Annales Societatis Geologorum Poloniae (1988), vol. 58: 481–485
PL ISSN 0208–9068

POLISH CALEDONIDES AND THEIR RELATION TO THE OTHER EUROPEAN CALEDONIDES. A DISCUSSION*

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J. Znosko (1986) discussed the evolution of the Paleozoic structures in the north-western and central parts of Poland, presenting the problem against a broad historical and geographical background. According to this author, the territory of Poland (except for its northeast part belonging to the East European platform) was affected by the Caledonian orogenic movements with all their consequences, namely: strong compression, metamorphism and magmatic processes. These have led, according to Znosko (1986), to the consolidation of the crust, so that the Devonian to Cretaceous strata are a typical cover of the epi-Caledonian platform.

The quoted paper was preceded by another one, published three years earlier (Znosko, 1983) where the geological structure of the Paleozoic of the central-south of Poland is discussed in more detail. Both papers deal, in more detail (Znosko, 1983) or more generally (Znosko, 1986), with the problem of the geological structure of the Góry Świętokrzyskie Mountains (some writers use the English translation of the name – Holy Cross Mts.). The Paleozoic rocks in these mountains are a fragment of the discussed structures, exposed there by erosion. In the remaining part of central Poland these structures are covered with Mesozoic strata. The study of the tectonics of the Paleozoic rocks in this region is of fundamental importance for the study of the substratum of the Mesozoic in the whole of central Poland. Having studied the tectonics of the Góry Świętokrzyskie for more than ten years, I feel obliged to address myself to this matter because the tectonic phenomena documented in the southern part of the Góry Świętokrzyskie (Kielce region) do not provide evidence that the Caledonian tectonic processes in this area were typically orogenic ones, in the classical sense of the word. On the basis of the facts I know, I do not fully reject the occurrence of tectonic movements in the Kielce region towards the end of the earlier Paleozoic. These movements, however,

* *Manuscript received March 1987.*

resulted only in gentle deformations and faults, due to the long-lasting but week horizontal compression. As a result of these processes, which occurred partly in subaerial conditions, the Lower Devonian strata directly overlie the Cambrian rocks in a large area in the southern part of the Góry Świętokrzyskie (Czarnocki, 1938).

This course of the processes is suggested by:

1) The predominantly small angular unconformities between the Upper Silurian and Lower Devonian (Emsian strata).

The angular differences are a few to less than twenty degrees in those places where the Silurian/Devonian contacts may be observed. For instance, the dips of strata in the Niewachlów anticline or Dymin anticline: Ordovician – 30–60° N (Bednarczyk, 1966, pp. 9–16), Devonian – 40–55° N (Bednarczyk *et al.*, 1970, p. 217), and only exceptionally are they greater, e.g. the dips in the northern limb of the Bardo syncline: Silurian – 45–65° S, Devonian – 12–15° S (Kowalczewski & Tomczyk, 1981, p. 149, fig. 18). It should also be noted that the Ordovician-Silurian strata of the Góry Świętokrzyskie, mostly represented by argillaceous shales (Tomczyk, 1956; Bednarczyk, 1966) were usually detached along their boundary with the Devonian sandstones, dolomites and limestones (*cf.* Tarnowska, 1983). The dysharmonic folding was undoubtly the main cause of the angular differences between the dip angles of older and younger Paleozoic strata.

The presented data indicate that the angular unconformities at the Silurian/Devonian boundary in the southern part of the Góry Świętokrzyskie are small, especially as compared to the angular unconformity found at the Cambrian/Ordovician boundary, which proves strong folding before the early Ordovician transgression. This latter unconformity attains several tens degree, e.g. in the Bardo syncline and the Szumsko brachysyncline (dips: Cambrian – 50–90° N, Ordovician – 10–30° N; Stupnicka, 1986, p. 5). One can hardly agree with Znosko (1983, p. 466) that the folding of the Vendian and Cambrian strata occurred together with the folding of the Ordovician-Silurian sequence.

2) The general agreement of the pre-Devonian and pre-Permian tectonic patterns.

The Ordovician and Silurian rocks occur in limbs of tectonic units which are built of Cambrian to Lower Carboniferous rocks (*Mapa geologiczna regionu Świętokrzyskiego*...1961; Bednarczyk *et al.*, 1970, fig. 1). This means that the post-Silurian tectonic movements were of less importance for the origin of the tectonic units in the Kielce region (Klimontów anticlinorium and Kielce-Łagów synclinorium) than the movements which occurred after the Early Carboniferous (Variscan orogeny).

3) The lack of evidence of typical post-Caledonian molasse in the Kielce region.

The sequence of Lower Devonian (Emsian) strata begins with red argillaceo-

us series containing sandy intercalations, initially thin, then thicker and thicker. Higher in the section there appear light, medium-grained sandstones with thin intercalations of fine gravels. Quartz is the main component of these rocks. The only exception is a thin layer of transgressive conglomerates which occur locally at the bottom of the sandstone series. The conglomerates contain Paleozoic rocks with the dominant proportion of the rocks from their direct substrate (Tarnowska, 1983, p. 40).

Znosko (1983, p. 464) considers that the synorogenic deposits laid down in marine conditions are the Upper Silurian Wydryszów Beds in the north of the Góry Świętokrzyskie and the Niewachlów greywackes in the south. The Wydryszów Beds, however, consist mainly of fine-grained material, well sorted and well segregated. The thickness of the Wydryszów Beds is only about 450 m (Przybyłowicz & Stupnicka, in preparation). Greater rock fragments, found in the Niewachlów conglomerates (Bardo syncline – Przybyłowicz, 1986), are of volcanic origin, hence they only prove the occurence of extrusive phenomena in this area during the Late Silurian.

It is to be stressed that the Ordovician and Silurian strata are thin in the southern part of the Góry Świętokrzyskie. While the thickness of the whole Paleozoic series (without Permian) may be estimated at 7000–8000 metres, the maximum thickness of the Ordovician-Silurian strata does not exceed one thousand metres (Bednarczyk, 1981, pp. 35–41; Tomczykowa & Tomczyk, 1981, pp. 50–51). These rocks were laid down in a shallow or moderately deep marine basin (Bednarczyk, 1981, table 4; Tomczykowa & Tomczyk, 1981, pp. 49–50). The small thickness of these rocks rules out the possibility of the „miogeosynclinal-orogenic" development of the basin, accepted by Znosko (1983, p. 463). The absence of any traces of metamorphism or magmatic phenomena does not permit one to include them into deposits of an eugeosynclinal basin.

No convincing evidence has been hitherto found in the Góry Świętokrzyskie that would point to the dominant role of the Caledonian orogeny in the evolution of this structure. Structural studies have been recently carried out in the vicinity of Zalesie near Łagów (Stupnicka, 1986). They include the Bardo syncline – the only syncline in the Kielce region built of Ordovician and Silurian strata unconformably covered with Lower Devonian sandstones. The syncline is a gentle assymetric brachysyncline, more than ten kilometres long. The northern limb, which is steeper (55–65° S), is bounded by a fault; hence it seems to be of flexural type.

The Ordovician and Silurian strata of the southern limb of the Bardo syncline are cut by faults with a NNW–SSE and NNE–SSW trend. The faults have resulted from submeridional (170°) horizontal compression (Stupnicka, 1986, p. 10). The faults do not continue into the Emsian sandstones, so they originated before or at the beginning of the Early Devonian, and may be attributed to the Caledonian movements. On the grounds of these observations

one can accept the occurrence of compression in the area of the southern part of the Góry Świętokrzyskie after the Late Silurian. This was not, however, the process that had decisive effect on the present structure of the Góry Świętokrzyskie.

Ordovician volcanism (Chlebowski, 1978) was developed on a small scale, as is indicated by the small thickness of the Ordovician strata – 130 – 140 m in the Kielce region (Znosko, 1983, p. 464; note that sandstones and limestones predominate in the section). The presence of this volcanism does not prove the hypothesis of Znosko (1983, p. 464) that a Caledonian geosyncline was present in the area of Góry Świętokrzyskie. Also the Late Silurian volcanism does not prove the Caledonian orogenic movements. I suppose that it marks tensional processes and not as J. Znosko interprets it, a strong compression accompanied by folding, and small- to large-scale thrusting (1986, p. 42). The presence of folds, scales and greater overthrusts in the Early Paleozoic structures of the Góry Świętokrzyskie and their close vicinity has been not proved. For this reason it can not be used as the basis for acceptance of the presence of a Caledonian orogen in the whole area of central Poland.

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