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Topaz from the Meldon aplite, Devonshire

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SUMMARY. Chemical analyses, optical properties, specific gravities, and cell dimensions are presented for six topazes. A linear relationship is confirmed between the *b* cell dimension and the OH/(OH+F) ratio.

THE Meldon aplite, near Okehampton, Devonshire, England, is a sodium- and lithium-rich aplite dyke about 20 to 25 m in thickness, which occurs about 1 km north-west of the main Dartmoor granite (Worth, 1920). Together with albite, quartz, and lepidolite as essential minerals, the aplite also contains accessory topaz, elbaite, apatite, and petalite. The main aplite dyke is cut by numerous small, coarse-grained veinlets composed chiefly of orthoclase, lepidolite, and quartz. Some of these veins contain important amounts of topaz whereas others contain elbaite.

Chemistry. The topazes were separated from the associated feldspars, lepidolite, quartz, and elbaite by combined magnetic and heavy liquid methods and chemically analysed by standard wet-chemical techniques. Fluorine was determined by the method of Grimaldi, Ingram, and Cuttitta (1955). The samples M5, OP, and MKC were obtained from the topaz-bearing pegmatitic veinlets, and the samples MO1 and M74 were separated from the aplite itself. An analysis (BB) is also included in table I of white saccharoidal topaz from the fairly coarse topaz–quartz rock of Belowda Beacon, Cornwall (cf. Russell, 1924).

The results are given in table I, where the analyses have also been recalculated on the basis of 24 (O,OH,F). The analyses show a general deficiency of Si, and this is accompanied by a slight general excess in the *XY* group, even after Al is added to Si to bring the *Z* group total to 4·00. This anomaly has been noted earlier in topaz analyses and probably may be attributed to negative error in the determination of the (OH+F) group.

Optical and physical properties. The refractive indices (determined by single variation method, except BB), optic axial angles, and specific gravities of the analysed topazes are given in table I, and these results are plotted against the molecular percentage of OH/(OH+F) in fig. 1. Good correlations are evident between this ratio and the refractive indices and specific gravity. The variation of the optic axial angle has been

TABLE I. *New analyses of topaz.*
Anal.: BB, R.A.H., all others M.N.C.

	M5	OP	MKC	M74	BB	MO1
SiO_2	31·41	31·43	32·80	32·06	31·94	32·19
TiO_2	0·00	0·00	0·00	0·00	0·01	0·00
Al_2O_3	56·41	56·16	55·03	56·25	55·80	56·12
FeO	0·00	0·03	0·01	0·00	0·07	0·00
MgO	0·17	0·15	0·13	0·06	0·07	0·01
CaO	0·03	0·10	0·11	0·02	0·13	0·00
F	20·01	19·20	18·19	17·40	17·24	17·05
H_2O^+	0·44	0·70	1·11	1·41	1·57	1·56
H_2O^-	0·09	0·12	0·15	0·15	0·03	0·18
	108·56	107·89	107·53	107·35	107·18	107·11
O = F	8·44	8·10	7.68	7·34	7·27	7·20
Total	100·12	99·79	99·85	100·01	99·91	99·91
Numbers of metal ions on the basis of 24 (O,OH,F)						
Si	3·874	3·864	4·023	3·927	3·922	3·945
$Al^{[4]}$	0·153	0·136	—	0·073	0·078	0·054
$Al^{[6]}$	7·991	8·003	7·956	8·050	7·980	8·054
Fe^{2+}	—	0·003	0·001	—	0·007	—
Mg	0·031	0·027	0·024	0·011	0·014	0·001
Ca	0·004	0·014	0·015	0·003	0·014	0·000
F	7·712	7·466	7·056	6·742	6·688	6·613
OH	0·359	0·575	0·908	1·153	1·281	1·277
ΣXY	8·026	8·047	7·996	8·064	8·044*	8·055
100 OH/(OH+F)	4·45	7·15	11·40	14·60	16·15	16·19
α	1·609	1·610	1·612	1·613	1·616	1·614
β	1·611	1·613	1·614	1·615	1·618	1·616
γ	1·618	1·620	1·622	1·623	1·625	1·625
$2V_\gamma$	69·7°	69·3°	67·8°	66·7°	61°	65·5°
D	3·571	3·566	3·550	3·539	3·55	3·531
a (Å)	8·393	8·394	8·395	8·392	8·390	8·391
b (Å)	8·792	8·797	8·802	8·807	8·805	8·812
c (Å)	4·648	4·651	4·640	4·639	4·650	4·653
Vol. ($Å^3$)	342·98	343·44	342·86	342·86	343·51	344·05

M5 and OP Topaz from simple, unzoned pegmatitic veins.
MKC Topaz from a zoned, topaz-rich pegmatitic vein.
M74 and MO1 Topaz from topaz-bearing aplite.
BB Topaz, topaz-quartz rock, Belowda Beacon, Roche, Cornwall (anal. also includes Fe_2O_3 0·32).
* Includes Fe^{3+} 0·029.

presented either as a straight line (Winchell, 1962) or as a convex curve (Deer, Howie, and Zussman, 1962). The present work emphasizes the curvilinear nature of this variation.

Cell dimensions. The cell dimensions of the analysed topazes are reported in table I, and the results for the *b* parameter are plotted against the OH/(OH+F) ratio in fig. 2. Although the A.S.T.M. card somewhat surprisingly averages the results for three separate samples from different occurrences, the first note on the systematic

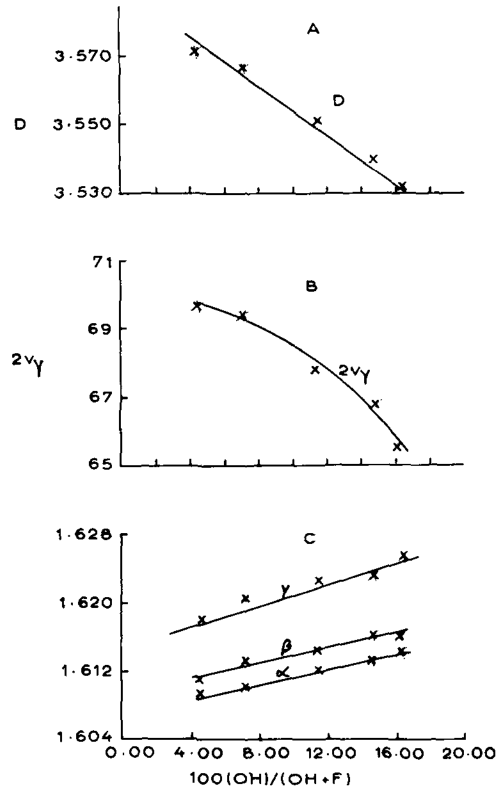

FIG. 1. The variation in the refractive indices, optic axial angle, and specific gravity of topaz in relation to 100 OH/(OH+F).

variation of the cell dimensions of topaz (Rosenberg, 1967) showed that there appeared (on the basis of three analysed samples) to be a linear relation between the *b* dimension and the OH/(OH+F) ratio. The present results confirm this, but the values obtained for the *a* and *c* parameters show very much less variation. As noted by Rosenberg, the substitution of the larger hydroxyl ion for the fluoride ion has a greater effect on *b* due to the presence in the structure of alternate oxygen and F-rich layers perpendicular to *b*. Rosenberg's data, however, suggests that although the *a* parameter does not vary significantly, that for *c*, although numerically smaller, also has a near linear relationship with the OH/(OH+F) ratio: this is not supported by the present results. It is of interest to compare also the unit cell volumes; these show less change than might have been expected and imply that with *a* sensibly constant *c* must vary inversely with the OH/(OH+F) ratio. Further work on the cell parameters of topaz is needed to clear up this anomaly.

Conclusions. It is thus confirmed that the *b* cell dimension of topaz increases progressively with substitution of OH^- for F^- and that determination of either 2V or the *b* dimension should serve to determine the OH/(OH+F) ratio for this mineral.

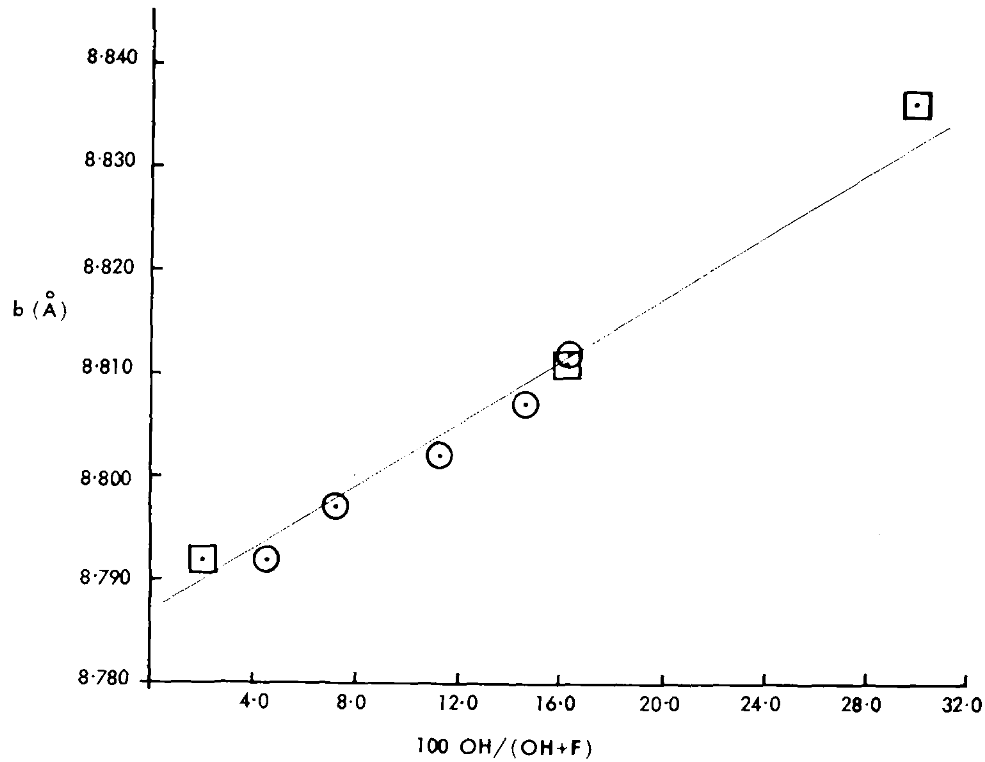

FIG. 2. The b cell dimension of topaz in relation to 100 OH/(OH + F).

Rosenberg (1967) has noted that samples with the lowest OH/(OH+F) ratios are from cavities in rhyolites whereas those with higher values occur in pegmatites and greisens. In the results reported here this tendency is also evident, with the three topazes from pegmatitic veins having low OH/(OH+F) values whereas those from the strongly metasomatized topaz-bearing aplite (and the metasomatic topaz–quartz rock) have higher values.

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