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An attempt to reconstruct the late Saalian to Plenivistulian (MIS6–MIS3) natural lake environment from the “Parchliny 2014” section, central Poland

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ABSTRACT

The article presents the early results of research of sediments from a palaeolake in the Kleszczów Graben, central Poland. A total of 190 samples were collected and then *ca* 10–30 samples were botanically (diatoms, pollen and woody macrofossils), zoologically (Cladocera, Mollusca and Ostracoda) and geochemically (elemental content, carbon and nitrogen isotopes) tested. The results of multiproxy analysis of the Eemian (Aleksandrów Formation) and Vistulian (Weichselian; Piaski Formation) deposits helped to reconstruct the environmental changes occurring in the studied palaeolake. Palynological diagram of individual spectra “Parchliny 2014” was divided into five zones that represent local sets of pollen zones (E3–E7; PA-1–PA-5). This diagram, although incomplete, reveals the distinct Eemian features.

Lithological, Cladocera and diatom analysis supported by geochemical studies indicate the existence of at least three main stages of the lake developed in the part of the basin. The lake originated from a post-Saalian melt-out kettle hole where the deposition of peats and organic, and mineral silts of different thicknesses to 10–12 m occurred (the first stage). In the second stage, initially existed a closed fairly deep Eemian lake under relatively warm conditions. The lower part of the section records an event of water body shallowing, consisting in its eutrophication, from oligotrophic to a lake of higher trophic status. Subsequently, in a cooler climate of Early Vistulian (Weichselian), the lake became shallower, and then open, flow and better oxygenated (flow-trough). Low frequency of ostracods and the absence of molluscs indicate slightly alkaline pH in the lower part of the water body, and neutral or slightly acidic pH in its upper part. At the bottom, the dominant organisms were diatoms, whereas toward the top, phytoplankton disappears and benthic taxa become predominant. Finally, in the third stage, in Plenivistulian, it was completely covered by mineral-organic and mineral sediments.

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1. Introduction

The extraction of brown coal in central Poland from opencast mines (in the Kleszczów tectonic graben) creates opportunities for comprehensive studies of Pleistocene deposits in an interdisciplinary approach. Initially, the studies were carried out in the Bełchatów (eastern) opencast lignite mine, and currently the mining operations are concentrated in the Szczerców (western) outcrop (Fig. 1). Location of both these outcrops beyond the limit of the LGM (Vistulian/Weichselian Glaciation) offers the possibility to provide details for the upper parts of the Pleistocene series, especially of the last interglacial and glacial periods.

In 2012–2014, when the uppermost mining level cut across non-glacial deposits filling the Szczerców Basin, research interest arouses about deposits of the Piaski and Aleksandrów Formations. These deposits appeared to be thick, and field work indicated that they are completely preserved in the section (Wachecka-Kotkowska et al., 2013, 2014), like those in the Bełchatów outcrop. The Aleksandrów and Piaski Formations are underlain by older deposits representing the Rogowiec and Ławki Formations (Krzyszowski, 1991, 1996; Allen and Krzyszowski, 2008; Krzyszowski et al., 2015). Locally, they are tectonically and glaciotectonically disturbed, or eroded by glacial or fluvial waters (Krzyszowski, 1992, 1995). Given the currently available data, it is possible that, in the analysed sections, this greater thickness of the deposits that accumulated during the last interglacial–glacial cycle (Eemian, Aleksandrów and Piaski Formations; Wachecka-Kotkowska et al., 2014) results from their deposition in topographic depressions that formed during deglaciation of the Wartanian ice sheet (Late Saalian, Rogowiec Formation; Allen and Krzyszowski, 2008) (Table 1).

The main aim of the article is to present the results of multiproxy analysis of sediments from the “Parchliny 2014” section, deposited in a palaeolake in the Kleszczów Graben, central Poland. The studies were conducted on a pilot basis due to the size of the fill (Fig. 2) and the possibility of collecting and analysing the samples. Taking into account the limited capability to perform

analyses, a random selection of samples for multidisciplinary research was made in some cases (e.g. Aalbersberg and Litt, 1998; Mirosław-Grabowska et al., 2015). Earliest results will allow for local-scale (e.g. Roman and Balwierz, 2010; Kołaczek et al., 2012; Niska, 2012; Niska and Mirosław-Grabowska, 2015) palaeoenvironmental reconstruction with respect to global changes (e.g. Behre, 1989; Zagwijn, 1996; Tzedakis, 2003; Lisiecki and Raymo, 2005) from the end of the Wartanian Glaciation (Late Saalian, MIS6) to the Plenivistulian (MIS3–2). The ultimate objective of the study is to evaluate the results of multiproxy analysis and to answer the question whether such multidisciplinary research (which is expensive) is justified for such a large geological feature exposed in a complete section.

2. Study area, geological and palaeoenvironmental setting

The study area is located in central Poland at the boundary of the Szczerców Basin and the Bełchatów Plateau (Fig. 1). It extends about 10–20 km to the north from the maximum limit of the Wartanian end moraines or glaciofluvial fans (Marks, 2004; Marks et al., 2006; Wachecka-Kotkowska, 2015). Throughout Pleistocene time, the sedimentation of glacial and interglacial deposits with a high thickness occurred (Marks, 2011).

The present study was conducted in the Szczerców outcrop. The other older one, Bełchatów outcrop, has already been reclaimed in part. The occurrence of brown coal deposits in the Bełchatów region is related to the existence of the Kleszczów tectonic graben (Krzyszowski, 1995). The two outcrops are separated by the Dębina salt dome structure (cf. Wieczorek and Stoński, 2013).

Geological studies in the Bełchatów outcrop made it possible to establish a lithostratigraphic framework for the Quaternary deposits (Krzyszowski, 1992). As research progressed the synthetic lithostratigraphic section was being subject to modifications (Krzyszowski, 1996; Allen and Krzyszowski, 2008; Krzyszowski et al., 2015). Finally, the lithostratigraphic section, supplemented by the results of absolute dating for mineral sediments and

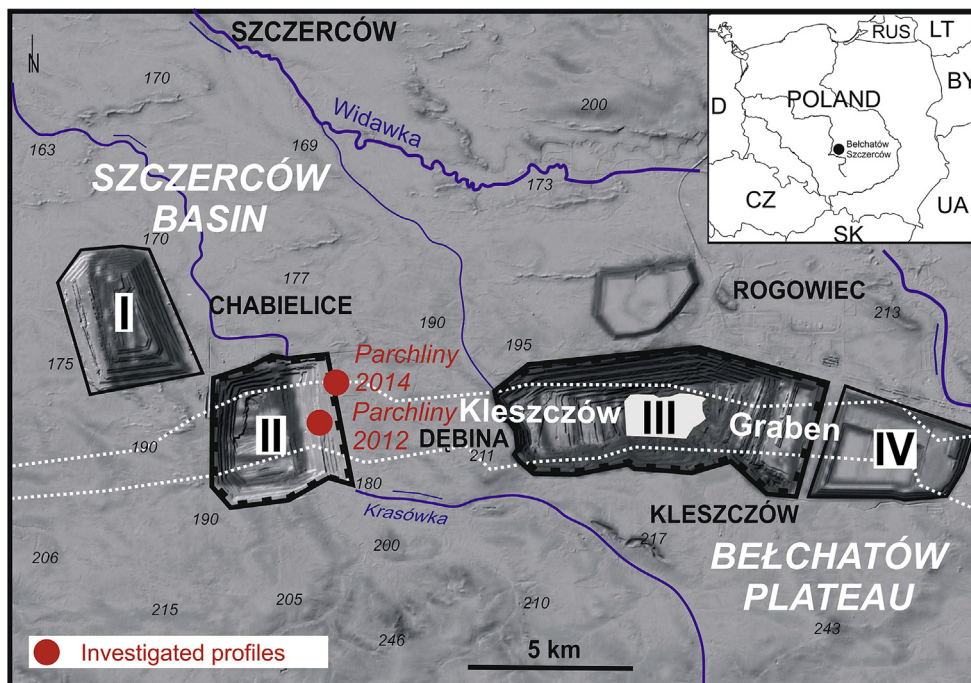


Fig. 1. Study area against the background of the Bełchatów Open Coal Mine facilities and relief of its surroundings (outer mine pile: I – Szczerców; mining fields: II – Szczerców, III – Bełchatów; inner mine pile: IV – Bełchatów); elevations are in italics (after D. Krzyszowski, D. Wieczorek and L. Wachecka-Kotkowska).

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