



Research papers

A Middle Miocene palynoflora from sinkhole deposits from Upper Silesia, Poland and its palaeoenvironmental context

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ABSTRACT

The paper presents results of pollen analysis of lignite sediments filling one of the sinkholes developed within the Triassic limestone outcropped in Tarnów Opolski, Upper Silesia, SW Poland.

Vertical changes in composition of sporomorph and algal assemblages of the sinkhole fill, clearly reflect a facies succession from open aquatic (pond)—with abundant fresh-water algae, to marshy one—with a considerable contribution of swamp forests, composed of *Taxodium*, *Glyptostrobus*, *Nyssa* and probably *Alnus*. The pond was surrounded by swamp-aquatic vegetation, composed of herbs, as well as riparian forests probably dominated by *Carya* and *Pterocarya*. Drier habitats were vegetated by mixed forests composed of *Carpinus*, *Quercus*, *Fagus*, *Cercidiphyllum*, Tilioideae and conifers, with an admixture of thermophilous taxa (such as *Castanea*, *Engelhardia*, *Platycarya*, *Reevesia*, and *Symplocos*). Results of the pollen analysis indicate that the climate was warm temperate and moderately wet.

Composition of pollen spectra and frequencies of palaeotropical and arctotertiary elements point at a Middle Miocene age of the deposits.

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1. Introduction

Palynological studies of Neogene continental sediments in Poland concern mostly material from lacustrine, lignite-bearing deposits (Grabowska and Słodkowska, 1993). Studies dealing with palynological matter from Neogene sinkholes fill deposits are extremely rare in both, Polish and world literature (e.g., Takahashi and Jux, 1982; Walsh et al., 1996; Rogala and Sadowska, 2003; Shunk et al., 2009). Also studies concerning Neogene macroremains preserved in palaeosinkholes are rare (Baranowska-Zarzycka, 1980; Ferguson and Knobloch, 1998; Farlow et al., 2001).

The current paper presents results of comprehensive investigation concerning the spore–pollen palynoflora and the algal micro-remains preserved in pond sediments filling a palaeosinkhole at Tarnów Opolski, Upper Silesia, Poland (Fig. 1). Well preserved sporomorphs and fossil fresh-water algae co-occurring allow for a detailed palaeoenvironmental reconstruction of a fresh-water algal palaeo-community and a vascular plant assemblage in this region. Furthermore the sporomorphs enable to date the sinkhole deposits.

2. Geological setting

The studied materials originate from one of the sinkholes developed within the Middle Triassic limestone outcropped in the western part of the Upper Silesian Upland, SW Poland (Figs. 1 and 2). The sinkholes visible in Tarnów Opolski quarry form depressions developed in reefal and bioclastic carbonates of the Karchowice and Diplopora Beds and range from 10 to 150 m in diameter attaining 30 m in depth. Downward progress of the sinkholes was constrained by underlying, impermeable marl deposits of the Terebratula Beds (Fig. 3).

The sinkholes are filled by variegated clayey and sandy clastics, sometimes with lignites. The latter are lining the bottom and sidewalls of the depression or form layered intercalations between the clastic fill. Other common component are iron hydroxides (limonite) forming irregular agglomerates exploited in prehistoric and medieval ironworks.

Unfortunately, owing to quarrying operation, original structures of the karst filling are commonly disturbed making the field observation difficult. Nonetheless, careful exploration of the sinkholes allows recognising the sedimentary succession of the sinkhole fill.

The age of the karst sinkholes and their sediments was uncertain so far, or generally is estimated as Neogene (Rogala and Sadowska, 2003). In the neighbouring area similar variegated siliciclastic deposits, including lignite debris, are sandwiched between Middle Miocene marine sediments and the Pleistocene till deposits hence their age has been assumed as Late Miocene (Michael, 1914; Quitzow,

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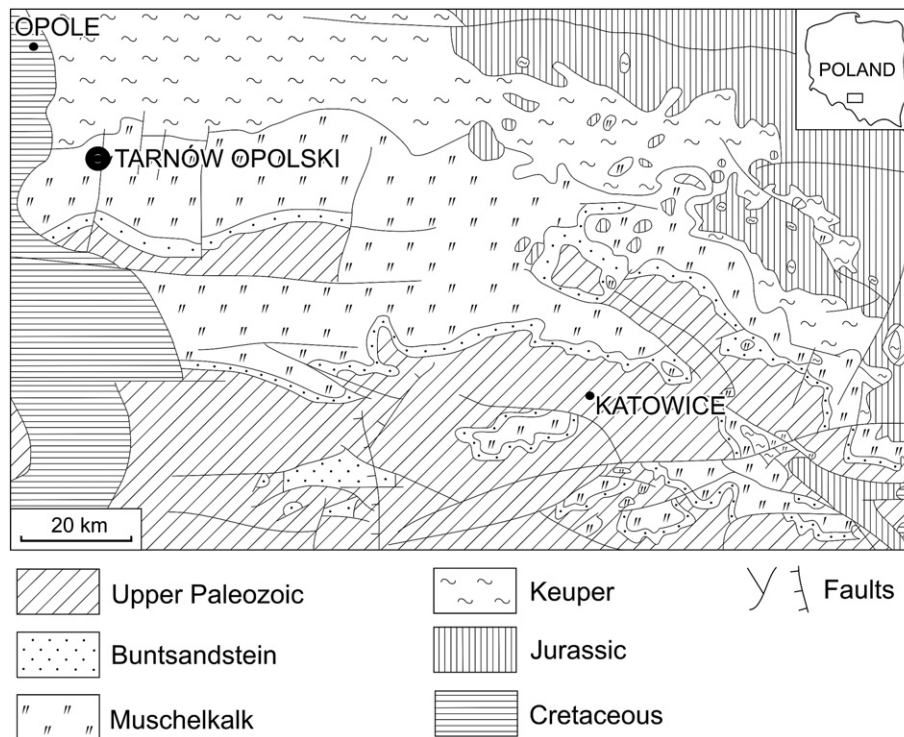


Fig. 1. Geological map of western part of Upper Silesia and location of the studied site.

1915). A more recent study on land snails occurring in comparable sediments from Opole (ca. 15 km NW from Tarnów Opolski) indicates a Middle Miocene age of these deposits (Stworzewicz, 1998).

3. Material and methods

The material was collected from a sinkhole at Tarnów Opolski (Fig. 2). A total of 16 samples were taken in 35 cm intervals from the depth of about 100 to 625 cm. Samples for pollen analysis were prepared according to the modified Erdtman's acetolysis method (Faegri and Iversen, 1975; Moore et al., 1991) using hydrofluoric acid to remove mineral matter. The microscope slides were made using glycerine jelly as a mounting medium. Depending on frequency of sporomorphs 1–3 slides from each sample were examined, and data from all spore–pollen spectra have been used to construct pollen diagram (Fig. 4). To simplify the pollen diagram some taxa with low frequencies are presented together. The percentage shares of the taxa

presented in the pollen diagram have been calculated from the total sum of pollen grains and spores; the proportion of fresh-water algal micro-remains was computed separately in relation to the total sum using the POLPAL computer program (Nalepka and Walanus, 2003). The taxa have been classified in terms of palaeofloristical element, mainly on the basis of the checklist of selected pollen and spore taxa from the Neogene deposits (Ziemińska-Tworzydło et al., 1994). The following elements have been distinguished in the studied material: palaeotropical (including tropical and subtropical), as well as arcto-tertiary (which includes warm temperate and temperate). Selected microphotographs of sporomorphs and fresh-water algal micro-remains are shown on Plates I–III.

4. Results of pollen analysis

All studied samples yielded well-preserved sporomorphs suitable for detailed pollen analysis. The taxonomical composition of the



Fig. 2. Field photograph of the studied palaeosinkhole in Tarnów Opolski quarry. Arrow indicates the studied section of the sinkhole fill.

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