MINERALOGICAL MAGAZINE, JUNE 1984, VOL. 48, PP. 301-3

Jadeite from southern Oscar II Land, Svalbard

ANCIENT glaucophane schists and eclogites are found in southern Oscar II Land, Svalbard. This area is part of the Western Complex of Svalbard (Harland *et al.*, 1979) and consists mainly of lower Palaeozoic rocks which have been subjected to both Caledonian deformation and metamorphism, and the later Palaeogene West Spitsbergen Orogeny (Harland and Horsfield, 1974). Stratigraphic, structural, and metamorphic observations of the lithologies of Oscar II Land have been described by Horsfield (1970), Harland *et al.* (1979), Hjelle *et al.* (1979), and Waddams (1983).

The above named authors have used different nomenclatures when describing the lithologic units in this area except that of the Vestgötabreen Formation (compare Harland *et al.*, 1979, to Hjelle *et al.*, 1979). This formation is best exposed in the Skipperbreen–Vestgötabreen ridge (78° 26′ N. 12° 49′ E.) through to southern Motalafjella (78° 20′ N. 12° 58′ E.) as a narrow fault bounded unit, approximately 300 m thick (fig. 1). This paper describes for the first time the presence of jadeite in Vestgötabreen Formation which marks the only occurrence of this mineral in Svalbard.

According to Horsfield (1972), glaucophane schists and eclogitic rock fragments were first found in 1957 by C. B. Wilson of the Cambridge Spitsbergen Expedition within the moraines of Eidembreen and Vestgötabreen. In 1962 D. Gee located the source area of these rocks at Motalafjella. Horsfield (1970, 1972, p. 31) was the first to map the area and he described coarse-grained glaucophane–garnet–muscovite schists and named these rocks the Vestgötabreen suite. He further recognized chloritoid and a 'pale green sodic pyroxene' within this suite. K/Ar age determinations on both whole rock and muscovite separates yielded apparent ages which lie between 620 and 410 m.y. (Horsfield, 1972, p. 34). Associated, although not incorporated with this suite by Horsfield, are epidote–actinolite greenstones.

Ohta (1979) mapped the distribution of these rocks in more detail and added the epidote–actinolite greenstones to the Vestgötabreen suite, renaming it the Vestgötabreen Formation. He divided the Vestgötabreen Formation into two members: (1) epidote–actinolite greenstones, phyllites, dolomites, and serpentinites in the lower part, and (2) glaucophane-bearing rocks, eclogites, calcareous schists, and dolomites in the upper part. Additionally, petrologic and chemical descriptions of garnet, calcic and sub-alkaline amphibole, alkali amphibole, chloritoid, white mica, aluminous epidote, chlorite, and omphacite ($Jd_{38.4}Ac_{13.6}Di_{45.0}$) were provided. The analysed omphacite occurred with glaucophane, garnet, muscovite, and quartz in the upper part of the Vestgötabreen Formation. Manby (1978), the only other investigator of this formation, noted that sodic pyroxenes were 'considerably degenerate' and variable in the jadeite component, although approximating omphacitic compositions.

Jadeite is found in the upper member of the Vestgötabreen Formation both east and west of Vestgötabreen at elevations less than 350 m. The mineral is commonly found in a very dusky purple coarsely crystalline silicic schist in which the interbanded grey olive-green micaceous layers and quartz–feldspar pods are 1–3 cm thick (see Table I for spectrographic analysis). Jadeite occurs in rocks which contain phengite + chlorite + quartz ± garnet ± glaucophane ± albite. Accessory minerals include calcite, rutile rimmed by sphene, pyrite, apatite, hematite, and ilmenite. Textural evidence indicates that phengite is late stage and not in equilibrium with jadeite.

The common habit of Vestgötabreen Formation jadeite is of disaggregated masses of fresh xenoblastic crystals approximately 60 microns in diameter. Radiating sheath-like habits, approximately 3 mm across, are also recognized. The jadeite is usually in contact with either quartz or albite and is commonly rimmed by hematite–sericite haloes. The jadeite mineral chemical data obtained on the Cambridge EDS microprobe are presented in Table II The ferrous/ferric iron ratios and stoichiometry were calculated by the methods of Papike *et al.* (1974) and the mineral characterized after the scheme proposed by Essene and Fyfe (1967) whereby augite is understood to be the diopside and hedenbergite components.

The large jadeitic component of Vestgötabreen Formation pyroxene ($Jd_{87.4}Ac_{5.2}Aug_{7.4}$) coexisting with albite and quartz provides a useful geobarometer for this formation. Temperature estimates are *not* tightly constrained by the mineral parageneses, although a range in temperature from 300 °C, as suggested by the absence of lawsonite, to a maximum temperature of 450 °C for the blueschist facies has been suggested (Turner, 1980). Using the experimental data of Newton and Smith (1967) and thermodynamic properties from Robie *et al.* (1979),

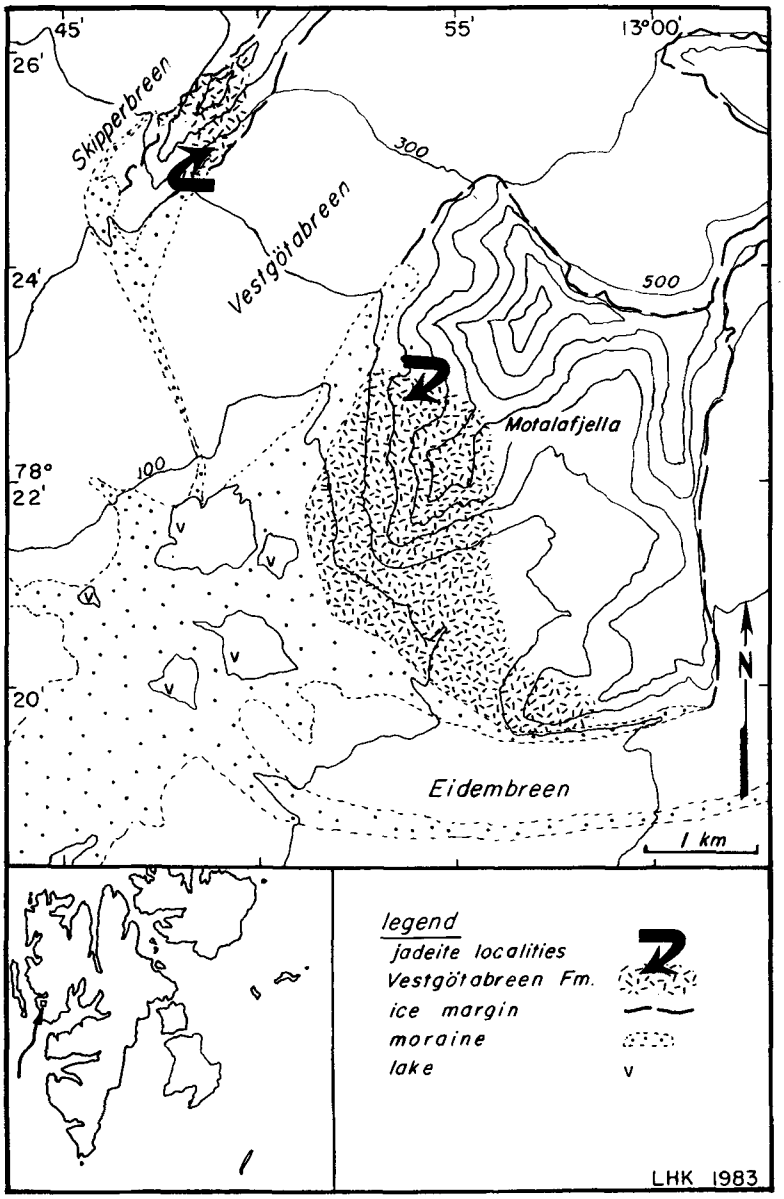

FIG. 1. Jadeite localities in Vestgötabreen Formation.

the following equation for the reaction, jadeite + quartz → albite, is presented:

$$P = -1037.9 + 19.153T - (RT\ln K)/\Delta V \pm 500 \text{ bars}$$

where P is pressure in bars, T is temperature in Kelvins, R is the gas constant, V is the volume, and K is the equilibrium constant. The jadeite component of Vestgötabreen Formation pyroxene is so close to Jd_{100} that it is in the Raoults law region. Therefore, it is assumed that the activity of jadeite is approximately equal to its mole fraction, hence the equilibrium constant, K, is approximately equal to X_{ab}/X_{jd}, which is 1.149.

Pressures of 9.9 ± 0.5 kbar at 300 °C to 12.8 ± 0.5 kbar at 450 °C have been estimated from the above equation. Continued research on the mineral

TABLE I. *XRF analysis of sample K3134*

SiO_2	79.94	Ba	873
Al_2O_3	10.54	Co	3
TiO_2	0.19	Cr	8
FeO*	2.01	Cu	41
MgO	0.70	Ga	16
CaO	0.43	La	42
Na_2O	3.59	Ni	3
K_2O	1.64	Nb	52
MnO	0.02	Pb	17
P_2O_5	0.01	Rb	39
LOI	0.91	Sr	49
		Th	19
Total	99.94	U	4
		V	3
		Y	96
		Zn	101
		Zr	422

X-ray fluorescence data obtained by the PW 1400 spectrometer at the University of Nottingham Laboratory. Oxide data are shown in wt. % oxide; elemental data in ppm; FeO* = total iron. Analysts: P. K. Harvey and B. P. Atkin.

Table II Jadeite analyses

Sample	K3117JD1	K3134JD1	K3134JD3	K3134JD5
SiO_2	59.791	59.847	59.894	59.361
Al_2O_3	22.387	21.302	21.208	21.276
FeO*	2.698	3.058	3.301	3.143
V_2O_5	-	-	0.103	-
MnO	-	0.111	0.108	-
MgO	-	0.365	0.726	0.496
CaO	0.241	1.791	2.071	1.980
Na_2O	11.196	13.246	13.644	13.710
total	100.369	100.530	100.942	99.869
number of cations based on six oxygens				
Si	2.022	2.026	2.025	2.025
Al	0.892	0.850	0.845	0.856
V	-	-	0.003	-
Fe^{3+}	0.076	0.074	0.049	0.051
Fe^{2+}	-	0.013	0.044	0.039
Mn	-	0.003	0.003	-
Mg	-	0.018	0.037	0.025
Ca	0.009	0.065	0.075	0.079
Na	0.989	0.924	0.894	0.907
total	3.988	3.974	3.974	3.975
endmember components				
jadeite	87.387	85.966	87.201	87.387
acmite	5.220	7.464	5.059	5.220
augite	7.393	6.570	7.740	7.393

parageneses of Vestgötabreen Formation will allow for a refined estimate of the metamorphic conditions and an interpretation of the geologic history of southern Oscar II Land.

Acknowledgements. Field-work was supported by a National Science Foundation grant (number DPP-8107663) to A. P. Morris at Wayne State University, Detroit, Michigan. Additionally, the author acknowledges the receipt of a Fulbright Grant during the course of this research. Constructive comments about this communication made by T. J. B. Holland are greatly appreciated.

REFERENCES

Essene, E. J., and Fyfe, W. S. (1967) *Contrib. Mineral. Petrol.* **15,** 1–23.

Harland, W. B., and Horsfield, W. T. (1974) *Geol. Soc. London Spec. Publ.* **4,** 747–55.

——— Manby, G. M., and Morris, A. P. (1979) *Norsk Polarinst. Skrift. Nr.* **167,** 119–44.

Hjelle, A., Ohta, Y., and Winsnes, T. S. (1979) Ibid. **167,** 145–69.

Horsfield, W. T. (1970) Unpubl. Ph.D. thesis. University of Cambridge.

——(1972) *Geol. Mag.* **109,** 29–36.

Manby, G. M. (1978) *Polarforschung,* **48** (1/2), 92–102.

Newton, R. C. and Smith, J. V. (1967) *J. Geol.* **75,** 268–86.

Ohta, Y. (1979) *Norsk Polarinst. Skrift. Nr.* **167,** 171–218.

Papike, J. J., Cameron, K. L., and Baldwin, K. (1974) *Geol. Soc. Am. Abstracts with Programs,* **6,** 1053–4.

Robie, R. A., Hemingway, B. S., and Fisher, J. A. (1979) *U.S.G.S. Bull.* 1452.

Turner, F. J. (1980) *Metamorphic Petrology.* McGraw-Hill, New York, 524 pp.

Waddams, P. (1983) *Geol. Mag.* **120** (3), 233–52.

[*Manuscript received 1 July 1983; revised 17 October 1983*]

Department of Earth Sciences, University of Cambridge, Cambridge CB2 3EQ

LESLIE HOWARD KANAT