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APPLICATION OF MUSCOVITE GEOBAROMETER TO GREENSHIST FACIES METAPELITES FROM WEST SPITSBERGEN

Abstract: The muscovite geobarometery of Precambrian metapelites of Elveflya Formation (Sofiebogen Group, Wedel Jarlsberg Land, South-West Spitsbergen) shows that the pressure is increasing from East (about 8 kbar) to West (9 – 10 kbar). This pattern is consistent with observed metamorphic isograde. However, the apparent pressures are higher than expected for greenshist metamorphic grade. This might reflect the influence of the Vimsodden-Kosibapasset dislocation zone.

Keywords: geobarometer, muscovite, Spitsbergen, metapelite, greenshist facies

INTRODUCTION

The muscovite barometer based on the muscovite d_{060} spacing monitors the baric conditions of low-grade metamorphism (Ramirez, Sassi, 2001). It can be a useful pressure estimate when mineral assemblages do not allow the application of other barometers. The increase of b_0 is largely due to increase of celadonite content in muscovite. The correlation of changes in muscovite d_{060} with pressure was found by Sassi & Scolari (1974) and assessed by Guidotti & Sassi (1986, 1998).

The d_{060} spacing was measured in white micas of the Precambrian metapelites of Elveflya Formation (Sofiebogen Group, part of Precambrian and Paleozoic Hecla Hoek Succesion, Wedel Jarlsberg Land, South-West Spitsbergen). The monoclinal Elveflya Formation, which outcrops West of Werenskioldbreen consists of greenshist facies metapelites (Czerny et al. 1993). The Vimsodden-Kosibapasset dislocation zone (V-K) cuts through the southern boundary of Elveflya formation. This dislocation represents probably a deeprooted fracture, showing multiple, recurring tectonic and igneous activity. In the Precambrian, in two separated events, the V-K dislocation was the channel of asceding magmas and also formed an important lithofacies boundary. During Caledonian folding, it was converted into a high-angle shear zone and in Cretaceus it was rejuvenated as a sinistral strike-slip fault (Czerny et al. 1993).

The samples were collected from mica-carbonate-quartz shists during the Polar Expedition in summer 2002 organised by AGH - University of Science and

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METHODS

The analytical procedures were similar to those of Sassi & Scolari (1974) and Guidotti & Sassi (1986). The rock slices were cut perpendicular to the rock foliation to enhance the peaks of muscovite d_{060} parameter and remove any other peaks from minerals in this range (Ramirez, Sassi 2001). Quartz present in the rock matrix and metallic sillicon have been used as an internal standard.

Philips X'pert PW3020 diffractometer in the range of 55-63°2Θ ($Cu_{K\alpha}$ radiation,) and URD-6 diffractometer in the range of 70-74°2Θ ($Co_{K\alpha}$ radiation) were used for the measurements and b_0 was calculated as $6 \cdot d_{060}$. The resulting pressures were estimated based on calibration plot by Ramirez & Sassi (2001) (Fig. 1).

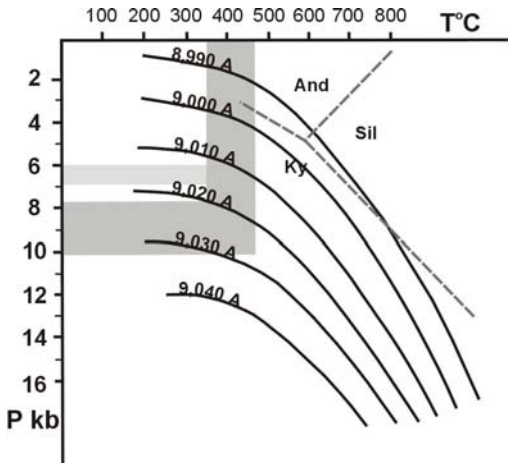

Fig. 1. The d_{060} calibration curves on P-T plot (after Ramirez, Sassi, 2001), with the range of results from this study (shaded area). Al_2SiO_5 triple point after Greenwood (1976, vide Ramirez, Sassi, 2001).

RESULTS AND DISCUSSION

Analyzed metapelites consist of quartz, muscovite, biotite, chlorite, calcite and dolomite. Temperatures of the metamorphism established using calcite-dolomite geothermometer are in the range of 350 - 450 °C (Bazarnik et al. 2003).

The results of measurements, calculated pressures and their spatial distributions are presented in Table 1 and Figure 2. The estimated pressures are in the range of 6 to 10 kb. The lowest pressures of 6-7 kb were recorded in mica-carbonate-quartz shists (samples: *Sp-6* and *Sp-32*) and correspond to the lowest temperatures (332°C and 365 °C, Bazarnik et al. 2003). Observed pressures increase from East (about

Table 1. Results of XRD analyses and estimated pressures.

No.	d_{060} (Å)	Parameter b_0 (Å)	P (kb)
$Co_{K\alpha}$ radiation (quartz standard)			
Sp–13	1.503	9.020	~ 8–9
Sp–14	1.503	9.019	~ 8–9
Sp –19	1.504	9.027	~9–10
Sp –28	1.505	9.028	~9–10
$Cu_{K\alpha}$ radiation (Si standard)			
Sp–36	1.504	9.024	~9

No.	d_{060} (Å)	Parameter b_0 (Å)	P (kb)
$Cu_{K\alpha}$ radiation (quartz standard)			
Sp–3	1.503	9.018	~ 8
Sp–6	*1.502*	*9.011*	*~ 6–7*
Sp–8	1.503	9.018	~ 8
Sp–14	1.503	9.017	~ 8
Sp–19	1.505	9.029	~9–10
Sp–27	1.505	9.028	~9–10
Sp–28	1.505	9.030	~10
Sp–32	*1.501*	*9.009*	*~ 6*
Sp–36	1.504	9.025	~ 9

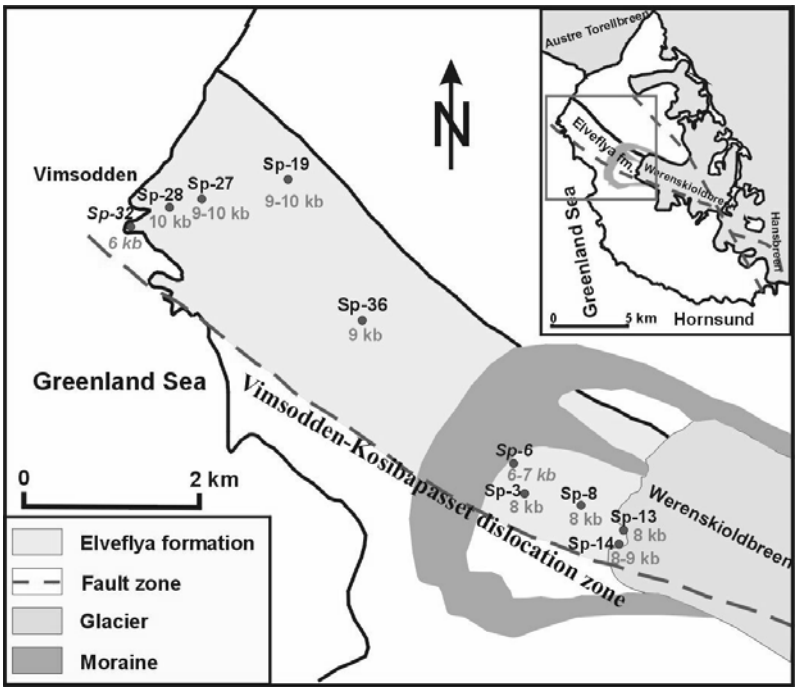

Fig. 2. Sample locations and resulting pressures.

8 kb in the foreland of Werenskioldbreen) to West (9 and 10 kb on Vimsodden). This pattern is consistent with increase in metamorphic grade from chlorite to biotite zone (Czerny et al. 1993).

The pressures between 8 and 10 kb appear to be too high for the greenshist facies metamorphism of these metapelites. It is possible that they reflect the presence of a regional-scale Vimsodden-Kosibapasset dislocation zone cutting through the southern boundary of Elveflya Formation parallel to the monocline. Details of this influence await further investigations.

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