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Amblygonite in leucogranites of the Tregonning-Godolphin Granite, Cornwall

EARLIER papers (Exley and Stone, 1966; Stone, 1975) have referred briefly to the occurrence of a mineral presumed to be amblygonite (mainly $LiAlPO_4F$) in west Cornwall. Tentative identification was based upon observations in thin section and the large amounts of Li, Al, P, and F in the host rocks. This note confirms its first reported occurrence in Cornwall.

Identification. A heavy mineral suite having a density between those of bromoform (2·89 g cm^{-3}) and *di*-iodomethane (3·33 g cm^{-3}) was separated from the 100–150 μm grain-size fraction of the crushed rock. This suite included tourmaline, apatite, topaz, and a milky-white mineral presumed to be amblygonite. Tourmaline was removed using a Cook magnetic separator. The milky-white mineral was concentrated further by floating the separated fraction on *di*-iodomethane and diluting with acetone in successive steps. Final handpicking of the milky-white mineral, leaving a residue of topaz and a little apatite, gave the fraction that was subsequently X-rayed using a 114·6 mm diameter Debye-Scherrer diffraction camera with Cu-$K\alpha$ radiation.

The X-ray pattern conforms closely with that of amblygonite given by Černá, Černý, and Ferguson (1973) and indexing was achieved by comparison with the published data. The cell parameters were determined by submitting the whole pattern to a standard regression computer program and are (error stated at one standard deviation): $a = 5{\cdot}14 \pm 0{\cdot}01$ Å, $b = 7{\cdot}21 \pm 0{\cdot}01$ Å, $c = 5{\cdot}06 \pm 0{\cdot}01$ Å, $V = 158{\cdot}0 \pm 0{\cdot}4$ Å^3, $\alpha = 113{\cdot}9 \pm 0{\cdot}1°$, $\beta = 98{\cdot}6 \pm 0{\cdot}1°$, $\gamma = 67{\cdot}3 \pm 0{\cdot}1°$. Estimates based upon these figures using the regression equations of Černá *et al.* (1973), but with the *b* parameter omitted owing to an impossibly high result obtained from it, and rounding the results to whole numbers, give an average weight percentage of F as 12 ± 2 (at two standard deviations with six results). Small errors in the cell parameters can result in large differences in the final result. However, even at the worst error, if *all* values gave *lower* results by two standard deviations of the figure for each cell parameter (a most unlikely situation), the average weight percentage of F is over 7. Hence the data are consistent with a composition within the amblygonite part of the amblygonite–montebrasite series (Moss, Fejer, and Embrey, 1969; Černá *et al.*, 1973).

The value of the specific gravity (determined with a pycnometer) of $3{\cdot}14 \pm 0{\cdot}04$ (at two standard deviations) is a little higher than that for pure amblygonite (3·11 in Černá *et al.*, 1973) and may reflect incomplete separation from topaz.

Occurrence. A study of the petrology of the Tregonning-Godolphin granite complex (Stone, 1975) has shown that, with the exception of the biotite-bearing Godolphin granite, most of the rocks carry lithium mica, probably lepidolite by analogy with similar rocks at Meldon (Chaudhry and Howie, 1973), and topaz and albite and are quite markedly enriched in Na, Li, Rb, Cs, P, Nb, Ge, Sn, and F (Stone, in preparation). These rocks include the Tregonning granite and its overlying roof zone and associated marginal granitic sheets. The roof rocks and the sheets are composed of leucogranites, aplites, and pegmatites, together with tourmaline-rich granite bands and occasional greisen bands. Amblygonite occurs in samples of leucogranite obtained from the roof at Carn Clodgy, near Rinsey (Grid. ref. SW. 594269), and from the sheets at the Megiliggar Rocks (Grid. ref. SW. 610266): it has not been observed so far in the closely associated aplites and pegmatites or in the Tregonning granite.

The leucogranites are millimetre-grained (1 mm to 3 mm grain diameters typical) hypidiomorphic equigranular rocks. Modes of two samples that contain amblygonite are given in Table I. The excess of euhedral to subhedral albite over anhedral potash feldspar produces the hypidiomorphic appearance. Tourmaline is commonly pale yellow (in thin section) and poikiloblastic; it sometimes veins the feldspars. Subhedral to euhedral topaz would appear to be rich in F: measurements of the *b* cell parameter ($8{\cdot}79 \pm 0{\cdot}01$ Å) and cell volume (342 ± 1 Å^3) substituted in the regression equations of Ribbe and Rosenberg (1971) indicate a composition fairly close to the upper limit of F in the F, OH sites.

Amblygonite has an irregular distribution. It tends to occur as interstitial grains measuring 0·2 to just over 4·0 mm across and commonly as isolated optically continuous pieces measuring *c.* 0·5 mm

TABLE I. *Amblygonite-bearing rocks*

A. Modes	1	2	B. Chemical analyses	3	4	5
Volume %			Wt.%			
Quartz	24·7	24·2	SiO_2	71·7	71·8	72·8
K-feldspar	18·0	19·0	TiO_2	0·03	0·03	0·04
Albite	40·7	42·5	Al_2O_3	16·1	16·1	16·4
Mica			Fe_2O_3	0·10	0·07	0·84*
(lepidolite)	10·8	9·4	FeO	0·42	0·38	
Tourmaline	0·6	0·2	MnO	0·11	0·10	0·09
Topaz	4·6	2·5	MgO	0·04	0·03	0·05
Amblygonite	0·2	1·7	CaO	0·24	0·21	1·28
Apatite	trace	trace	Na_2O	4·75	5·06	2·77
Others	0·4	0·5	K_2O	3·71	4·04	3·95
			Li_2O	0·57	0·51	0·94
	100·0	100·0	P_2O_5	0·63	0·73	0·48
			F	1·74	1·41	1·40†
No. of sections (2–3 cm^2 area)	4	3				

* Total iron as Fe_2O_3. † Analysis by R. Fuge.

1 and 3: Amblygonite-bearing leucogranite, Megiliggar Rocks (MS0040).

2 and 4: Amblygonite-bearing leucogranite, Carn Clodgy (amended version of analysis given in Exley and Stone, 1966, Table 8, col. 1) (MS0044).

5: Meldon microgranite from western end of quarry (MS0330).

Analysts: M. Stone and D. L. Dallow.

across. Amblygonite sometimes shows alteration to fine-grained lamellar aggregates (probably clay) and is commonly partly replaced by white mica. Fresh samples show typical fine lamellar twinning and occasionally a second set of lamellar twins.

Chemical analyses of two leucogranites containing amblygonite are compared with a new analysis of the Meldon microgranite in Table I. Kingsbury (1966) reports finding amblygonite in pegmatite in the Meldon microgranite; this occurrence, together with those occurrences reported from west Cornwall in this note, conform with the comparable enrichment of all these rocks in Li, P, Al, and F.

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