206B	10206C
SiO ₂	42.0	34.0	34.6	36.2	36.3	35.4	36.0	36.4	36.5
TiO ₂	0.05	—	0.4	0.3	2.2	0.2	1.1	0.15	0.6
Al ₂ O ₃	16.7	34.4	32.9	29.4	23.1	28.3	30.2	30.5	30.6
FeO*	7.0	7.0	6.7	9.7	12.3	10.8	11.8	13.0	8.5
MnO	8.9	—	—	—	—	—	—	0.1	—
MgO	0.9	6.4	6.2	7.4	7.8	6.7	3.8	3.5	6.3
CaO	16.8	1.4	2.0	2.2	4.5	1.3	1.9	2.3	1.7
Na ₂ O	—	1.7	2.0	1.8	1.0	2.0	1.7	1.7	1.9
K ₂ O	—	—	—	—	—	—	—	0.1	—
B ₂ O ₃	6.2	11.5	12.0	10.3	9.6	10.6	10.9	9.6	11.4
Total	98.55	96.4	96.8	97.3	96.8	95.3	97.4	97.35	97.5

10272 Manganaxinite: † α 1.680, β 1.689, γ 1.693, $2V_{\alpha}$ $66 \pm 2^{\circ}$, D 3.30 ± 0.02 .

10204 Tourmalinized sandstone: ‡ A, green tourmaline forming bulk of rock, ϵ 1.620, ω 1.653, a 15.98 Å, c 7.20 Å; B, brown vein tourmaline ϵ 1.624, ω 1.655.

10181 Bluish-brown tourmaline sprays in grandidierite hornfels: ϵ 1.620, ω 1.650.

10203 Tourmaline pegmatite: A deep olive-brown corroded crystals, ϵ 1.635, ω 1.688, a 15.99 Å, c 7.18 Å, B blue-green tourmalines forming polar overgrowths on A, ϵ 1.620, ω 1.653.

10206 Zoned tourmaline from tourmalinized rhyolite: A olive-brown cores of crystals, ϵ 1.627, ω 1.654; B blue marginal areas, ϵ 1.629, ω 1.655; C green outermost rims of crystals, ϵ 1.620, ω 1.650.

* Total Fe calculated as FeO.

† Refractive indices have errors of ± 0.003 .

‡ Cell dimensions have errors of ± 0.02 Å.

All data indicate that the tourmalines are intermediate between dravite and schorl although compositionally variable; there appears to be a general trend towards enrichment in B₂O₃ and Na₂O and a decrease in total iron on the outer rims of zoned crystals and in late veins and overgrowths. An unusual feature revealed by the analyses was the exceptionally high titanium content of the deep olive-brown tourmalines, which suggests that in the Cuvier tourmalines brown pleochroic colours may be caused by titanium. Otherwise no correlation between major element constituents and pleochroic colour was noticed.

Tourmalines appear to inherit their composition, in part, from their host rock. Tourmalines with the highest Fe:Mg ratios are from rocks with high Fe:Mg ratios (rhyolite and pegmatite). Tourmalines from metasediments have lower Fe:Mg ratios.

A metasandstone that had been tourmalinized along veins crosscutting bedding was partially analysed to compare the composition of tourmaline-rich (42 % modal tourmaline; total Fe as Fe₂O₃ 4.55 %, MgO 2.82 %, TiO₂ 0.20 %, CaO 0.38 %, Na₂O 0.98 %, K₂O 1.12 %, Li₂O 0.05 %) and tourmaline-poor (9 % modal tour-

maline; total Fe as Fe_2O_3 3.50 %, MgO 2.08 %, TiO_2 0.20 %, CaO 0.42 %, Na_2O 1.96 %, K_2O 2.24 %, Li_2O 0.10 %) bands of the same bed. The analyses indicate that tourmalinization was accompanied by an increase in iron and magnesium and by a decrease in alkalis.

In summary, the Cuvier tourmalines are iron-magnesium tourmalines, chemically variable, showing a tendency for B and Na to increase and Fe to decrease in later crystals and, with the possible exception of Ti, lacking any correlation between major element constituents and pleochroic colour. The compositions of the tourmalines appear to be initially dependent on that of the host rock but they may also be affected by metasomatizing solutions during tourmalinization.

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A magnesioriebeckite from the Samalpatti area, Tamilnadu, India

DURING geological investigations in the Samalpatti area, Dharmapuri district, Tamilnadu, South India, a fibrous variety of blue amphibole was collected from the aplitic rocks exposed one mile north of Samalpatti; it occasionally ranges from dark green to black in colour. In pegmatites and syenitic rocks the mineral occurs both as disseminated and radiating crystals up to 6 inches in length and as veins in the host rocks. The veins normally range from a few inches to a foot in length, but in places may reach a length of 50 ft and width of 8 ft.

In thin section the mineral is blue in colour, with strong absorption in the fast vibration direction. The optical characters are: α blue, β green, γ 1.678, light yellowish-green, $2V_\gamma$ 85°, $\gamma-\alpha$ 0.0129, $\alpha: [001]$ 8°. Sp. gr. 3.28.

A pure sample of the mineral was chemically analysed by R. Ramasamy following the methods of A. W. Groves; the alkali determinations were made with an Eel flame photometer: SiO_2 52.12 %, TiO_2 0.30, Al_2O_3 2.20, Fe_2O_3 14.77, FeO 10.83, MnO 0.62, MgO 10.03, CaO 2.91, K_2O 0.50, Na_2O 4.73, H_2O 1.17, sum 100.18. On