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MIDDLE DEVONIAN CONODONTS AND STRUCTURAL IMPLICATIONS FOR ŚWIĘTOMARZ–ŚNIADKA SECTION (HOLY CROSS MOUNTAINS)

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Abstract: The paper presents a new interpretation of the geological structure and stratigraphy of the Devonian in the Świętomarz–Śniadka section. The uppermost Śniadka Formation (equivalent to the Nieczulice Formation), was described previously from the northern part of the section between exposures of the sandstones and shales of the Świętomarz Formation. The present study revealed the presence in the mentioned area of Sitka Coral-Crinoid Limestone Member and the Sierżawy Member, referable to the Skały Formation. Black, thin-bedded limestones, occurring here, were assigned to the upper part of the Sierżawy Member. Conodont assemblages indicate that the Sitka Coral-Crinoid Limestone Member corresponds to the *hemiansatus* Zone, whereas most of the Sierżawy Member represents the *timorensis – rhenanus*/*varcus* zones. The presence of the North American species *Icriodus janaea* is documented for the first time in Poland. Clay shales and marls with *Maenioceras terebratum* are considered to be the uppermost part of the Sierżawy Member. These stratigraphic data are the basis for a new interpretation of the geological structure of the Bodzentyn Syncline.

Key words: Holy Cross Mts, Łysogóry Region, Middle Devonian, conodonts, geological section.

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INTRODUCTION

The Świętomarz–Śniadka section, located in the NE part of the Holy Cross Mountains, in the Łysogóry region, is one of the key exposures of the Middle Devonian in the Bodzentyn Syncline and the only one in Poland, where rocks of this age, containing goniatites, are exposed (Fig. 1). The section studied is characterized by the occurrence of several, longitudinal faults that have given rise to multiple repetitions of the same, lithostratigraphic units along the Psarka valley.

The complex, tectonic structure and a N–S variability of facies have resulted in many discrepancies in the understanding of the stratigraphy of the exposed succession. Czarnocki (1950) wrote: “An attempt of detailed subdivision of the section using palaeontological methods, despite the meticulous and detailed analysis by Sobolew (1909) did not give positive results”. In addition to dolomites, Sobolew (1909) distinguished the following stratigraphic units in the succession: crinoidal limestones, the Sierżawy Beds and the Świętomarz Beds (Fig. 2). Czarnocki (1950) assigned Sobolew’s first two units to the Skały Series, and upgraded the Świętomarz Beds to the series (lithostratigraphic unit) level. Like Sobolew, Czarnocki (1950) included the olive-green shales with *Maenioceras terebratum* and the “micaceous, sandy greywackes” in the Świętomarz Series. Later workers included only the last mentioned rocks, which are recognized easily in field, in the Świętomarz Formation (Kłossowski, 1985; Turnau and Racki, 1999 and others).

In contrast to Czarnocki (1950), most scientists (Filonowicz, 1962, 1969; Mizerski, 1981; Kłosowski, 1985; Malec, 1988; Turnau and Racki, 1999; Halamski, 2005) have considered the outcrops, located between two sandstone exposures of the Świętomarz Formation in the northern part of the section, opposite Śniadka village (Fig. 3), as representing the youngest part of the succession, forming the axial part of the structure. It is the Śniadka Formation of Kłossowski (1985) and the Nieczulice Formation of Malec (1988) and Turnau and Racki (1999). However, the present study indicates the presence of the Sitka Coral-Crinoid Limestone Member and the Sierżawy Member (subdivision after Kłossowski, 1985) in that part of the section, an interpretation that was confirmed by means of conodonts. Black, thin-bedded limestones, occurring in that area, were assigned to the upper part of the Sierżawy Member. These facts imply a different view of the geological structure of the section, very close to that, presented by Czarnocki (1950, fig. 13). Such an interpretation of the structure an-

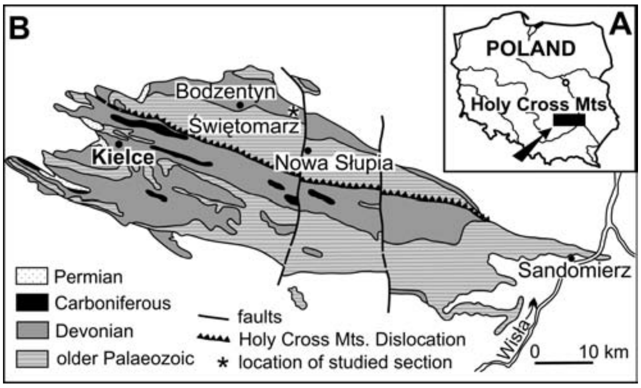

Fig. 1. Location maps. **A** – General map of Poland, showing location of Holy Cross Mountains. **B** – map of Holy Cross Mountains, showing location of sections studied (simplified after Turnau and Racki, 1999)

swers some questions, already posed by Sobolew (1909) with regard to the stratigraphic position of the olive-green shales with *Maenioceras terebratum* (at five documented localities), assigned by him to the Świętomarz Beds: are these shales located below (near Świętomarz) or above the Świętomarz sandstones (near Śniadka) and do all occurrences represent the same, stratigraphic unit? In later papers, shales with a similar goniatite fauna were assigned to: the upper part of the Sierżawy Member in the Skały Formation, near Świętomarz, and to the lower part of the Śniadka Formation, near Śniadka (Kłossowski, 1985) or to the topmost part of the Skały Formation (Skały Beds) and lower part of the Nieczulice Formation (Nieczulice Beds) by Malec, 1988 and Turnau and Racki, 1999.

Conodonts were used as a tool to resolve these stratigraphic issues; the samples were collected from all of the units mentioned and, in particular, from rocks of the Śniadka Formation. Remarks on the presence of conodonts in the Świętomarz–Śniadka section are rare and short, focussing on determinations of single species (Kłossowski, 1985; Malec, 1988, 1999); later papers give lists of conodonts for particular, stratigraphic units (Woroncowa-Marcinowska, 2001; Dzik, 2002). Givetian conodonts were studied in the neighbouring successions of the Łysogóry region and the nearby Radom–Lublin region (Malec, 1996, 1999; Malec and Turnau, 1997; Woroncowa-Marcinowska, 2005; Narkiewicz and Bultynck, 2007; Narkiewicz, 2011). The modified view on the geological structure of the section is based on material, collected over a period of several years.

GEOLOGICAL AND STRATIGRAPHIC SETTING

The lithostratigraphic units, after Kłossowski (1985) referable to formations and members, with some modifications follow earlier subdivisions (Sobolew, 1909; Czarnocki, 1950). In the section, the Skały Formation comprises the Sitka Coral-Crinoid Limestone Member and the Sierżawy Member; its contact with the Wojciechowice Formation is tectonic in nature. The Sitka Coral-Crinoid Limestone Member is composed of pale-grey, medium- and

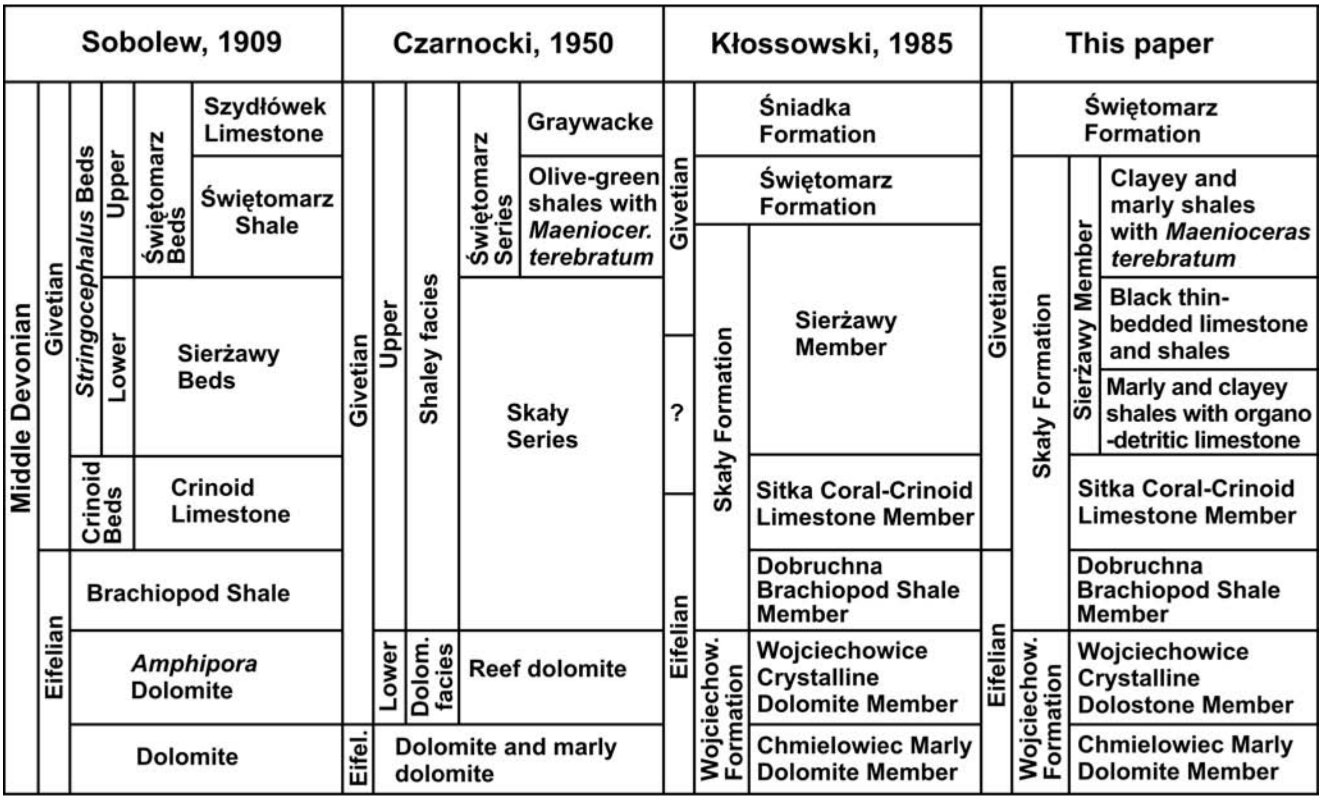

Fig. 2. Middle Devonian subdivision in Świętomarz–Śniadka section

thick-bedded limestones, with a total thickness of up to 8 m. The most common fauna are colonies of Tabulata and Rugosa and crinoid trochites; stromatoporoids are in places a substantial component of the rocks. The Sierżawy Member is a complex unit and comprises dark-grey, grey-brown and green-grey, clay and marly shales, micritic, organo-detritic and black, thin-bedded limestones, with the thickness of particular interbeds reaching 50 to 100 cm. In the topmost part of the Sierżawy Member, there are clay and marly olive-green, greenish-yellow shales, with flat siderite concretions and single beds of yellow, marly limestones, characterized by the presence of a cephalopod fauna with *Maenioceras terebratum*. This sequence is about 35 m thick. The total thickness of the Sierżawy Member, containing numerous fauna, reaches about 120 m. The Świętomarz Formation is dominated by fine quartz sandstones, interbedded with clay and silty shales, and characterized by a rich assemblage of mechanical and organic hieroglyphs. This formation shows an incomplete thickness in the northern part of the section, where it reaches about 30 m, whereas in its central part, the thickness is slightly above 50 m. The topmost part of Sierżawy Member and Świętomarz Formation are characterized by a specific colour (olive-green) and abundance of mica, mainly biotite and muscovite, because of which they are easily distinguished in the field.

The complex, tectonic structure of the section required detailed analysis of the best exposed parts of it, i.e. from the northern (exposure I in Fig. 3), central (exposures II and III in Fig. 3), and southern part (exposure IV in Fig. 3). Exposures I and II represent, a fragment of the overturned northern limb of the Bodzentyn Syncline, repeated, owing to the presence of a fault. The northern exposure I (I in Fig. 4) contains both members of the Skały Formation and the greater part of the Świętomarz Formation; with the older strata best exposed, whereas the upper part of the Sierżawy Member is poorly visible.

To the S of the strata of the Świętomarz Formation, occurring opposite the asphalt road in Śniadka (exposure II in Figs 3 and 4), rocks were observed in the S part of a small gully, which according to this research represent the Sitka Coral-Crinoid Limestone Member and the lower part of the Sierżawy Member, namely strongly ferruginous crinoidal limestones, marly limestones and marls with a rich fauna, interbedded with clay shales. Malec (1988) refers to this part of the section as the "northern exposure of the Nieczulice Formation". The black, "thin-bedded limestones", occurring farther south, are considered by him to be the youngest part of the formation. In this locality, rocks from exposure I are tectonically repeated; the upper part of the succession is well represented as black, thin-bedded limestones, which are repeated many times, owing to closely spaced faults and longitudinal fractures, giving the impression of a much greater thickness, as much as three times larger. The latter horizon of these limestones passes into clay and marly shales, with goniatites and styliolinids. The succession terminates with sandstones and shales of the Świętomarz Formation. In addition to the sandstones, exposure II entirely represents the "Śniadka Formation" of Kłossowski.

Exposures IIIa and IIIb (Figs 3, 4) are similar and represent the same upper part of the Skały Formation and the Świętomarz Formation. They are located on both sides of the axial part of the structure (shale and sandstone). Exposure IV represents the uppermost part of the Sierżawy Member and the Świętomarz Formation. In exposures IIIb and IV, the beds are in a normal position, with dips to the N, and are fragments of the S limb of the overturned syncline.

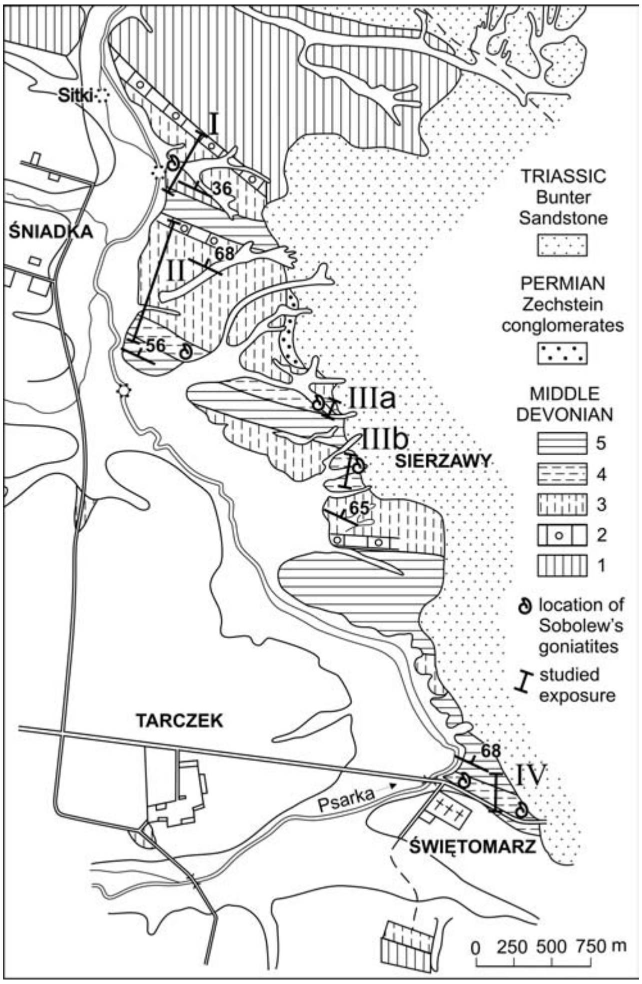

Fig. 3. Schematic geological map of Świętomarz–Śniadka section (reinterpreted after Sobolew, 1909, fig. 1 and Czarnocki, 1950, fig. 13). 1 – Wojciechowice Formation, dolostones; 2–4 – Skały Formation: 2 – Sitka Coral-Crinoid Limestone Member; 3–4 – Sierżawy Member: 3 – marly and clayey shales with organo-detritic and dark limestone; 4 –clayey and marly shales with *Maenioceras terebratum*, 5 – Świętomarz Formation, shales and sandstones

MATERIAL

Conodont material was obtained from 10 positive samples among 20, collected from the coral-crinoid limestones of Sitka Member (exposures I and II, Figs 3, 4), limestones and carbonate concretions of the Sierżawy Member (exposures I–IV), and marly shales of the Świętomarz Formation (exposure II). Among the 10 samples analysed, 5 yielded relatively well preserved and abundant conodont material, with both juvenile and adult specimens represented. The most abundant and fossiliferous material was found in sam-

Table 1

Frequencies of conodont elements in samples from Świętomarz–Śniadka section

Sections	Section I					Section II				Sect. IV
Conodont zones	*hemi-ansatus*	*timorensis*	*rhenanus/varcus*			*hemi-ansatus*	*rhenanus/varcus*			
			lower	*upper*						
Samples	**14**	**1**	**2a**	**2b**	**3a**	**4a**	**4**	**5**	**5a**	**7**
Polygnathus l. linguiformis	6		1	10					7	
P. hemiansatus			cf.1				2			
P. weddigei		1		1						
P. timorensis					1		cf.2	cf.1	1	
P. varcus			2	2			1			
P. xylus xylus				2						
P. ensensis → timorensis									2	
P. ensensis				cf.1					cf.1	
Icriodus regularicrescens			cf.1	3			2			
I. platyobliquimarginatus				5			1		1	
I. obliquimarginatus				2	1		1			
I. arkonensis arkonensis									2	
I. cf. *excavatus*										1
I. lindensis				3			2		2	
I. brevis				13	1		3			
I. difficilis				8	1					
I. janaea									4	
Belodella devonica		3				5	1			
Neopanderodus sp.	1					2	5			

ple 2b. The collection studied comprises over 200 specimens of conodonts, belonging to 4 genera: *Belodella, Icriodus*, *Neopanderodus* and *Polygnathus* and 17 species. The occurrence and number of elements in particular samples are given in Table 1.

BIOSTRATIGRAPHY

The biostratigraphic analysis is based mainly on conodont material. Owing to the lack of existing evidence for the youngest age of the "Śniadka (equivalent to Nieczulice) Formation", particular attention was focussed on studies of this part of the section (exposure II, Figs 3, 4). The conodont biostratigraphic scheme was based on the subdivision by Bultynck (1987, 2007). The conodont assemblages distinguished correspond to the *hemiansatus* – *rhenanus*/*varcus* zones (Fig. 4, Table 1).

The oldest conodont assemblage, recovered from the Sitka Coral-Crinoid Limestone Member, contains *Belodella devonica*, *Neopanderodus* sp. and *Polygnathus linguiformis linguiformis* (exposure I, sample 14 and exposure II, sample 4a, Figs 4, 5A–D, 6A, B–G, Table 1). It may represent the *hemiansatus* Zone, because the lower part of the Sierżawy Member in the Skały Formation (sample 1) contains *P. weddigei* (Fig. 5F), the appearance of which indicates the *timorensis* Zone (Bultynck, 1987).

The remaining assemblages from the Sierżawy Member lie within the *rhenanus*/*varcus* Zone. The conodont assemblage from exposure I, sample 2a, and exposure II, sample 4 (Fig. 4, 5E, K, 6H–S, Table 1), representing the lower part of the Sierżawy Member, contains *P. ensensis*, *Polygnathus linguiformis linguiformis*, *P. timorensis*, *P. varcus*, *Icriodus brevis*, *I. lindensis*, *I. obliquimarginatus*, *I. platyobliquimarginatus* and *I. regularicrescens*. The upper part of the Sierżawy Member (exposure I, sample 3a), located above the bed with goniatites including *Tornoceras* sp., *Agoniatites* cf. *obliquus* (Whidborne) (personal collection, sample 3), *Holzapfeloceras* sp. and *Agoniatites* sp. (Dzik, 2002), corresponds to the upper part of the *rhenanus*/*varcus* Zone. It differs from the previous assemblage in the appearance of *Icriodus difficilis* (Bultynck, 1987). In exposure I, near the horizons with goniatites, distinguished by Dzik (2002, sample Sn-1) *Bipennatus bipennatus* (Bischoff et Ziegler) was found together with *Icriodus brevis*.

The last conodont assemblage, occurring in the black, thin-bedded limestones (exposure II, sample 5a, Figs 3, 4, 7A–K, M, N, Table 1), contains species, similar to those of the previous assemblages (*Polygnathus ensensis*, *P. linguiformis linguiformis*, *P. timorensis*, *I. platyobliquimarginatus*), but differs in having a greater diversity of icriodid conodonts, *Icriodus janaea* and *I. arkonensis*. *Icriodus janaea* has been described from the Plum Brook Formation, Ohio, U.S.A., and assigned to the Upper *ensensis* Zone (Sparling, 1995). The Plum Brook Formation is located between the Delaware Limestone Formation (Eifelian, an unconformable contact) and the Prout Dolomite Formation (the Middle *varcus* Zone, corresponding to the *ansatus* Zone of Bultynk,

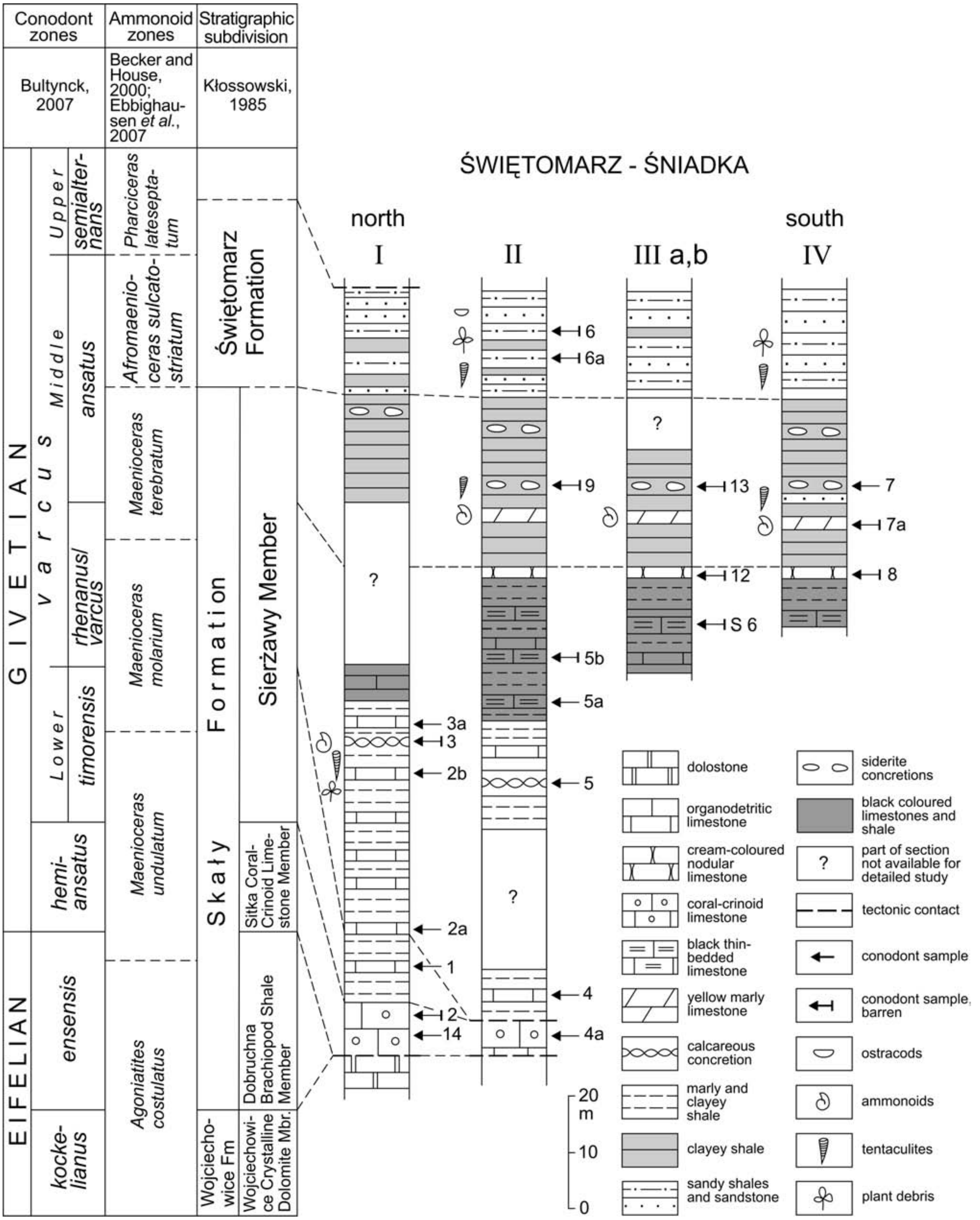

Fig. 4. Correlation of Givetian exposures studied at Świętomarz–Śniadka (simplified) with position of conodont samples

1987). However, owing to the presence of *Polygnathus xylus xylus* and *Icriodus brevis*, Desantis *et al.* (2007) later assigned *I. janaea* and its assemblage to the *timorensis* Zone. Taking into consideration the entire assemblage from sample 5a and the fact that *I. janaea* was found only at one locality, it is suggested that this and the similar assemblages, described above, may correspond to the *rhenanus*/*varcus* Zone.

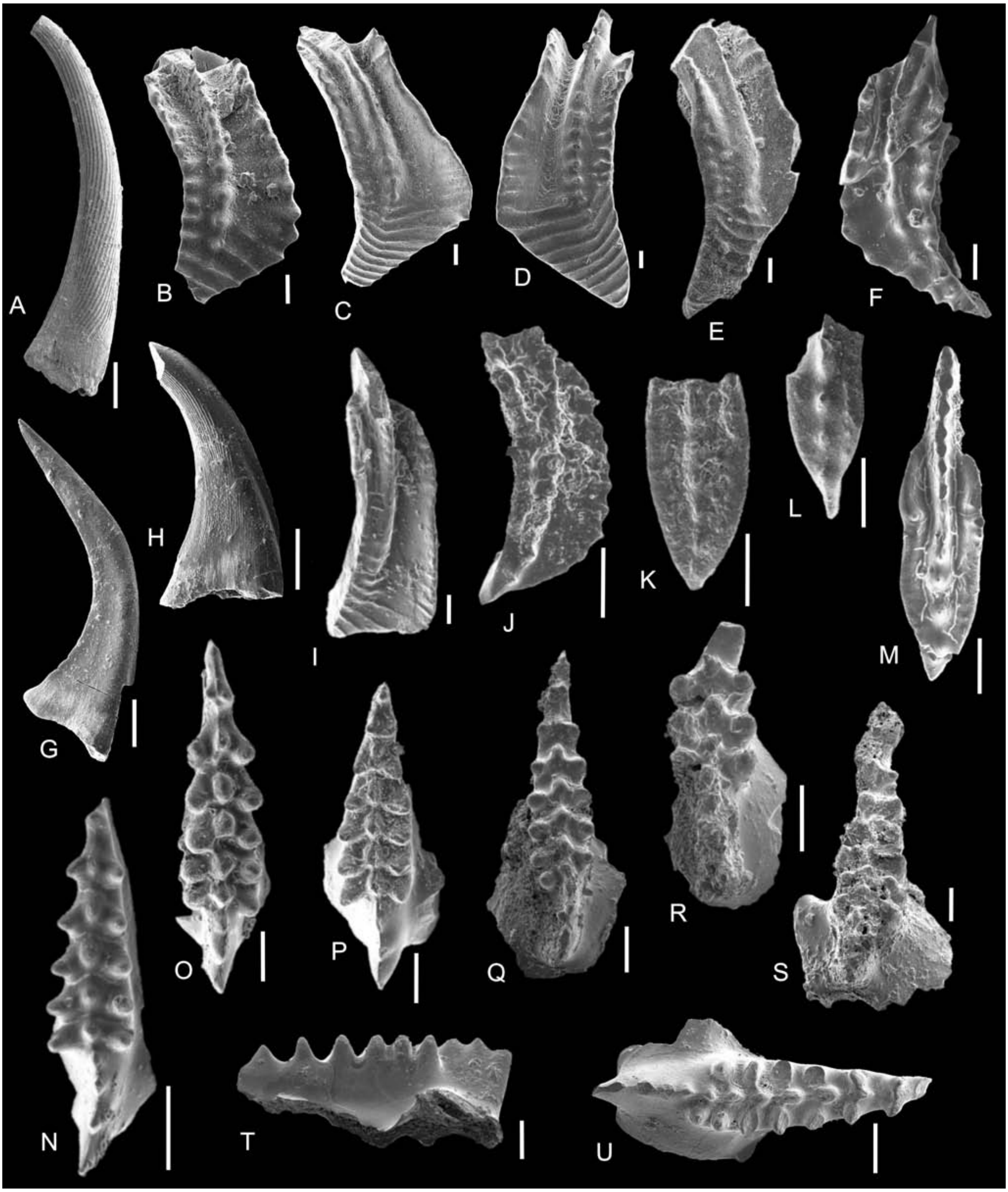

Fig. 5. Conodonts from Lower and lower part of Middle Givetian at Świętomarz–Śniadka, exposure I (Figs 3, 4), Skały Formation. Length of scale bars = 100 µm. **A, H** – *Neopanderodus* sp., A – sample 14, H – sample 1. **B–E**, **I** – *Polygnathus linguiformis* Hinde, B–D – sample 14, E – sample 2a, I – sample 2b. **F, J** – *Polygnathus weddigei* Clausen, Leuteritz et Ziegler, F – sample 1, J – sample 2b. **G** – *Belodella devonica* (Stauffer), M element (after Dzik, 2002), sample 1. **K** – *Polygnathus* cf. *xylus* Stauffer, sample 2a. **L** – *Polygnathus* cf. *varcus* Stauffer, L – sample 2b. **M** – *Polygnathus timorensis* Klapper, Philip et Jackson, sample 3a. **N** – *Icriodus lindensis* Weddige, sample 2b. **O, P, T, U** – *Icriodus brevis* Stauffer, sample 2b. **Q** – *Icriodus regularicrescens* Bultynck, sample 2b. **R** – *Icriodus* cf. *platyobliquimarginatus* Bultynck, sample 2b. **S** – *Icriodus difficilis* Ziegler et Klapper, sample 3a. A–D – Sitka Coral-Crinoid Limestone Member, E–U – Sierżawy Member; A, G, H, T – lateral views, B–F, I–S, U – upper views

Fig. 6. Conodonts from Lower and lower part of Middle Givetian at Świętomarz–Śniadka, exposure II (Figs 3, 4), Skały Formation. Length of scale bars = 100 µm. **A, H** – *Neopanderodus* sp., A – sample 4a, H – sample K-4. **B–G**, **J–M** – *Belodella devonica* (Stauffer), B–G – sample 4a, J, K–M – sample 4. **I** – *Neopanderodus transitans* Ziegler et Lindström, sample 4. **N** – *Polygnathus* cf. *timorensis* Klapper, Philip et Jackson, sample 4. **O** – *Polygnathus varcus* Stauffer, sample 4. **P** – *Icriodus obliquimarginatus*, sample 4. **Q** – *Icriodus platyobliquimarginatus* Bultynck, sample 4. **R**– *Icriodus* cf. *regularicrescens* Bultynck, sample 4. **S** – *Icriodus regularicrescens* Bultynck, sample 4. A, B–G – Sitka Coral-Crinoid Limestone Member, H, I, J–S – Sierżawy Member; A–M – lateral views, N–S – upper views

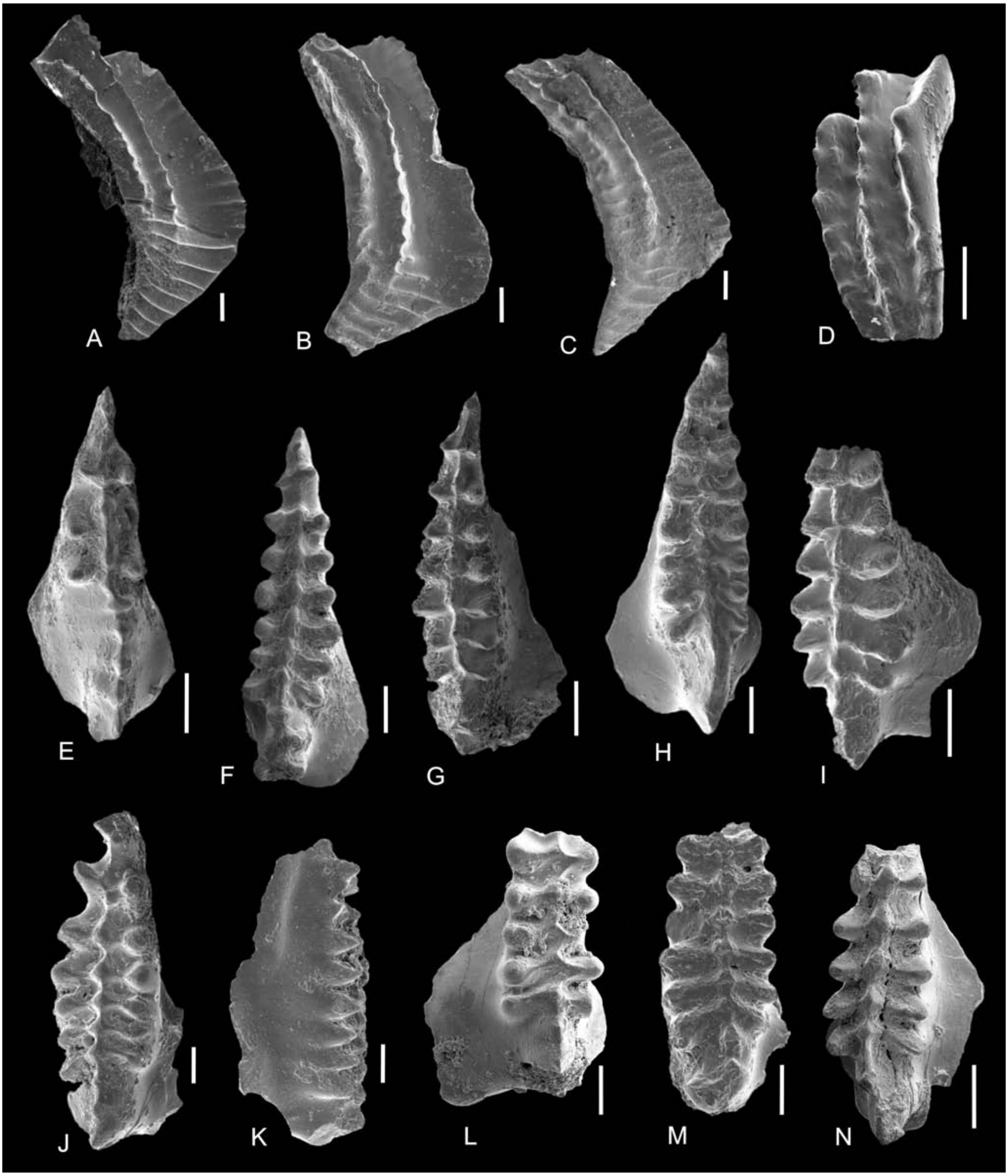

Fig. 7. Conodonts from lower part of Middle Givetian at Świętomarz–Śniadka, exposure II (Figs 3, 4, sample 5a) and exposure IV (Fig. 3, 4, sample 7), Skały Formation. Length of scale bars = 100 µm. **A**–**C** – *Polygnathus linguiformis* Hinde. **D** – *Polygnathus ensensis* › *P. timorensis* Klapper, Philip et Jackson. **E** – *Icriodus platyobliquimarginatus* Bultynck. **F**, **G**, **M** – *Icriodus janeae* Sparling. **H**, **N** – *Icriodus* cf. *lindensis* Weddige. **I**–**K** – *Icriodus* aff. *arkonensis* Stauffer; A–K, M, N – sample 5a. **L** – *Icriodus* cf. *excavatus* Weddige, sample 7. A–N – Sierżawy Member; A–J, L–N – upper views, K – lateral views

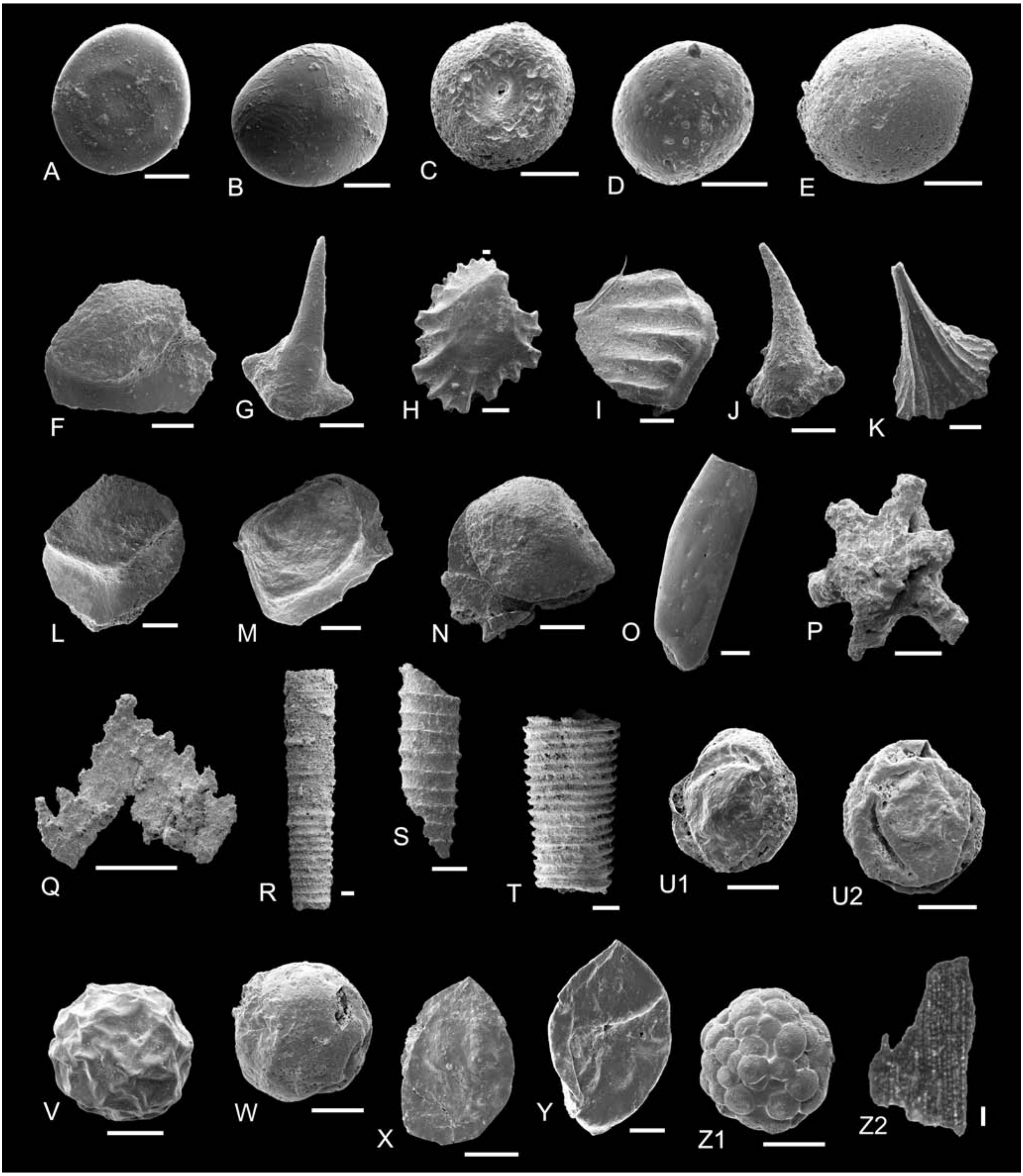

Fig. 8. Lower and Middle Givetian microfossils from Świętomarz–Śniadka (Fig. 4). Length of scale bars = 100 µm. **A–E** – globular microproblematica, A, B – sample 1, C–E – sample 13. **F–O** – fish remains, F, G – sample 2b, H–K – sample 4a, L–O – sample 5a. **P** – calcareous octactinellid sponge spicule, sample 5a. **Q** – element of Ophiocistoidea scleroform, sample 5a. **R–T** – fragments of tentaculites, sample 5a. **U–Y** – leiospheres, U – sample 12, V – sample 7a, W – sample 13, X – sample 6a, Y – sample 6. **Z1** – framboid, sample S6. **Z2** – fragment of charred wood, sample 5. H–K – Sitka Coral-Crinoid Limestone Member, A, B, F, G, L–W, Z1, Z2 – Sierżawy Member; X, Y – Świętomarz Formation

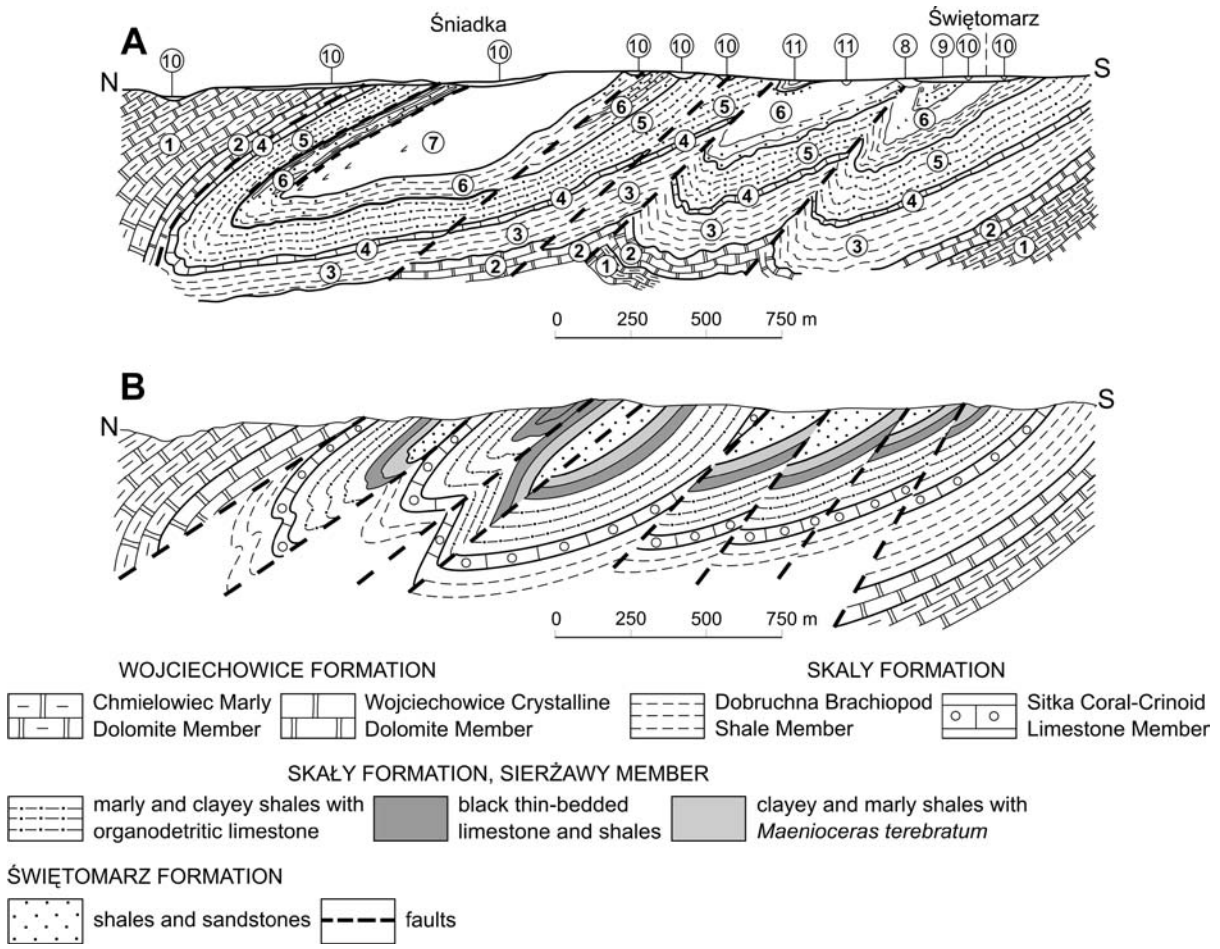

Fig. 9. Cross-sections through central part of Bodzentyn Syncline between Świętomarz and Śniadka, as exposed along Psarka River. **A** – taken from Kłossowski (1985, fig. 2), explanations refer to numbers in circles: 1 – Wojciechowice Formation, Chmielowiec Marly Dolomite Member, 2 – Wojciechowice Crystalline Dolomite Member, 3 – Skały Formation, Dobruchna Brachiopod Shale Member, 4 – Sitka Coral-Crinoid Limestone Member, 5 – Sierżawy Member, 6 – Świętomarz Formation, 7 – Śniadka Formation, 8 – Zechstein conglomerate, 9 – Buntsandstein, 10 – loess, 11 – delluvia. **B** – new interpretation (based on data from this paper)

Conodonts have not been found in the thin carbonate interbeds in formations, which essentially consist of clay and marly shales with goniatites, near Świętomarz and Śniadka (Figs 3, 4, exposures I–IV, Table 1) with the exception of sample 7 (exposure IV) with *Icriodus* cf. *excavatus* (Fig. 7L). This species has a wide distribution, namely from the Upper *rhenanus*/*varcus* Zone up to the Middle/Upper Devonian boundary (Bultynck, 2003). The goniatites, *Sobolewia nuciformis* (Whidborne), *S. rotella* (Holzapfel), *Maenioceras terebratum* (Sandberger et Sandberger), *M.* cf. *decheni* (Kayser), *Wedekindella* cf. *brilonensis* (Kayser), and other species, determined and illustrated by Sobolew (1909), indicate the *Maenioceras terebratum* Zone (MD II-C). However, the presence of *M.* cf. *decheni* and *W.* cf. *brilonensis* points to the upper part of this zone (MD II-C2), which corresponds to the conodont *ansatus* Zone and to the Upper *pumilio* level (Ebbighausen *et al.*, 2007). This fact indicates that the shales with goniatites are younger than the black, thin-bedded limestones that were considered to be the youngest in the succession (Kłossowski, 1985; Turnau and Racki, 1999, and others).

Besides conodont elements, the residue of the Middle Givetian samples contains semi-spherical, microproblematic forms (Fig. 8A–E), fish teeth and scales (Fig. 8F–O), sponge spicules (Fig. 8P), scleroform elements (Fig. 8Q), tentaculite fragments (Fig. 8R–T) and leiospheres, which come mainly from the boundary beds between the Skały and Świętomarz Formations, i.e. the black limestones (exposure II, sample 5b), carbonate concretions in the uppermost part of Sierżawy Member and the silt beds of the Świętomarz Formation (Fig. 8U–Y). As noted by Filipiak (2002), the presence of large *Leiosphaeridia* (> 200 µm) indicates improved, trophic conditions, which in turn indicates conditions of oxygen depletion in the basin. Framboidal pyrite structures, 210 µm in diameter (Fig. 8Z1), found in the black limestones (sample S6, Figs 3, 4, exposure IIIb) may indicate their diagenetic origin in the deposits below the oxic or dysoxic water column (Zatoń *et al.*, 2008). Fragments of charred wood (charcoal) with well preserved, internal structure have been found in similar black limestones (Fig. 4, sample 5, Fig. 8Z2). Aggregates of euhedral pyrite or separate elements of pyritized fossils are common in the residue of deposits from the upper part of the Skały Formation and the Świętomarz Formation.

Rocks of the uppermost part of Skały Formation, as well as the Świętomarz Formation, were the subject of palynologic analysis by Turnau and Racki (1999). Two subzones, Ex 2 and Ex 3, of the *Aneurospora extensa* Zone were distinguished here, namely subzone Ex 2 for the "Świętomarz beds" and Ex 3 for the "Nieczulice Beds" (equivalent to the uppermost part of the Skały Formation herein). According to the authors (Turnau and Racki, 1999), subzone Ex 2 is characterized by the presence of *Chelinospora concinna*, whereas Ex 3 has *Samarisporites triangulatus*. *Chelinospora concinna* was noted from the middle or even Upper *varcus* Zone, whereas *Samarisporites triangulatus* appears much earlier, in the *ensensis* Zone (Loboziak *et al.*, 1991; Streel and Loboziak, 1994; Streel, 2009). The position of *Chelinospora concinna*, concordant with the Middle/Upper *varcus* Zone, confirms the concept of the geological structure of the section, presented here, that the clay and marly shales with *Maenioceras terebratum* (*rhenanus*/*ansatus*) are older than the shales and sandstones of the "Świętomarz beds" (*ansatus-semialternans* zones?; Figs 3, 4). Regardless of the opinion of "some geologists", Turnau and Racki (1999) put "exposure SSII" from the S part of the section above the "Świętomarz beds".

The data presented here require modifications to the interpretation of the geological cross-sections, presented by Filonowicz (1962, 1969), Mizerski (1981) and Kłossowski (1985). These changes are applicable to the central part of the syncline (Fig. 9A). The new data, presented above, are shown in Fig. 9B. Data for the S part of the section are from Sobolew (1909), Filonowicz (1962, 1969) and Malec (1988, 1999).

CONCLUSIONS

Studies of conodonts in the Świętomarz–Sniadka section focussed on the members of the Skały and Świętomarz formations. In the Skały Formation, the Sitka Coral-Crinoid Limestone Member corresponds to the *hemiansatus* Zone and the greater part of the Sierżawy Member to the *timorensis* – *rhenanus*/*varcus* Zones. The North American species *Icriodus janaea* Sparling was found for the first time in Poland.

The uppermost part of Sierżawy Member – clay and marly shales with *Maenioceras terebratum* – may correspond to the conodont *ansatus* Zone and in the stratigraphic section studied occurs below the Świętomarz Formation.

In exposure II (Figs 3, 4, 9), located between the sandstones and clay shales of the Świętomarz Formation in the N part of the section, the presence of the Sitka Coral-Crinoid Limestone and Sierżawy members was documented in the place of the "youngest" Śniadka Formation (equivalent to the Nieczulice Formation). These units are strongly ferruginous crinoidal limestones, marly limestones and marls with a rich fauna, interbedded with clay shales, as well as black, thin-bedded limestones. Their age was confirmed by means of conodont assemblages in the Skały Formation. As a result, a new interpretation of the geological structure and stratigraphy of the Świętomarz–Śniadka section is presented (Fig. 9B).

It was noted that some characteristics, such as the content of the cephalopod fauna, the black colour of the sediments with *Leiosphaeridia*, and the abundance of the styliolinids in the marly bed as well as the occurrence together of benthic and pelagic faunas (Sobolew, 1909), may be proof of correlation of the clay and marly shales with *Maenioceras terebratum* in the Skały Formation with the Upper *pumilio* Horizon (Lottmann, 1990).

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