ttn ± opq or hbl + pl + cpx + opx + cum ± cor ± saph ± chl ± kfs ± ttn ± opq in the upper sheet. Hornblendes and plagioclases from both units are zoned. The amphibole cores are composed of actinolite or actinolitic hornblende replacing the magmatic pyroxene. Small recrystallized grains correspond to magnesio-hornblende in the lower belt and magnesio-hornblende up to tschermakite in the upper belt. Plagioclase evolves from magmatic andesine (An40–50) to metamorphic andesine-labradorite (An45–55) in both belts and rare bytownite (An71–90) in the upper one. Physical conditions of metamorphism were estimated using the thermometer by Holland and Blundy (1994): T = 650 ± 30 C for the lower unit and 750 ± 30 C for the upper unit. Moreover, the reaction sapphirine + H_2O – chlorite + corundum occurring in the upper gabbros determines the temperature of 750 °C for the pressures of 10 kbar.

The microstructural analysis performed using the PolyLX Toolbox by O. Lexa suggests that the deformation in a microscale changes depending on temperature. The eastern gabbros are characterized by "core and mantle" structures (Cumbest et al., 1989) typical for the less deformed domains. Amphibole and plagioclase grains deform preferentially by a mechanism of subgrain rotation. The newly formed recrystallized grains rim the host grain without attaining any significant crystal or shape preferred orientation (CPO, SPO). On the contrary, metagabbros from the mylonitic zones display a strong CPO and SPO of both elongated grains of amphibole and less elongated grains of plagioclase. The dominant slip system for amphiboles is supposed to be (100) [001] according to the CPO measurements.

The upper gabbros show a recrystallization mechanism of grain boundary migration with possible nucleation and growth of new recrystallized grains. The fabric with conserved original magmatic grains has already a strong CPO and SPO of amphiboles, probably due to a passive grain rotation and a subgrain formation at the early stages of the foliation development. With increasing intensity of recrystallization, amphibole grains lose the CPO and SPO and their fabric becomes more equigranular. On the contrary, the plagioclases attain stronger CPO and SPO than in the less deformed stages. The dominant slip system for amphiboles appears to be (100) [001] with minor contributions of (010) [001].

The microstructural analysis is going to be completed by the investigations of elastic properties of representative metagabbros, which were selected according to the relative proportion of amphibole and plagioclase, and to the intensity of deformation. To reveal the P-wave velocity distribution, the acoustic sounding technique by Pros et al. (1998) is used. Travel times of ultrasonic signal are measured, going through the sample sphere having 50 ± 0.02 mm in diameter. The measurements are conducted up to the pressure of 400 MPa. The P-wave velocities are calculated on the basis of measured travel times and sphere diameter. Furthermore, a map of isolines of the P-wave velocity distribution (Klíma and Pšenčík, 1977) is constructed in order to determine the real extreme velocities and the mean P-wave velocity as a weighted average of all independent measured directions for a given pressure. The P-wave velocity distribution in amphibolites depends on the proportion af amphibole and plagioclase as well as on the fabric intenisty (Barruol and Kern, 1996). This combined microstructural and P-wave velocity study will help to better understand the velocity anisotropy and shear wave splitting in the lower mafic crust.

References

BARRUOL G. and KERN H., 1996. Seismic anisotropy and shear-wave splitting in lower-crustal and upper mantle rocks from the Ivrea Zone - experimental and calculated data. *Phys. Earth Planet. Inter.*, 95: 175-194.

CUMBEST R.J., DRURY M.R., VAN ROERMUND H.L.M. and SIMPSON C., 1989. Dynamic recrystallization and chemical evolution of clinoaphibole from Senja, Norway. *Contrib. Min. Pet.*, 101: 339-349.

HOLLAND T. and BLUNDY J., 1994. Non-ideal interactions in calcic amphiboles and their bearing on amphibole-plagioclase thermometry. *Contrib. Min. Pet.*, 116: 433-447.

KLÍMA K. and PŠENČÍK I., 1977. Processing of the velocity anisotropy of rocks and minerals. Naukova Dumka.

PROS Z., LOKAJÍČEK T. and KLÍMA K., 1998. Laboratory Approach to Study of Elastic Anisotropy on Rock Samples. *Pure appl. Geophys.*, 151: 619-629.

P-T Paths within the Variscan Accretionary Prism Based on Illite Crystallinity and b Dimensions of Micas from Metamudrocks of the Kaczawa Mountains, SW Poland

Ryszard KRYZA[1], Jan ZALASIEWICZ[2], Richard J. MERRIMAN[3], Alan S. COLLINS[4] and Simon J. KEMP[3]

[1] *University of Wroclaw, Institute of Geological Sciences, Poland*
[2] *Department of Geology, University of Leicester, U.K.*
[3] *British Geological Survey, Keyworth, Nottingham, U.K.*
[4] *Tectonics Special Research Centre, Curtin University of Technology, Perth, W Australia*

Variably metamorphosed mudrock successions are present within the Variscan accretionary prism preserved in the Kaczawa Mountains in SW Poland (Fig. 1). Overall, the Kaczawa complex comprises diverse Cambrian? through Early Carboniferous sedimentary and volcanic rocks which include substantial bodies of mélange (Haydukiewicz 1987; Baranowski et al. 1998). These mélange bodies contain a remarkedly preserved assemblage of sedimentary and tectonic fabrics similar to those described from recent accretionary prisms (Collins et al., 2000). Metavolcanics and associated metasedimentary rocks in some tectonic slices have been metamorphosed to blueschist facies (ca. 10 kbar, 300–400 °C) then subsequently overprinted under lower greenschist facies conditions (<6–8 kbar, 350–450 °C; Kryza et al., 1990). In contrast, part of the mudrock successions, e.g. the Rzeszówek and Stanislawów/Chelmiec mélange, shows little evidence of strong metamorphic recrystallization. This suggests the juxtaposition of rocks which have been transported to various depths and which have followed various PT paths.

To find possible differences in metamorphic grade attained in different tectonic units, we applied X-ray diffraction techniques to measure the crystallite size (illite crystallinity) and b-cell dimension of white micas in the mudrocks (Merriman and Peacor, 1999). Preliminary results indicate considerable heterogeneity of illite crystallinity (IC) values for samples representing different bodies of the Kaczawa complex (Table 1). Two

Tectonic units	Sample	Illite crystallinity	Maturity zone
Chelmiec	35/S 25.9	0.26	Anchizone
	35/S 478.8	0.23	Epizone
	35/S 900.4	0.30	Anchizone
Rzeszowek	RZ1	0.36	Anchizone
	RZ2	0.19	Epizone
	RZ3	0.26	Anchizone
Swierzawa	WD1	0.22	Epizone
	J6B2	0.23	Epizone
Radzimowice	AZ-B2	0.20	Epizone
	CHR	0.16	Epizone

Tab. 1. Illite crystallinity values for mudrocks from the Kaczawa complex (maturity zones from Merriman and Peacor, 1999 and refs. therein).

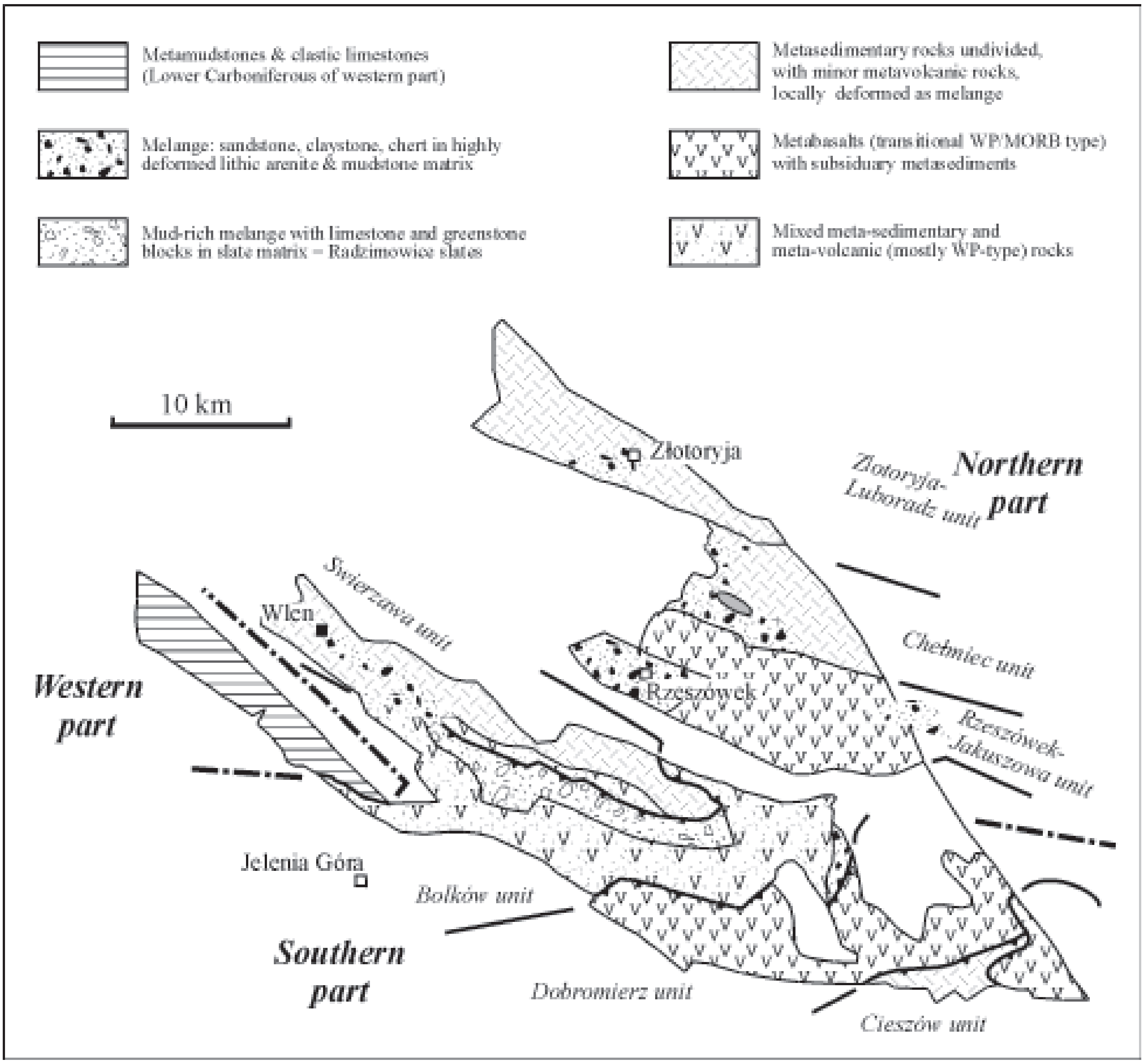

Fig. 1. Map of the Kaczawa complex in the West Sudetes (modified after Baranowski et al., 1990).

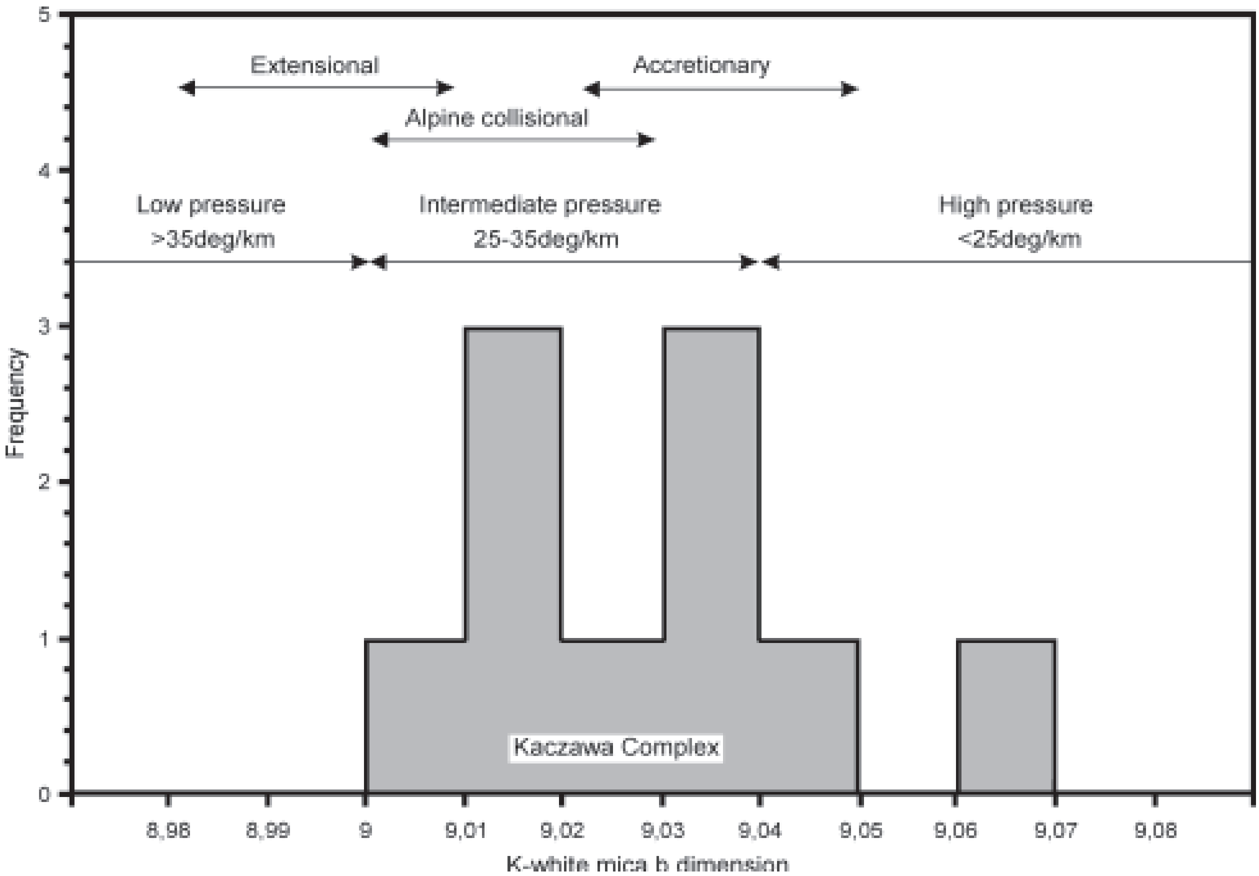

Fig. 2. Distribution of b-cell dimensions in white micas from mudrocks from the Kaczawa complex.

samples of the Rzeszówek mélange (Fig. 1) fall within the anchizone (IC = 0.36 & 0.26) and one (from a large block of sandstone) within the epizone (IC 0.19). Similarly, two samples from the Chełmiec unit borehole core 35/S represent the anchizone (IC = 0.30 & 0.26), and one the epizone (IC 0.23). IC values for three samples of the Radzimowice slates range between 0.16 and 0.23, typical of the epizone. Recently obtained data on Cal-Dol thermometry in interbedded metamorphic limestones indicate a maximum T of ca. 350 °C within this part of the rock complex. The b-dimension results of all the white-mica samples, between 9.00 and 9.07 A, plot within intermediate- and high-pressure ranges, i.e. characteristic of alpine-collisional and accretionary settings (Fig. 2).

Our preliminary results provide new evidence that the metamorphic conditions attained different levels in different parts of the sedimentary and volcanic successions. No metamorphic mineral growth, besides white mica and chlorite growth and quartz recrystallization, is found within the matrix of the mélange, precluding burial to significant depths. In contrast, coherent thrust sheets of passive margin sediments and volcanic rocks, that underlie the mélange, preserve blueschist-facies assemblages that indicate burial to at least c. 25 km (Kryza et al., 1990). These thrust slices were incorporated into the mélange as they were exhumed, the interleaving occurring near surface. More detailed illite work promises to illuminate the pattern of subduction/exhumation in different parts of the Variscan accretionary prism in the West Sudetes.

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References

BARANOWSKI Z., HAYDUKIEWICZ A., KRYZA R., LORENC S., MUSZYNSKI A., SOLECKI A. and URBANEK Z., 1990. Outline of the geology of the Gory Kaczawskie (Sudetes, Poland). *Neues Jahrbuch für Geologie und Paläontologie Monatshefte*, 179: 223-257.

BARANOWSKI Z., HAYDUKIEWICZ A., KRYZA R., LORENC S., MUSZYNSKI A. and URBANEK Z., 1998. The lithology and origin of the metasedimentary and metavolcanic rocks of the Chełmiec Unit (Gory Kaczawskie, Sudetes). *Geologia Sudetica*, 31: 33-59.

COLLINS A.S., KRYZA R. and ZALASIEWICZ J.A., 2000. Macrofabric fingerprints of Late Devonian Early Carboniferous subduction in the Polish Variscides, the Kaczawa complex, Sudetes. *Journal of the Geological Society*, 157: 283-288.

HAYDUKIEWICZ A., 1987. Melanże Gor Kaczawskich. In: Przewodnik 58 Zjazdu Pol. Tow. Geol., Walbrzych, 17-19 Wrzesnia 1987, pp.106-114.

KRYZA R., MUSZYNSKI A. and VIELZEUF D., 1990. Glaucophane-bearing assemblage overprinted by greenschist-facies metamorphism in the Variscan Kaczawa complex, Sudetes, Poland. *Journal of Metamorphic Geology*, 8: 345-355.

MERRIMAN R.J. and PEACOR D.R., 1999. Very low-grade metapelites: mineralogy, microfabrics and measuring reaction progress. In: M. Frey and D. Robinson (Editors), Low-grade metamorphism. Blackwell Science, pp. 10-60.