

## DZIADZIO P. S., GAŹDZICKA E., PLOCH E., SMOLEŃ J., BIOSTRATIGRAPHY AND SEQUENCE STRATIGRAPHY OF THE LOWER CRETACEOUS IN CENTRAL AND SE POLAND – DISCUSSION

Sylwester MAREK, Anna RACZYŃSKA & Krzysztof LESZCZYŃSKI\*

Państwowy Instytut Geologiczny, ul. Rakowiecka 4, 00-975 Warszawa; \*e-mail: krzysztof.leszczynski@pgi.gov.pl

Dziadzio *et al.* (2004) made a revision of the uppermost Jurassic and Lower Cretaceous stratigraphy in boreholes drilled along the south-western boundary of the Plock and Lublin Trough and in the Carpathian Foreland, using the sequence stratigraphic method. These authors suggest a different model of the geological structure of the region from that previously assumed for the north-eastern slope of the Gielniów – Holy Cross Mts. area bounded by deep fault zones of Nowe Miasto – Ilża (SW–NE) and Nowe Miasto – Grójec (NW–SE) (Hakenberg & Świdrowska, 1977; Żelichowski, 1972, 1979; Fig. 1).

According to the previous views on the geological structure of the margins of the Holy Cross Mts and the adjoining Lublin region (between Magnuszew and Radom), an elevation in topography, showing uplifting trends from Berriasian (late Volgian) through early Valanginian times, existed in this area at the Jurassic/Cretaceous transition (Marek, 1968, 1983a, b, c; Niemczycka, 1976a, b). The Radom – Magnuszew area was subjected to strong erosion during the Berriasian and early Valanginian, which resulted in the removal of part of Kimmeridgian, Tithonian, Berriasian and Lower Valanginian deposits (Niemczycka & Brochwicz-Lewiński, 1988; Gutowski, 1998; Kutek, 1994). The late Valanginian sea transgressed northeastwards onto a flat Upper Jurassic surface, reaching the line Wilga – Izdebnó – Ciepeliów (Fig. 1). The Hauterivian sea continued the transgressive trend. Subsequently, the Radom area became uplifted and the Middle Albian sea transgressed onto the Lower Hauterivian, Valanginian and even Kimmeridgian basement (Cieśliński & Pożaryski, 1970). Such a history of the evolution of the Radom – Magnuszew area during late Jurassic and early Cretaceous times is inferred from both analyses of drillcores and a correlation of well logs from several tens of deep boreholes and a number of shallow ones drilled in the NE margin of the Holy Cross Mts (Malinowska, 1970; Krassowska (ed.), 1973, 1977; Niemczycka (ed.), 1974, 1975; Witkowski, 1966; Dąbrowska, 1957).

According to Dziadzio *et al.* (2004), borehole sections from the north of the Lublin region indicate stratigraphic continuity, spanning the Upper Jurassic and Lower Creta-

ceous interval, and thus the lack of stronger diastrophism resulting in denudation processes affecting uppermost Kimmeridgian through Lower Valanginian rocks. The spectacular example of the concept is stratigraphy from the Białobrzegi IG 1 borehole. Part of the section, previously considered the Lower Kimmeridgian, was assigned by these authors to the Tithonian, Berriasian, Valanginian and Hauterivian, whereas Upper Valanginian and Hauterivian deposits were identified as Barremian and Aptian–Albian (Fig. 2).

In the Radom – Magnuszew area, Upper Jurassic deposits are represented by marls and limestones, commonly oolitic and organodetrital with conglomerates of shells and coquinas composed of molluscs and gastropods with subordinate crinoids and echinoids. Conglomerates of *Exogyra*, *Lopha* and *Cucullea* oyster shells are especially important as stratigraphic indicators. According to Pugaczewska (1971), *Exogyra virgula* (Detr.) is known from the Kimmeridgian and Tithonian; however, it is most frequent in Kimmeridgian deposits of both Poland and Europe (Karczewski, 1965; Karczewski in: Krassowska (ed.), 1977). In the more complete Upper Jurassic sections from the margins of the Holy Cross Mts, similar deposits are documented by Kimmeridgian guide ammonites (Kutek, 1968, 1969; Malinowska, 1970; Malinowska (ed.), 1988). Apart from macrofaunal evidence, Kimmeridgian age of the deposits has also been proved by microfaunal data; drillcore samples from the Białobrzegi IG 1 borehole (depth interval 1061.3–1062.7 m) contain foraminifers and ostracods of early Kimmeridgian age (Bielecka, in: Krassowska (ed.), 1977).

The overlying Upper Valanginian deposits from the depth of 958.0–933.0 m (25-m-thick cored interval; Fig. 2) are represented by claystones and marly mudstones with occasional sandstone interbeds. The rocks contain abundant mollusc shells and fragments of ammonites found at the depths of 952.1 m, 952.5 m and 952.0 m (Marek, in: Krassowska (ed.), 1977; Marek, 1983c). These are guide ammonites of the genus *Dichotomites* (Fig. 3A–G). It is worth noting that Upper Valanginian ammonites of *Saynoceras verrucosum* d'Orbigny and *Prodichotomites complanatus* (Koenen) were also found at Krzyżanowice near Ilża (Wit-

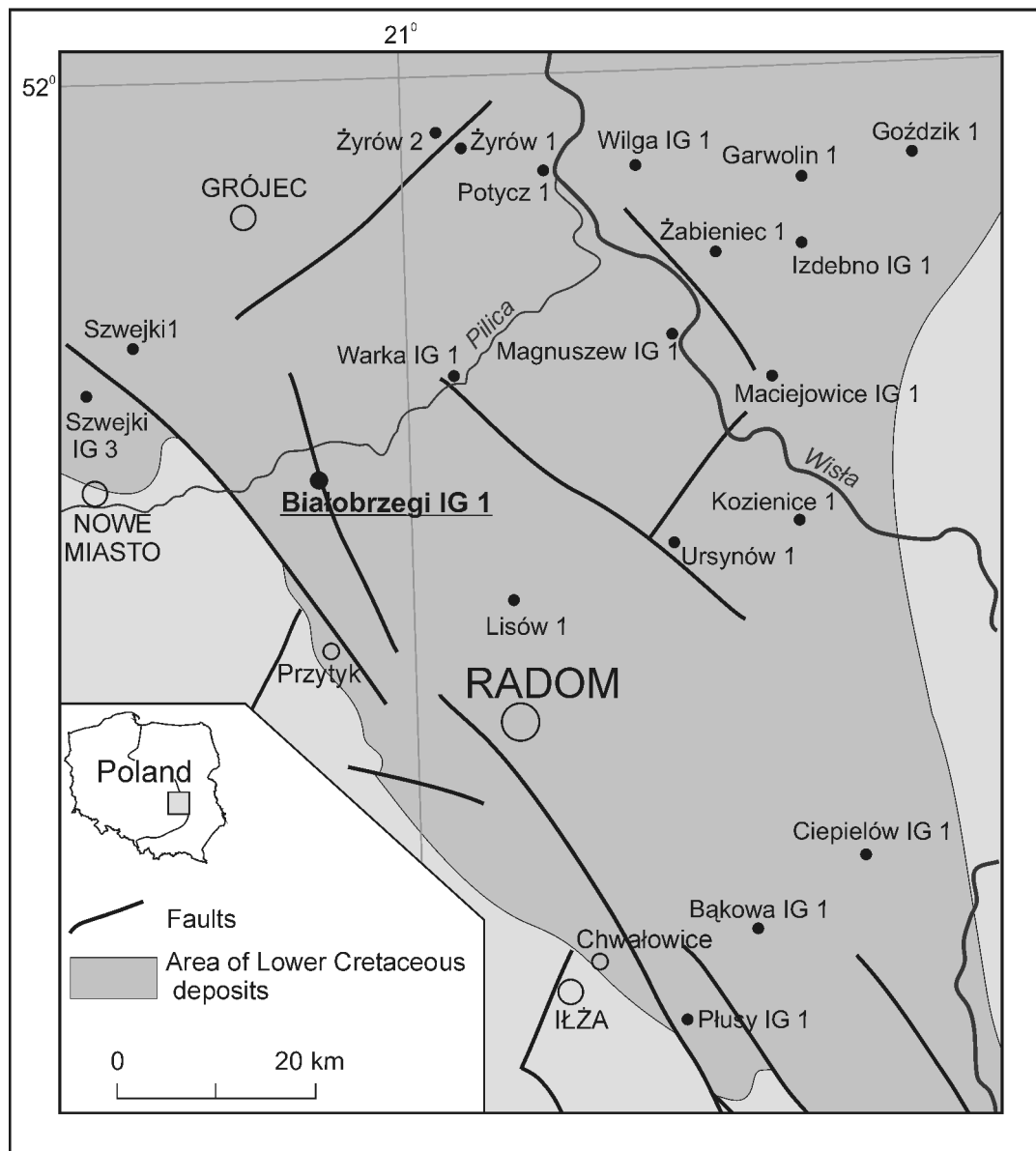


Fig. 1. Location of boreholes and geology of the Magnuszew – Radom region

kowski, 1966). Foraminifers and ostracods from Białobrzegi IG 1, analysed by Szejn (Krassowska (ed.), 1977), and represented by specimens such as *Epistomina cretosa* Ten Dam, *Epistomina caracolla caracolla* (Roemer), *Lenticulina nodosa* (Reuss), *Conorboides hofkeri* (Bart & Brand), *Vaginulina medicarinata* Ten Dam, *Protocythere hechti* Triebel and *Mandocythere frankei* Triebel, also indicate early Valanginian age. The latter species is very characteristic of Upper Valanginian deposits.

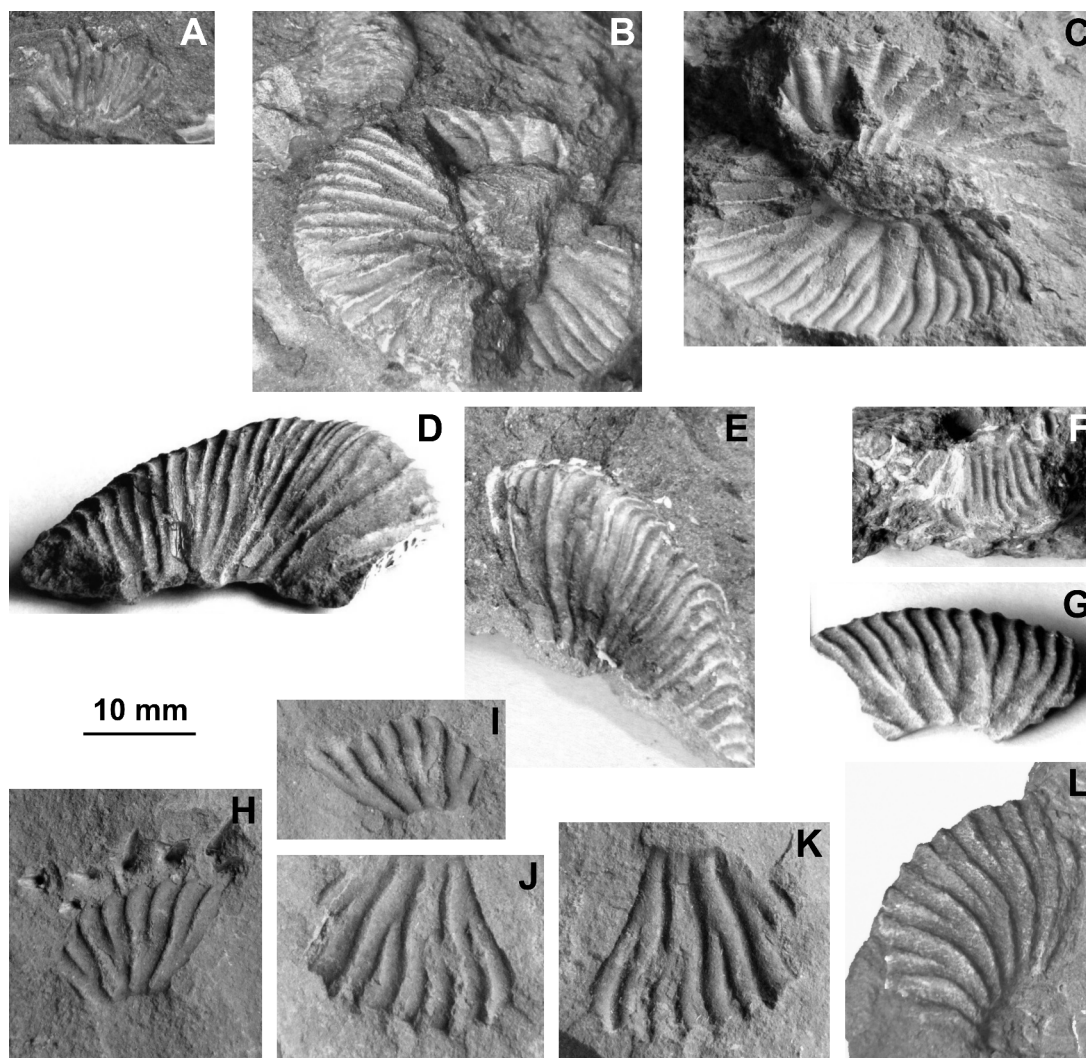
A similar microfaunal assemblage is also cited by Smoleń (Dziadzio *et al.*, 2004; fig. 13) from the Białobrzegi IG 1 borehole. However, it is accompanied by *Gavelinella barremaniana* Bettenstedt indicating, according to that author, that the deposits are of Barremian–Aptian age.

The overlying series from the depth of 933.0–921.0 m (12 m thick), originally included in the Lower Hauterivian,

is represented by claystones and mudstones with an intervening sandstone bed (Fig. 2). Infrequent and poorly preserved bivalves were found in the upper portion of this cored interval. However, the most important are ammonite specimens from the depths of 924.8 m, 925.5 m and 925.9 m, which most likely represent the genus *Endemoceras* (Fig. 3H–L; Marek, in: Krassowska (ed.), 1977). From that interval, Smoleń (Dziadzio *et al.*, 2004) cited the foraminifers of *Gyroidinoides* aff. *infracretaceus*, *Hedbergella infracretacea* and *Gavelinella barremaniana*, typical in cited author's opinion, of the Barremian and Aptian. Also nannoplankton zones (Zones 10–13) prove, according to Gaździcka (Dziadzio *et al.*, 2004), Barremian–Aptian age of these rocks.

Putting aside the problem of stratigraphical dating of the Głowaczów Formation (lacking of ammonites; Niem-





**Fig. 3.** Lower Cretaceous ammonites from the Białobrzegi IG 1 borehole. **A** – *Dichotomites* sp., PGI Museum 1652.II.291 (195), Białobrzegi IG 1 (952.1 m), Upper Valanginian; **B** – *Dichotomites* sp. (ex gr. *bidichotomus-crassus* Kemper 1978), PGI Museum 1652.II.276 (180), Białobrzegi IG 1 (952.5 m), Upper Valanginian; **C** – *Dichotomites* sp. (ex gr. *bidichotomus-crassus* Kemper 1978), PGI Museum 1652.II.277 (181), Białobrzegi IG 1 (952.5 m), Upper Valanginian; **D** – *Dichotomites* sp. (cf. *bidichotomus* Leymerie 1814), PGI Museum 1652.II.278 (182), Upper Valanginian; **E** – *Dichotomites* sp. (cf. *bidichotomus* Leymerie 1814), PGI Museum 1652.II.278a (182a), Białobrzegi IG 1 (952.9 m), Upper Valanginian; **F** – *Dichotomites* sp., PGI Museum 1665.II.77, Białobrzegi IG 1 (952.5 m), Upper Valanginian; **G** – *Dichotomites* sp. (ex gr. *bidichotomus* Leymerie 1814), PGI Museum 1652.II.78, Białobrzegi IG 1 (952.5 m), Upper Valanginian; **H** – *Endemoceras* sp., PGI Museum 1665.II.306, Białobrzegi IG 1 (924.8 m), Lower Hauterivian; **I** – *Endemoceras* sp., PGI Museum 1665.II.307, Białobrzegi IG 1 (924.8 m), Lower Hauterivian; **J** – *Endemoceras* sp., PGI Museum 1665.II.308, Białobrzegi IG 1 (925.5 m), Lower Hauterivian; **K** – *Endemoceras* sp., PGI Museum 1665.II.308a, Białobrzegi IG 1 (925.5 m), Lower Hauterivian; **L** – *Endemoceras* sp. (ex gr. *noricum-enode*), PGI Museum 1665.II.111, Białobrzegi IG 1 (925.9 m), Lower Hauterivian

et al., 2004). The state of preservation of the specimen, in particular of its ventral surface, prevents unambiguous identification. However, relief of its side, especially sigmoidally curved ribs (not observed in *Deshayesites* specimens), suggests that this is a Lower Hauterivian ammonite of the genus *Endemoceras*. In addition, the presence of ventral knobs and thus of a ventral furrow is more probable than the lack of the features. Hauterivian age of this sequence is also indicated by its position immediately above Upper Valanginian deposits containing *Dichotomites* fauna. It is worth noting that single ammonite specimens of presumed Aptian–Albian age were found in much younger beds of the Gopło

Member (Mrozek, 1975; Marek, 1977, 1983c; Raczyńska, 1979; Marek & Raczyńska, 1979).

The sequence stratigraphic method, employed by Dzia-dzio et al. (2004) and based on interpretation of well logs supported by biostratigraphic data, undoubtedly provides a more reliable correlation scheme of sequence boundaries, especially higher-order ones, and thus producing a model of sedimentary basin evolution over large areas. However, if the sedimentary basin is locally subjected to stronger tectonic activity and variable subsidence rate, there is an increased risk of correlating sequences of different ages. It should also be borne in mind that, on the one side, various



lithologies may generate similar record on well logs but, on the other side, similar lithologies can repeatedly appear along the section. The principal problem is the sharp discrepancy between the stratigraphy based on ammonites typical of the Boreal Province and the results of investigations of calcareous nannoplankton distinctive of the Tethyan stratigraphic schemes. It should be stressed that pelagic and free-swimming ammonites always have an advantage over passive and sea current-transported nannoplankton.

## REFERENCES

- Cieśliński, S. & Pożarski, W., 1970. Cretaceous. In: *The stratigraphy of the Mesozoic in the margin of the Góry Świętokrzyskie*. (In Polish, English summary). *Prace Instytutu Geologicznego*, 56: 185–231.
- Dąbrowska, Z., 1957. Profile of beds on the boundary of the Jurassic and Cretaceous at Krzyżanowice near Iłża (Middle Poland). (In Polish, English summary). *Biuletyn Instytutu Geologicznego*, 105: 205–216.
- Dziadzio, P. S., Gaździcka E., Ploch E., Smoleń J., 2004. Biostratigraphy and sequence stratigraphy of the Lower Cretaceous in Central and SE Poland. *Annales Societatis Geologorum Poloniae*, 74: 125–196.
- Gutowski, J., 1998. Oxfordian and Kimmeridgian of the north-eastern margin of the Holy Cross Mountains, Central Poland. *Geological Quarterly*, 42: 59–72.
- Hakenberg, M. & Świdrowska, J., 1997. Propagation of the south-eastern segment of the Polish Trough connected with bounding fault zones from the Permian to the Late Jurassic. *Comptes rendus de l'Académie des Sciences Paris, Serie Iia*, 324: 793–803.
- Karczewski, L., 1965. Fauna and stratigraphy of the Malm in the vicinity of Radomsko. (In Polish, English summary). *Biuletyn Instytutu Geologicznego*, 192: 97–145.
- Krassowska, A. (ed.), 1973. *Profile głębokich otworów wiertniczych Instytutu Geologicznego. Magnuszew IG 1*. (In Polish). Zeszyt 4, Warszawa.
- Krassowska, A. (ed.), 1977. *Profile głębokich otworów wiertniczych Instytutu Geologicznego. Białobrzegi IG 1*. (In Polish). Zeszyt 38, Warszawa.
- Kutek, J., 1968. The Kimmeridgian and uppermost Oxfordian in the SW margins of the Holy Cross Mts (Central Poland). Part I – Stratigraphy. *Acta Geologica Polonica*, 18: 493–586.
- Kutek, J., 1969. The Kimmeridgian and uppermost Oxfordian in the SW margins of the Holy Cross Mts (Central Poland). Part I – Paleogeography. *Acta Geologica Polonica*, 19: 222–321.
- Kutek, J., 1994. Jurassic tectonic events in south-eastern cratonic Poland. *Acta Geologica Polonica*, 44: 167–221.
- Leszczyński, K., 1997. The Lower Cretaceous depositional architecture and sedimentary cyclicity in the Mid-Polish Trough. *Geological Quarterly*, 41: 509–520.
- Malinowska, L., 1970. Upper Jurassic. In: *The stratigraphy of the Mesozoic in the margin of the Góry Świętokrzyskie*. (In Polish, English summary). *Prace Instytutu Geologicznego*, 56: 135–184.
- Malinowska, L. (Ed.), 1988. *Geology of Poland. Atlas of guide and characteristic fossils. Mesozoic, Jurassic*. Part 2b. Wydawnictwa Geologiczne, Warszawa, 476 pp.
- Marek, S., 1968. Outline of the Lower Cretaceous stratigraphy in the marginal trough. (In Polish, English summary). *Kwartalnik Geologiczny*, 12: 345–368.
- Marek, S., 1977. Kreda dolna. In: Marek, S. (ed.), *Geological structure of the eastern part of the Mogilno-Lódź Trough*. (In Polish, English summary). *Prace Instytutu Geologicznego*, 80: 83–99.
- Marek, S., 1983a. The Neocomian in the Warsaw – Radom area (In Polish, English summary). *Kwartalnik Geologiczny*, 27: 287–297.
- Marek, S., 1983b. Lithological-stratigraphic characteristics of the Lower Cretaceous in the zone of the Grójec Fault. (In Polish, English summary). *Biuletyn Instytutu Geologicznego*, 344: 111–117.
- Marek, S., 1983c. Lower Cretaceous. In: Marek, S. (ed.), *The geological structure of the Warsaw (Płock) Trough and its basement*. (In Polish, English summary). *Prace Instytutu Geologicznego*, 103: 161–177.
- Marek, S., 1988. Palaeothickness, lithofacies and palaeotectonics of the epicontinental Lower Cretaceous in Poland. (In Polish, English summary). *Kwartalnik Geologiczny*, 32: 157–174.
- Marek, S. & Raczyńska, A., 1979. Lithostratigraphic subdivision of epicontinental Lower Cretaceous in Poland and proposals for its rearrangement. (In Polish, English summary). *Kwartalnik Geologiczny*, 23: 631–637.
- Marek, S. & Pajchłowa, M. (Eds.), 1997. The epicontinental Permian and Mesozoic in Poland. (In Polish, English summary). *Prace Państwowego Instytutu Geologicznego*, 153, 452 pp.
- Mrozek, K., 1975. *Budowa geologiczna struktur wgłębnych w południowej części synklinorium łódzkiego*. (In Polish). Wydawnictwa Geologiczne, Warszawa, 61 pp.
- Niemczycka, T. (ed.), 1974. *Profile głębokich otworów wiertniczych Instytutu Geologicznego. Ciepeliów IG 1*. Zeszyt 20, Warszawa.
- Niemczycka, T. (ed.), 1975. *Profile głębokich otworów wiertniczych Instytutu Geologicznego. Zeszyt 26. Bąkowa IG 1*. Warszawa.
- Niemczycka, T., 1976a. Upper Jurassic rocks of the eastern Poland area (between the Vistula and the Bug Rivers). (In Polish, English summary). *Prace Instytutu Geologicznego*, 77: 1–99.
- Niemczycka, T., 1976b. Lithostratigraphy of Upper Jurassic deposits in the Lublin – Radom area (SE Poland). (In Polish, English summary). *Acta Geologica Polonica*, 26: 569–601.
- Niemczycka, T., 1978. The Middle Jurassic and Lower Oxfordian lithofacies in the Lublin – Radom area. *Acta Geologica Polonica*, 28: 485–501.
- Niemczycka, T. & Brochwicz-Lewiński, W., 1988. Evolution of the Upper Jurassic sedimentary basin in the Polish Lowlands. (In Polish, English summary). *Kwartalnik Geologiczny*, 32: 137–155.
- Pugaczewska, H., 1971. Jurassic Ostreidae of Poland. *Acta Palaeontologica Polonica*, 16: 195–311.
- Raczyńska, A., 1979. The stratigraphy and lithofacies development of the younger Lower Cretaceous in the Polish Lowlands. (In Polish, English summary). *Prace Instytutu Geologicznego*, 89: 1–78.
- Witkowski, A., 1966. Remarks on the NE Lower Cretaceous margin of the Święty Krzyż Mts. (In Polish, English summary). *Przegląd Geologiczny*, 12: 517–521.
- Żelichowski, A. M., 1972. Evolution of the geological structure of the area between the Góry Świętokrzyskie and the River Bug. (In Polish, English summary). *Biuletyn Instytutu Geologicznego*, 263: 7–95.
- Żelichowski, A. M., 1979. Geological structure of the Marginal Basin basement at the boundary of its Warsaw and Lublin sections. (In Polish, English summary). *Kwartalnik Geologiczny*, 23: 125–139.