Hietanen, A. (1967) *Geol. Soc. Am. Special Paper* 86, 56 pp.
Manby, G. M. (1978) *Geology of North Central Prins Karls Forland, Svalbard.* Unpubl. Ph.D. thesis, Univ. Cambridge.
Morris, A. P. (1979) *Geology of South Central Prins Karls Forland, Svalbard.* Unpubl. Ph.D. thesis, Univ. Cambridge.
von Englehardt, W. (1961) *Bull. Geol. Inst. Univ. Uppsala*, **40**, 189–204.
White, A. J. R. (1959) *Geol. Mag.* **96**, 285–307.

[*Manuscript received 20 March 1982*]

Dept. of Geology, Goldsmiths' College, University of London, Creek Road, Deptford, London SE8 3BU G. M. MANBY

MINERALOGICAL MAGAZINE, MARCH 1983, VOL. 47, PP. 93–4

A new occurrence of dalyite

THE potassium (sodium) zirconium silicate dalyite has been discovered during an electron microprobe investigation of a potassic peralkaline syenite dyke from the Sunnfjord area of Western Norway. Dalyite was first discovered in a peralkaline granite from Ascension Island (Van Tassel, 1952) and was subsequently shown to be a new type of phyllosilicate containing four-, six-, and eight-membered rings of SiO_4 tetrahedra (Fleet, 1965). The mineral has also been recorded in peralkaline quartz syenites from Sáo Miguel, Azores (Cann, 1967).

The Sunnfjord syenite occurs as an inconspicuous E.–W. dyke, 10 cm wide, cutting brecciated mangerites on the north side of Dalsfjord, Sunnfjord, W. Norway. The medium-grained syenite resembles a sandstone and was described as such when first noticed and sampled by Professor N. H. Kolderup in 1921. The syenite consists largely of microcline and a Si-rich and Al-poor phlogopite together with small amounts of eckermannite, carbonate apatite, calcite, celadonite, saponite, and labuntsovite (Semenov and Burova, 1955) and accessory dalyite and baryte (Furnes, Mitchell, Robins, Ryan and Skjerlie, in prep.). The dyke has a K-Ar age of 260 ± 2 Ma (Furnes *et al.*, op. cit.).

The presence of dalyite in the syenite has been confirmed in the X-ray diffraction pattern of a heavy-liquid separate (> 2.75 g/cc) (Table I). It occurs as colourless, transparent to brown, translucent grains often with subhedral to euhedral K-feldspar inclusions and commonly surrounded by phlogopite. It is strongly fluorescent under the electron beam, and in this respect resembles benitoite and wadeite (Carmichael, 1967).

The single published analysis of dalyite (Van Tassel, 1952) showed it to have the formula $K_2Zr Si_6O_{15}$ with sodium and small amounts of Fe replacing part of the K (Table II). Electron microprobe analyses of the Sunnfjord dalyite were carried out on an ARL SEMQ housed at the Geological Institute of the University of Bergen using an accelerating voltage of 15 kV, a beam current of 7 nA, standard wavelength-dispersive techniques (Reed, 1975) and ZAF data reduction. The following synthetic oxides, pure metals and well-characterized or simple, stoichiometric minerals were employed as standards: jadeite (for Na); Al_2O_3; wollastonite (for Ca and Si); Beeson apatite (for P); PSU orthoclase (for K); TiO_2; pure Mn, Fe, and Zr; benitoite (for Ba). Individual point analyses of five crystals are reported in Table II. They show significant substitution of Ti for Zr,

TABLE I. *d-spacings and relative X-ray intensities for dalyite from Sunnfjord*

Dalyite, Ascension (Van Tassel, 1952)		Dalyite, Sunnfjord	
d	$I_{est.}$	*d*	$I_{est.}$
6.54	60	6.51	40
5.90	80	5.90	80
4.31	80	4.31	75
4.20	100	4.21	100
3.58	100	3.59	100
3.36	60	*	
3.08	100	3.08	100
2.85	60	*	
2.62	100	2.65	100
2.42	60	2.42	50

Cu-$K\alpha_1$ radiation, Phillips APD 10 system.
* = Masked by other minerals.

TABLE II. *Electron microprobe analyses of the Sunnfjord dalyite*

	1	2	3	4	5	6	7	8	9	10	11		12	
SiO_2	63.39	61.86	64.94	64.12	64.22	62.75	62.25	62.53	62.58	62.04	63.07		61.85	
Al_2O_3	0.03	0.01	0.00	0.15	0.06	0.01	0.13	0.12	0.07	0.03	0.06		—	
TiO_2	0.64	1.22	1.59	0.83	0.88	1.08	1.54	1.21	1.61	1.71	1.23		—	
ZrO_2	19.49	18.83	19.13	20.17	19.68	18.29	19.22	18.46	20.23	20.16	19.37		21.70	
CaO	0.04	0.00	0.03	0.00	0.00	0.04	0.04	0.06	0.00	0.02	0.02		—	
MgO	0.00	0.08	0.00	0.00	0.05	0.65	0.10	0.08	0.02	0.06	0.10		—	
MnO	0.05	0.00	0.06	0.00	0.00	0.04	0.05	0.00	0.00	0.03	0.02		—	
FeO	0.22	0.30	0.26	0.31	0.19	0.60	0.31	0.19	0.15	0.28	0.28		0.37*	
K_2O	15.93	16.64	14.08	15.80	16.36	15.79	15.33	15.98	16.17	13.93	15.60		14.60	
Na_2O	0.04	0.00	0.09	0.00	0.00	0.00	0.19	0.00	0.00	0.07	0.04		1.75	
BaO	0.08	0.03	0.11	0.04	0.03	0.00	0.19	0.21	0.20	0.22	0.11		—	
P_2O_5	0.10	0.12	0.00	0.00	0.00	0.04	0.10	0.00	0.00	0.00	0.04		—	
	100.01	99.08	100.29	101.41	101.47	99.28	99.45	98.82	101.03	98.55	99.94		100.91†	
Ions on the basis of 15(O)														
Si	6.036	5.980	6.075	6.020	6.030	6.008	5.965	6.024	5.942	5.974	6.006		5.95	
Al	0.004	0.001	0.000	0.016	0.007	0.001	0.015	0.013	0.008	0.004	0.007		—	
Ti	0.046	0.089	0.112	0.059	0.062	0.078	0.111	0.088	0.115	0.124	0.088	0.994	—	
Zr	0.905	0.888	0.873	0.923	0.901	0.854	0.898	0.867	0.937	0.947	0.899		1.01	
Ca	0.004	0.000	0.003	0.000	0.000	0.004	0.005	0.006	0.000	0.002	0.002		—	
Mg	0.000	0.011	0.000	0.000	0.006	0.092	0.014	0.011	0.002	0.009	0.015		—	
Mn	0.004	0.000	0.005	0.000	0.000	0.003	0.004	0.000	0.000	0.002	0.002		—	
Fe	0.017	0.024	0.020	0.025	0.015	0.048	0.025	0.015	0.012	0.022	0.022		—	
K	1.936	2.052	1.680	1.893	1.959	1.929	1.874	1.964	1.958	1.711	1.896	1.951	1.79	
Na	0.007	0.001	0.017	0.000	0.000	0.000	0.036	0.000	0.000	0.013	0.007		0.32	2.11
Ba	0.003	0.001	0.004	0.001	0.001	0.000	0.007	0.008	0.008	0.008	0.004		—	
P	0.008	0.009	0.000	0.000	0.000	0.003	0.008	0.000	0.000	0.000	0.003		—	

* Fe_2O_3.
† Includes 0.64% H_2O.

1–10. Point analyses of dalyite from Sunnfjord.
11. Arithmetic mean of analyses 1–10.
12. Analysis of dalyite from Ascension (Van Tassel, 1952).

insignificant concentrations of Na and small amounts of Fe apparently replacing K. These analyses suggest that the composition of dalyite can be more precisely expressed by the formula $(K,Na,Fe)_2(Zr,Ti)(Si_6O_{15})$.

Dalyite would appear to be compositionally related to zektzerite, $LiNaZrSi_6O_{15}$ (Dunn *et al.*, 1977; Ghose and Wan, 1978), sogdianite, $(K,Na)_2Li_2(Li,Fe,Al,Ti)_2 Zr_2(Si_2O_5)_6$ (Dusmatov *et al.*, 1969) and darapiosite, $KNa_2LiMnZnZr Si_{12}O_{30}$ (Semenov *et al.*, 1975) as well as wadeite, $K_2Zr Si_3O_8$ (Prider, 1939). Wadeite crystallizes from highly undersaturated peralkaline magmas, while dalyite, like zektzerite, sogdianite, and darapiosite, is associated with saturated to oversaturated peralkaline rocks. Both wadeite and dalyite crystallize from potassic magmas.

REFERENCES

Cann, J. R. (1967) *Mineral. Mag.* **36,** 227–32.
Carmichael, I. S. E. (1967) *Contrib. Mineral. Petrol.* **15,** 24–66.
Dunn, P. J., Rouse, R. C., Cannon, B., and Nelen, J. A. (1977) *Am. Mineral.* **62,** 416–20.
Dusmatov, V. D., Efimov, A. F., Kataeva, Z. T., Khoroshilova, L. A., and Yanulov, K. P. (1969) *Dokl. Akad. Nauk SSSR*, **182,** 1176–7.
Fleet, S. G. (1965) *Z. Kristallogr.* **121,** 349–68.
Ghose, S., and Wan, C. (1978) *Am. Mineral.* **63,** 304–10.
Prider, R. T. (1939) *Mineral. Mag.* **25,** 373–87.
Reed, S. J. B. (1975) *Electron Microprobe Analysis.* Cambridge Univ. Press, Cambridge.
Semenov, E. I., and Burova, T. A. (1955) *Dokl. Akad. Nauk SSSR*, **101,** 1113–16.
——Dusmatov, V. D., Khomyakov, A. P., Vorankov, A. A., and Kazakova, M. E. (1975) *Zap. Vses. Mineral. Obshch.* **104,** 583–5.
Van Tassel, R. (1952) *Mineral. Mag.* **29,** 850–7.

[*Manuscript received 8 January 1982; revised 7 May 1982*]

Geologisk Institutt, avd. A, 5014 Universitetet i Bergen, Norway B. ROBINS, H. FURNES
Dept. of Geology, University College, Galway, Ireland P. RYAN