Pre-Upper Devonian Unconformity in the Kłodzko Area (Polish Sudetes) Excavated: A Record of Mid-Devonian Metamorphism and Deformation

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Since the work of Suess (1888), the Sudetes have been considered a part of the Variscan belt, shaped mainly by Late Devonian and Carboniferous tectonothermal activity (e.g. Oberc 1980, Teisseyre 1980). However, occurrences of unmetamorphosed Upper Devonian sedimentary rocks in the close proximity of metamorphosed Palaeozoic sequences gave rise to alternative interpretations which made the Caledonian orogeny mainly responsible for the tectonic evolution of the Sudetes (Bederke 1924, Don 1990, Oliver et al. 1993).

One of the best known sites of a pre-Upper Devonian unconformity is the one along the boundary between the Kłodzko Metamorphic Unit and the Bardo Unit in the central Sudetes. The former unit comprises low- to medium-grade metasedimentary and metaigneous rocks of lower- to mid-Palaeozoic age (Wojciechowska 1990), including fossiliferous crystalline limestones previously assigned to the Ludlovian (Gunia and Wojciechowska 1971) and recently reinterpreted as lower Givetian (Hladil et al. 1998). The Bardo Unit is formed of various sedimentary successions, ranging in age from the Ordovician to Carboniferous, and displaying complex structural relationships (Oberc 1957, 1987, Wajsprych 1978, Haydukiewicz 1990). Along the NNW-SSE-trending boundary between the two units, the metamorphic basement rocks are overlain by c. 60 m thick, unmetamorphosed, Upper Devonian and Tournaisian sediments, including thin basal conglomerates, calcareous breccias and detrital limestones.

The unconformable contact between the Upper Devonian limestones and the metamorphic basement was described in detail by Bederke (1924) and since then it has been interpreted by many geologists as an evidence for Caledonian deformation (see refs. above). Many others, however, argue that the unconformity was formed due to early Variscan tectonic activity (Oberc 1980, Aleksandrowski et al., in press).

The importance of the unconformity in question remains in contrast with the annoying fact that it is nowhere exposed at present (possibly except for the gabbro blocks? at the base of the Wapnica section), and has been inaccessible for direct observation for decades (c.f. Oberc 1957). Therefore, new excavation works were done to confirm the existence and character of the contact between the metamorphic basement and the sedimentary cover.

Two localities, Łączna and Gołogłowy, were selected for the excavation based on detailed mapping and EM31 conductivity survey. At both localities, four trenches 2.5–3 m deep and up to 24 m long, were dug across the expected contact zone. Along the trenches at both sites the unconformity was excavated.

At Łączna, the metamorphic basement rocks are represented by dark grey and greenish phyllites. The foliation dips steeply to the N (15/80) and the mineral lineation is moderately inclined to the E (90/45). At Gołogłowy, the basement rocks appear to be fine-grained, moderately foliated, greyish greenstones (instead of the expected, from the map, gneisses) and display similarly oriented foliation (10/75) and lineation (85/40). At each site, the metamorphic rocks are in primary, sedimentary contact with the overlying basal sedimentary breccias and conglomerates. There is no evidence of tectonic disturbance at the contact. The sediments are strongly weathered but look rather massive near the contact, containing large amount of mostly subrounded pebbles of different size, up to 40 cm across, representing fragments of calcareous breccias (intraformational breccias) and lithologies found in the metamorphic basement: phyllites, greenstones and crystalline limestones. Upward in the sequence, the amount and size of the pebbles decrease and the rocks become more distinctly bedded. Bedding at both localities is roughly perpendicular to the foliation of the underlying metamorphic rocks (Łączna: 105/45, Gołogłowy: 95/50, 75/50).

The age of the limestones overlying the basal conglomerates was palaeontologically dated to upper Frasnian and Famennian (Bederke 1924, Gunia 1977). Based on the recently revised lower Givetian age of the crystalline limestones from Mały Bożków in the matamorphic basement (Hladil et al. 1998), the time span between the metamorphism and deformation of the basement rocks and the unconformable deposition of the calcareous sediments is rather short, around 10 Ma. Thus, the unconformity points to the exhumation of shortly earlier deformed and metamorphosed rocks at the turn of the Middle and Late Devonian. At that time, however, continuous basinal sedimentation in other areas, e.g. in the Kaczawa Unit in the north, apparently lasted at least till the end of the Devonian. Therefore, the discussed unconformity reflects the first exhumation of a Variscan nappe pile during late Devonian times, contemporaneous with continuous metamorphism at lower crustal levels and uninterrupted sedimentation in adjacent synorogenic basins (c.f. Oberc 1980, Aleksandrowski et al., in press).

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