The c. 340 Ma metamorphism and deformation in the Variscan foreland, Wielkopolska, Poland

A. ŻELAŹNIEWICZ[1] – D. MARHEINE[2] – T. OBERC-DZIEDZIC[3]

[1] Instytut Nauk Geologicznych PAN, pansudet@pwr.wroc.pl
[2] Université Montpellier 2, marheine@dstu.univ-montp2.fr
[3] Uniwersytet Wrocławski, toberc@ing.uni.wroc.pl

A Variscan foreland in western Poland comprises two NW-trending basement highs which are concealed under Carboniferous through Triassic strata of the Fore-Sudetic Monocline (FSM). Both highs consist of multiply deformed quartz-sericite±albite± chlorite phyllites, at least in part of volcanogenic origin. In the northeasterly situated Wolsztyn-Leszno High (WLH) such multiply deformed phyllites were drilled in 7 boreholes. Phyllites in the Święciechowa 1 borehole were sampled for Ar-Ar dating, They possess moderately to steeply dipping S_1 foliation which is involved into asymmetric F_2 folds with shallowly dipping axial-plane foliation S_2. The latter is marked by rotated and recrystallized white mica forming up to 0.5 mm thick sericite layers. A minute stretching lineation of quartz (L_{2q}) on the S_2 foliation planes matches the dip- to oblique-slip motion with kinematics inferred from S-C structures. The S_2 shear planes intersecting the opposite limbs of the mesoscopic F_2 folds record the same sense of movement. This suggests that the shearing with persistently thrust displacement of the hanging walls overprinted earlier F_2 folds. Although the drillcores were not orientated, subcrop outline and gravimetric data show that the WLH stretches NW-SE and dipmeter data for boreholes penetrating Carboniferous successions close to the WLH document SW-ward dips of Upper Viséan–Lower Namurian flysch beds (unpublished petroleum industry data). Combining these data, NW-trending structural grain of the phyllites and similar SW-ward regional dip of their foliations are supposed. The distribution of steep and shallow attitudes of the S_1 planes in boreholes (based on log data and scarce drillcores) allow to infer that an overall structure of the WLH is that of a large-scale overturned fold. Its inverted limb well recorded contractional thrust deformation with inferred top-to-the NE/N kinematics. It is the very limb that was sampled for the Ar-Ar age determination.

The sample was prepared for analyses in the way permitting to measure isotopic ratios for the sericite flakes forming the S_2 layers. Since most of the measured isotopic ratios are very similar yielding ages between 346 and 337 Ma, we assume that all the dated sericites grew inside the S_2 layer, and the S_1 micas could hardly escape resetting. The dated sericites are estimated to have grown below or close to the blocking temperature of argon in white mica (350 ± 50 °C). Therefore, the growth ages of the S_2 synkinematic micas and the age of the F_2 folding and development of the S_2 foliation has most probably been obtained. Taking into account the error in estimation of temperature conditions during D_1 and D_2 which is within the same limit and because of good structural constraint on the studied S_2 mica layer, we suggest that the obtained age of 340.1±2.6 Ma dates the lower greenschist facies metamorphism and most probably refers to the D_2 folding and shearing rather than to poorly constrained D_1 event, or to post-D_2 cooling.

The FSM phyllitic highs are commonly unconformably covered by Rotliegendes, but in few places also by either Upper Viséan flysch series (Górecka et al. 1977) or Upper Carboniferous molasse, and they delivered clasts to overlying late Viséan-early Namurian flysch basin (Kłapciński – Lorenc, 1984). The latter was mainly sourced from the Saxo-Thuringian Sudetes in which most of the deformation occurred between 345–335 Ma (Marheine et al., 2002). The FSM basement may be interpreted as allochthonous Saxo-Thuringian fragments of a deformed and metamorphosed Palaeozoic succession derived in the south from the suture zone between Saxothuringia and Bohemia and moved generally northward during thick-skinned thrusting prior to late Viséan flysch sedimentation. Structural and petrographic characteristics of the Wielkopolska phyllites resemble schistose rhyolitic metatuffs of the Southern Phyllite Zone (c. 488 Ma of the Drehna phyllites) and are also similar to some quartz-sericite phyllites (Ordovician or Devonian protolith age) of the Kaczawa Complex in the West Sudetes. Alternatively, the FSM basement may represent an independent terrane, referred to as the Wielkopolska terrane, positioned between Baltica and Saxo-Thuringia, belonging to the Armorican Terrane Assemblage (Tait et al. 1997). The Saxo-thuringia and Wielkopolska terranes are separated by the Odra Fault Zone (OFZ) and differ in their gravimetric (Grabowska – Raczyńska, 1991) and magnetic (Królikowski – Wybraniec, 1996) patterns. The Wielkopolska terrane may have likewise been derived from the Cadomian periphery of Gondwana. Early Carboniferous transpressional collision between Saxothuringia and Wielkopolska which carried Palaeozoic basinal sediments produced a subvertical suture coinciding with the OFZ, which is unnoticed by seismic reflection data (Żelaźniewicz et al. 1997). This suture comprises medium-grade metasediments with evidence of strike-slip shearing, intruded by mostly unfoliated post-tectonic granitoids of Tournaisian age (Dörr et al. 2002) thereby testifying to the termination of ductile activity in the OFZ in still pre-Viséan times coinciding with late D_2 thrusting in Wielkopolska. In the NE, Wielkopolska collided with Baltica over the Dolsk Fault Zone and both formed

basement for a Variscan foreland basin subsequently concealed under thick Permo–Mesozoic strata of the Polish Basin.

References

Dörr, W. – Bylina, P. – Żelaźniewicz, A. – Franke, W. (2002): Tournaisian late- to-post-tectonic granitoids from the Odra Fault Zone, southwestern Poland: U-Pb zircon evidence. Schrift Dt Geol Ges 21: 101.

Górecka, T. – Juroszek, C. – Karwowski, L. – Kłapciński, J. – Lorenc, S. – Mierzejewski, M. – Sachanbiński, M. – Ślusarczyk S. (1977): Utwory skalne podłoża permu zachodniej części monokliny przedsudeckiej i perykliny Żar oraz przyległej części bloku przedsudeckiego. Prace Naukowe Instytutu Górnictwa Politechniki Wrocławskiej 22: 3–92

Grabowska, T. – Raczyńska, M. (1991): Structure of the Earth's crust on the Polish Lowland in the light of gravimetric modelling. Publs Inst Geophys Pol Acad Sc A–19 (230): 85–110

Kłapciński, J. – Lorenc, S. (1984): Osady karbonu na południe od Poznania. Carboniferous sediments S of Poznań. Acta Universitatis Wratislaviensis. Prace Geologiczno-Mineralogiczne 9: 19–33

Królikowski, C. – Wybraniec, S. (1996): Gravity and magnetic maps of Poland – historical background and modern presentation. Publs Inst Geophys Pol Acad Sc M-18 (273): 87–89

Marheine, D. – Kachlik, V. – Maluski, H. – Patočka, F. – Żelaźniewicz, A. (2002): The Ar-Ar ages from the West Sudetes (NE Bohemian Massif): constraints on the Variscan polyphase tectonothermal development. *In:* Winchester, J. A. – Pharaoh, T. C. – Verniers, J. (eds): Palaeozoic Amalgamation of Central Europe. Geological Society Special Publication.

Tait, J. – Bachtadse, V. – Franke, W. – Soffel, H. C. (1997): Geodynamic evolution of the European Variscan fold belt: palaeomagnetic and geological constraints. Geol Rundschau 86: 585–598

Żelaźniewicz, A. – Cwojdziński, S. – England, R. W. – Zientara, P. (1997): Variscides in the Sudetes and the reworked Cadomian orogen: evidence from the GB-2A seismic reflection profiling in southwestern Poland. Geological Quarterly 41, 289–308.