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Early Oxfordian radiolaria from Kraków Upland, Carpathian Foreland, South Poland – palaeoecological remarks

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Abstract. Abundant radiolarian fauna have been found in the Upper Jurassic deposits of the Kraków Upland (South Poland) at Zalas quarry. The assemblage comprises twenty-five species of Radiolaria. The species belong to the orders Nassellaria (16 species) and Spumellaria (9 species). The assemblage has been correlated with *cordatum* ammonitic subzone (Early Oxfordian). The radiolarians show features of Boreal faunas, influenced by Tethyan realm.

Key words: Radiolaria, Early Oxfordian, Kraków Upland, palaeoecology

Geological setting

During the Late Jurassic time, the area investigated was a part of northern Tethyan shelf, with diverse carbonate sedimentation.

The section investigated is located at Zalas quarry, situated about six kilometres south from Krzeszowice town (southern Poland) (Fig. 1). The Middle and Upper Jurassic deposits overlay porphyry, which are explored there. Stratigraphically, lower part of this section is represented by stromatolite (Fig. 2). There follows calcareous-marly complex (Matyja & Tarkowski, 1981). The lowermost bed of these deposits consists of marly limestone yellow-coloured at the base, and red at the top, with infrequent siliceous sponges and ammonites indicating *bukowskii* and *costicardia* ammonitic subzones (Early Oxfordian age – see Matyja & Tarkowski, 1981). It is overlain by grey marly limestones interbedded by green to grey marls with siliceous sponges, ammonites, belemnites and brachiopods, which are followed by grey marls and marly limestones. These strata belong to the *cordatum* and *tenuicostatum* ammonitic subzones (early to middle Oxfordian age – see Matyja & Tarkowski, 1981).

The radiolarian fauna has been found within the layer of green-grey marls, which belong to the *cordatum* ammonitic subzone (Matyja & Tarkowski, 1981). The Radiolaria occur with common sponge's spicules (Criccorhabd and Rhax), and abundant foraminifers of species *Spirillina gracillis* Terquem.

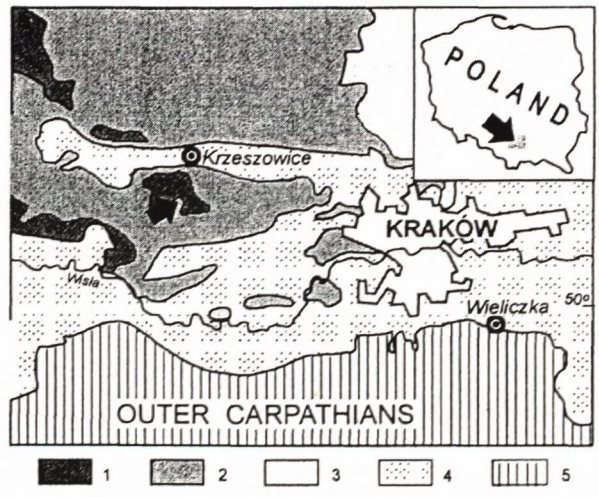

Fig. 1. Location of the area investigated in the vicinity of Kraków (geological map after Żytko et al. (1988), simplified); Fore-Carpathian platform elements: 1 – pre-Jurassic strata; 2 – Jurassic; 3 – Cretaceous; 4 – undivided Carpathian Foredeep deposits; 5 – undivided Carpathians units. Black arrows mark location of Zalas quarry

Characteristic of the radiolarian assenblage

Radiolaria are common in the sample investigated, but they are generally poorly preserved. The association comprises nine taxa belonging to order Spumellaria and sixteen taxa of Nassellaria. Spumellarians belong to four families and seven genera as: Cavaspongidae (genus *Cavaspongia*), Patulibracchidae (genera *Paronaella*, *Angulobracchia*), Xiphostylidae (genera *Xiphostylus*, *Triactoma*), and Orbiculiformidae (genera *Crucella*, *Orbiculiforma*). Nassellaria are represented by nine families and fourteen genera: Syringocapsidae (*Parapodocapsa*), Theoperidae (genera *Artocapsa*, *Cyrtocapsa* and *Dictyomitrella*), Spongocapsulidae (genus *Obesacapsula*), Sethocapsidae (genus *Stylocapsa*), Williriedellidae (genus *Zhamoidellum*), Archaeodictyomitridae (genera *Hsuum*, *Stichomitra*), Pseudodictyomitridae (genus *Parahsuum*), Xithidae (genus *Crolanium*), and Amphipyndacidae (genera *Dibolachras*, *Podocapsa* and *Syringocapsa*).

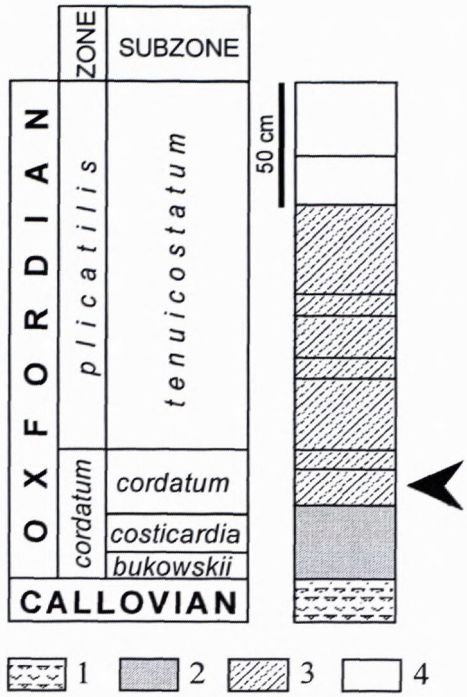

Fig. 2. Stratigraphic profile with ammonite zonal scheme (after Matyja & Tarkowski, 1981). Arrow marks position of radiolarian sample: 1 – stromatolite; 2 – marly limestone yellow and red; 3 – grey marly limestone with green and grey marls; 4 – grey marls and marly limestone.

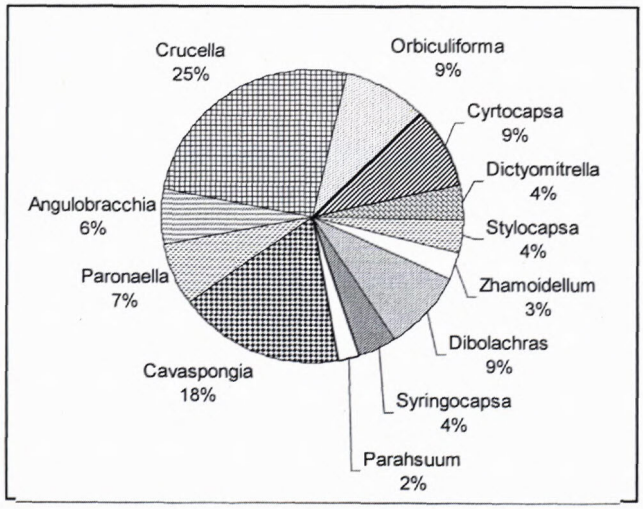

Fig. 3. Frequency of the radiolarian genera in the sample investigated

The following semi-quantitative features permit characterisation of the assemblage investigated (Fig. 3):

1. dominance of spumellarians in number of specimens (62 percent of all specimens found);

2. abundance and high diversity of spongy spumellarians as *Crucella*, *Cavaspongia*,0 *Orbiculiforma*, *Paronaella*, and *Angulobracchia*;

3. scarcity of Williriedellidae, Xitidae and Spongocapsulidae;

4. absence of *Parvicingula*, *Praeparvicingula* and *Mirifusus*.

Palaeoecological remarks

The radiolarian fauna exhibit features, which are related to the particular palaeoceanographical setting of the area investigated during the Early Oxfordian. One of them is abundance of spongy spumellarians, which dominate in number of specimens. This fact was interpreted by previous authors as indicating cold water influence (cf. Quaternary assemblage: Alperin, 1993) and a shallow–water depositional environment (cf. Late Cretaceous assemblage: Empson-Morin, 1984). Spongy spumellarians are also interpreted to be cosmopolitan in the recent oceans, but they are mostly abundant under unstable oceanic conditions (Blueford & King, 1983; Anderson *et al.*, 1989). Abundant spongy spumellarian assemblage were recorded in the Late Jurassic deposits from the Antarctic Peninsula (Kiessling, 1999). According to this author, low salinity and salinity fluctuations were the major reasons for the great abundance of this group.

Distribution of some Late Jurassic and Early Cretaceous radiolarian taxa were controlled also by palaeoceanographic factors recorded by climatic belts (Pessagno & Blome, 1986; Baumgartner, 1992, 1993; Kiessling, 1999). One of the important markers were presence or absence of Pantanellidae and Parvicingulidae. (Pessagno & Blome, 1986; Baumgartner, 1992, 1993; Hull, 1995; Kiessling, 1999). In the Northern Hemisphere, four radiolarian provinces were distinguished based on these taxa content: Central Tethyan Province, Northern Tethyan Province (Tethyan Realm), Southern Boreal Province, and Northern Boreal Province (Boreal Realm).Total absence of pantanellids and „Ristola-type" parvicingulids as well as common occurrence of orbiculiformids were characteristic to higher palaeolatitudes (Northern Boreal Radiolarian Province) (Pessagno & Blome, 1986; Vishnevskaya, 1997; Kiessling, 1999).

The absence of pantanellids and „Ristola-type" parvicingulids in our assemblage confirm that, it represent the Boreal radiolarian fauna.

Tethyan taxa as Williriedellidae, Xithidae, Syringocapsidae and Spongocapsulidae are also present within the radiolarian assemblage investigated. This fact suggests Tethyan influences on the southern part of the European Platform (Kraków area) during the early Oxfordian.

However the assemblage does not include the Tethyan forms such as *Mirifusus* and *Ristola*, which were suggested to be rather deep-dwelling (Steiger, 1992) and are expected to be absent in shallow environments.

In summary, the radiolarian investigated shows features of Boreal faunas, influenced by Tethyan realm. Assemblage includes mixed cold and warm water taxa, which prefered shallow–water depositional environment. It confirm the investigations of ammonites fauna carried out by Garlicka and Tarkowski (1980). These autors suggested, that in the Oxfordian, the area investigated was situated in the zone of mixing influences of Submediterranean and Boreal provinces.

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