

## PLEISTOCENE STRATIGRAPHY AND TILL PETROGRAPHY OF THE CENTRAL GREAT POLAND LOWLAND, WESTERN POLAND

Jerzy Adam CZERWONKA and Dariusz KRZYSZKOWSKI

**A b s t r a c t:** The central Great Poland Lowland (Poznań and Leszno regions, western Poland) has an important Pleistocene sequence. There are no Lower Pleistocene deposits and the Middle Pleistocene comprises only glacial suites, except for one interstadial fluvial series. The Upper Pleistocene sequence comprises interglacial (Eemian) lacustrine sediments, Middle and Late Weichselian fluvial series and Late Weichselian glacial deposits. Ten till horizons from 8 glacial episodes have been recognized in the central Great Poland. All the tills have unique petrographic properties which are the basis for lithostratigraphic sub-division of the glacial deposits and for long – distance correlations. Other features, such as grain size, heavy minerals, quartz roundness characteristics and CaCO<sub>3</sub> content, are very variable within each stratigraphic horizon. Precise chronostratigraphic positioning of the Middle Pleistocene deposits is impossible due to the lack of index interglacial/interstadial organic deposits. Previously, the Mazovian (Holsteinian) fluvial deposits have been described in the central Great Poland. The recent work unambiguously negates the occurrence of Mazovian deposits in the region investigated. The positions of the tills of central Great Poland are inferred by correlation with the neighbouring regions, which contain more index (interglacial) horizons. Currently, three Elsterian tills, one Odranian (older Saalian), four Wartanian (younger Saalian) and two Weichselian) tills are recognized. Moreover, the number of tills is changeable regionally. Three glacial episodes occurred during the Wartanian near Poznań, but only one episode near Leszno. The Weichselian glacial sequences indicate an occurrence of one till within the Leszno phase (maximum extent of this glaciation) and two tills within the Poznań phase. The last suggests an ice-sheet re-advance during the Late Weichselian near Poznań. The Middle Pleistocene fluvial deposits, the Pawłowiec Pyroxene Formation, is considered to be Elsterian in age by its position between the middle and upper Elsterian tills. This formation was deposited by a fluvial system flowing from the Sudeten Mts. to the north.

The glacial sediments of central Great Poland have very changeable thicknesses, from several up to 110 m. Large depressions with multiple and thick till sequences are separated by elevations where the same glacial deposits are thin or absent, with Neogene suites exposed on the ground surface. The origin of these depressions is ambiguous; they probably were formed due to glacial erosion. The depressions have been filled during the Odranian stage with the till having its largest thicknesses within the depressions (up to 60 m, exceptionally 85 m), whereas its thickness beyond them is usually much less. The Elsterian tills follow a similar pattern, but Wartanian and Weichselian tills do not have a clear connection with the basement topography. They form horizontal beds with reasonably uniform thicknesses (4–20 m), usually occurring at the same altitude, which is unique for different tills.

The Elsterian and Odranian sequences of central Great Poland can be firmly correlated with sequences of similar age in the southwestern and westernmost Poland. In turn, the Wartanian and Upper Pleistocene sequences correlate with those of the Konin region (eastern Great Poland), rather than with those of western and southwestern Poland.

STRATIGRAPHIC, SEDIMENTOLOGICAL AND ECOLOGICAL ASPECTS  
OF THE EEMIAN LACUSTRINE DEPOSITION NEAR ZBYTKI,  
WESTERN POLAND

Dariusz KRZYSZKOWSKI and Jarosław WINNICKI

**A b s t r a c t:** An Eemian suite near Zbytki, Leszno Upland, was deposited in a small and shallow lake (kettle hole). It has similar geomorphic and stratigraphic position to many other Eemian sites in central Poland, and it is located probably within an extensive Eemian lake district. The lacustrine suite contains mostly silt, clayey silt and clay. Organic sedimentation was limited practically to the latest phases of the interglacial (organic mud, peat). Eemian deposits fill up depressions within the Wartanian till and are covered by Weichselian/Holocene fluvial deposits. The interglacial lake developed generally from oligotrophic through mesotrophic to eutrophic and finally, to dystrophic conditions and peatbog. This simple evolution was interrupted twice during the early stage of the interglacial. The lake shallowed rapidly what caused distinct ecological changes, including destruction of macrophytes in the littoral zone, changes in diatom flora and chemistry of the lake. The shallowness of the lake that occurred at the beginning of the optimum phase induced especially great changes. These may be interpreted as ecological disaster. The lake became brackish, with strong reduction conditions at its bottom; diatoms and molluscs disappeared almost completely. Then, during the climatic optimum of the interglacial, the lake was very shallow, with highly expanded periphytonic zone, limited open water in the lake and limited occurrence of diatoms.

## THE EEMIAN INTERGLACIAL SITE AT ZBYTKI NEAR LESZNO, SOUTHWESTERN POLAND

Teresa KUSZELL

**A b s t r a c t:** This paper presents palynological data from two sections: Zbytki 1 and Zbytki 2, investigated in the Leszno Upland, southwestern Poland. Both sections occur in the same lake basin. The organic deposits lie 2–4 m below the ground surface. They are underlain by a till, assumed to belong to the Wartanian stage. The sections show distinct diagnostic features of the Eemian Interglacial for this region of Poland. The Zbytki 1 section includes initial phases of the Eemian, together with a part of the optimum phase; the Zbytki 2 section contains a complete Eemian succession. The history of vegetation and a comparison with other Eemian sites in southwestern and central Poland are also presented.

## DIATOMS FROM THE EEMIAN LACUSTRINE SEDIMENTS AT ZBYTKI, LESZNO UPLAND, WESTERN POLAND

Barbara MARCINIAK

**A b s t r a c t:** Diatom analysis of the Eemian lacustrine sediments from the section Zbytki 2, Leszno Upland, western Poland, indicates numerous diatoms in the lower part of the sequence, i.e. those deposited during the pre-optimal and at the beginning of the optimal phase of an interglacial. This stage of lake development is represented by three diatom phases: Z1, Z2 and Z3. Littoral, alkaliphilous and eurytopic species of the genus *Fragilaria* predominate during the first stage of the lake development (diatom phase Z1). During the diatom phase Z2, the genus *Cyclotella* is more abundant. It represents littoral-planktonic and oligohalobous flora, typical for oligotrophic and mesotrophic lakes. The diatom phase Z3 is characterized by frequent *Fragilaria brevistriata*, *Amphora libyca*, *Stephanodiscus* sp. and *Nitzschia* sp., which are accompanied by halophilous, euryhaline, mesohalobous and alkalibiontic diatoms. The latter clearly indicate an increased salinity and strong alkalic conditions in the lake. The upper part of the section Zbytki 2, accumulated during the optimal and post-optimal phases of an interglacial, are characterized by sparse diatoms (diatom phases Z4 and Z5). The lake has become progressively shallower with abundant macrophytes. Such conditions were not favourable for diatoms.

## FOSSIL PLANT PIGMENTS IN LACUSTRINE SEDIMENTS OF THE EEMIAN INTERGLACIAL NEAR ZBYTKI, WESTERN POLAND

Bazyli CZECZUGA

**A b s t r a c t:** The history of evolution of an Eemian lake near Zbytki, Leszno region, western Poland, has been reconstructed using plant pigment concentration. Two borings have been analyzed, one from the central, the other one from the littoral part of the lake basin. Generally, the lake developed from relatively deep, oligotrophic-mesotrophic lake to a shallow, eutrophic one in the optimum phase of the interglacial. Then, it became a dystrophic lake and finally a peatbog. In the littoral zone, however, this sequence is disturbed due to distinct changes of the water level. At least two periods of very low water level and low plant production are recognized, in spite of a general climatic amelioration.

## THE MINERAL AND CHEMICAL COMPOSITION OF THE EEMIAN LACUSTRINE DEPOSITS AT ZBYTKI, WESTERN POLAND

Krystyna CHOMA-MORYL

**A b s t r a c t:** Eemian lacustrine sediments from Zbytki (Leszno region, western Poland) were deposited in a small lake filled mainly with the clastic material derived from a till plateau, lying around the lake. Changes in the water depth are marked by a changing content of  $\text{SiO}_2$  and  $\text{CaO}$ . Silica deposition predominated during deep and calcium during shallow water conditions. A very characteristic feature was the formation of gypsum, especially connected with the increased production of organic matter and phosphorous in the lake at the beginning of the optimum phase of the interglacial.

## MALACOFUNA OF THE EEMIAN INTERGLACIAL IN THE LESZNO-LAKE DISTRICT

Stefan Witold ALEXANDROWICZ

**Abstract:** Three new localities of the Eemian Interglacial including molluscs-bearing sediments, are reported from the Leszno-Lake District, central part of the Great Poland Lowland: Zbytki, Kopaszewko and Rogaczewo. The sections at Zbytki and Kopaszewko have mollusc faunas typical of shallow lakes, with humid meadows and marshes in the neighbourhood. This fauna represent the early stage of the interglacial only. The Rogaczewo section contains complete interglacial molluscan assemblages, from its early, lacustrine stage up to the last phase, with the formation of swamp. The fauna of these sections is very similar to the majority of assemblages of the Eemian Interglacial of the Great Poland Lowland.

## HISTORY OF GLACIATION IN THE ZONE OF MAXIMUM EXTENT OF THE LATE WEICHSELIAN ICE-SHEET NEAR LESZNO, WESTERN POLAND

Dariusz KRZYSZKOWSKI and Beata GRATZKE

**A b s t r a c t:** This paper presents detailed geological and geomorphological analysis of the marginal zone of the last glaciation near Leszno, western Poland, with special reference to the pre-Weichselian basement. Tertiary clay is commonly exposed at the ground surface or occurs below a thin cover of younger deposits. Location of tunnel valleys is very conservative, younger troughs are incised within or along the older ones. The Elsterian and Odranian tunnel valleys are of similar size and they are much larger than younger troughs from the Wartanian and Weichselian stages. The older Pleistocene deposits occur practically only within the tunnel valleys, whereas deposits from the Wartanian and Weichselian stages may occur both in troughs and on uplands. Maximum extent of the Weichselian ice-sheet is located at the lithological boundary in the basement, which changes from clay to till-sand. The ice limit at its maximum extent was in steady-state conditions (dynamic equilibrium), enabling formation of sedimentary scarps of proglacial sandurs. The region investigated has two Weichselian systems of tunnel valleys, one trending from NW to SE or from N to S, and the second one trending from NE to SW or NEE to SWW. Also, there are two esker systems with different orientations, and the till fabric and petrography show two possible directions of the ice flow. Several geological and morphological features suggest that the NE-SW system is younger and it was formed during a readvance. Subglacial erosion during the first advance directly followed pre-existing tunnel valleys. During the readvance, a quite new system was formed with a complete change of the ice flow direction and with no connections to the pre-existing morphology. The uplands are covered only by a lodgement till with no sediments or landforms from the ice-sheet decay. This suggests clean ice in the major part of the Weichselian ice sheet near Leszno and temperate conditions at the base of the ice sheet.



PRE-GLACIAL DEPOSITS NEAR STANKOWO, LESZNO REGION,  
WESTERN POLAND, AND THEIR RE-DEPOSITION DURING  
THE MIDDLE PLEISTOCENE

Jerzy Adam CZERWONKA, Beata GRATZKE and Dariusz KRZYSZKOWSKI

**A b s t r a c t:** Pre-glacial deposits (Stankowo Formation) of the Leszno region are the northernmost pre-glacial deposits in western Poland which were deposited by a river flowing from the Sudeten Mts. Near Leszno, this river formed at least 10 km wide valley which was occupied by a braided fluvial system. Petrological features suggest that this river, most probably the pre-Odra River, came from the eastern Sudeten. Pre-glacial deposits were re-deposited during the Middle Elsterian and a new series (Świerczyna Formation) was formed. It contains pre-glacial and glacially-derived material („mixed” series). Re-deposition occurred, most probably, at the marginal zone of the ice-sheet during the deglaciation.

QUATERNARY GEOLOGY NEAR CZEMPIŃ AND MOSINA,  
CENTRAL GREAT POLAND LOWLAND, WITH REFERENCES  
TO THE EEMIAN LACUSTRINE SEDIMENTATION

Jacek CHACHAJ and Dariusz KRZYSZKOWSKI

**A b s t r a c t.** The region near Czemiń and Mosina is characterized by an incomplete Quaternary sequence. There are no Lower Pleistocene (pre-glacial) deposits at all. The Middle Pleistocene is represented only by Middle and Upper stadials of the Elsterian and the Wartanian (younger Saalian) stages. The Odranian (older Saalian) and the Mazovian (Holsteinian) deposits have not been recognized. The Upper Pleistocene is represented by Eemian lacustrine deposits and late Weichselian glacial, aeolian and fluvial deposits. The latter is represented by terraces of the Warsaw-Berlin Pradolina (Urstromtal) and the river Warta valley. The Holocene is represented by fluvial and organic deposits. Two new Eemian sites have been found near Czemiń. The sedimentary succession and ecological evidence show that both Eemian lakes were rather shallow, but they had different size. The smaller one developed in a kettle-hole on the upland, and the larger lake developed within a tunnel valley.

## THE EEMIAN INTERGLACIAL IN KOPASZEWKO AND ROGACZEWO NEAR CZEMPIŃ, CENTRAL GREAT POLAND LOWLAND, WESTERN POLAND

Teresa KUSZELL

**A b s t r a c t.** This paper presents palynological data from two sections: Kopaszewko (drillhole 1/Cz) and Rogaczewo (drillhole 2/Cz), which are located in the central Great Poland Lowland, near Czempin. Organic sediments in the Kopaszewko drillhole are overlain by the Weichselian till and are underlain by Wartanian, dolomite-rich till. The organic sequence of the Rogaczewo section lies above the till, assumed to be Wartanian in age, but it is overlain by only upper Weichselian fluvial sands and mud. The pollen assemblages and their succession clearly show that the organic sediments at both sites belong to the Eemian Interglacial, although only the Rogaczewo section has all the Eemian pollen zones. The vegetation development in both sections are very similar to the pollen succession of other Eemian sites in central-western Poland. This suggests that a large region of Great Poland Lowland (central-western Poland) was characterized by the same vegetation history during the Eemian.

THE PLEISTOCENE WOOD REMAINS FROM THE INTERGLACIAL DEPOSITS  
AT ROGACZEWO AND ZBYTKI, LESZNO LAKE DISTRICT,  
WESTERN POLAND, WITH SPECIAL REFERENCE TO THEIR STRUCTURAL  
FEATURES ENABLING PRESERVATION

Władysław PYSZYŃSKI

**A b s t r a c t.** The wood remains have been found within the Eemian sequences of Rogaczewo and Zbytki, western Poland. These are *Pinus silvestris* L., *Alnus glutinosa* Gaertn., and *Quercus* sp. in Rogaczewo and *Pinus silvestris* L., *Alnus glutinosa* Gaertn. and *Hippophaë rhamnoides* L. in Zbytki. The wood of *Hippophaë rhamnoides* L. has not hitherto been described from the interglacial Pleistocene sequences of Poland. The paper discusses also a general occurrence of wood remains within the Pleistocene interglacial sequences, with special reference to Eemian deposits in western and central Poland. Only 15 genera are represented by fossil wood; 12 belonging to heartwood and three to sapwood. Good preservation of wood is related to specific anatomic structure and chemical composition of wood, as well as to the type of deposits in which the wood remains occur.

QUATERNARY GEOLOGY OF THE NORTH-EASTERN PART  
OF THE POZNAŃ-LAKE DISTRICT BETWEEN POZNAŃ AND SZAMOTUŁY,  
WESTERN POLAND

Waldemar GOGOLEK

**A b s t r a c t.** The paper describes the Quaternary sequence and its basement of the central part of Great Poland Lowland, westwards from Poznań. The Quaternary basement is formed mainly of the Poznań Clay. Four elements were recognized at the top surface of this formation. These are the Sama valley, Samica valley (tunnel valleys?), and Więckowice Depression which are separated by the Grzebienisko-Chrustowo Elevation. The valleys and the depression contain very thick Quaternary sequences whereas the elevation is characterized only by thin Quaternary deposits. Nine till beds, with different petrographic content were recognized. Six of them have unquestionable stratigraphic position and they represent the South Polish Glaciation (Elsterian, two tills), the Odranian Glaciation (one till), the Wartanian Glaciation (two tills) and the Baltic Glaciation (Weichselian, one till). Three tills have poorly documented stratigraphic position, but they probably come from the Elsterian, Wartanian and late Weichselian. Additionally, one possible interstadial series was documented palynologically. It occurs between Wartanian tills. Interglacial deposits are found neither in borings nor in exposures, in contrast to the adjacent areas.

## QUATERNARY GEOLOGY NEAR OBORNIKI, CENTRAL GREAT POLAND LOWLAND, WITH REFERENCES TO PALAEOONTOLOGICAL DATA

Sylwester SKOMPSKI

**A b s t r a c t.** The Oborniki region is characterized by a thick Neogene sequence, partly deposited in a tectonic graben, representing the Oligocene, Miocene and a part of the Pliocene. The Lower Pleistocene is represented only by the thin, preglacial Łukowo Formation. The Middle Pleistocene sequence is very incomplete. Only one Elsterian till and the Wartanian till are recognized with certainty. The occurrence of the Odranian till is questionable. The Upper Pleistocene is represented by the Eemian fluvial and lacustrine deposits and Weichselian fluvial and glacial deposits. The last come from an ice-sheet transgression and decay, and are very often expressed in morphology, forming till plains, sandurs, end moraines, push moraines, kame and eskers, etc. The main erosional forms are tunnel valleys, in part re-modelled into river valleys during the Weichselian Lateglacial. The Holocene is represented by fluvial and organic deposits. Several stratigraphic horizons in the region investigated comprise palaeontological findings, including vertebrates, molluscs and ostracods.

THE FLORAL CHARACTERISTIC OF UPPER PLEISTOCENE ORGANIC  
SEDIMENTS AT BOGDANOWO AND ZŁOTKOWO NEAR POZNAŃ,  
WESTERN POLAND

Hanna WINTER

**A b s t r a c t:** This paper presents palynological data from three profiles: Bogdanowo 1, Bogdanowo 2 and Złotkowo, which occur in central Great Poland Lowland, western Poland, near Poznań. The Bogdanowo profile represent deposits of one lake basin, and the Złotkowo profile comes another one. The lacustrine deposits are at both sites overlain by a till. The pollen succession at Złotkowo indicates that the deposits are of Eemian age and sedimentation occurred up to the beginning of the optimal phase of this interglacial. The Bogdanowo lacustrine suites were deposited only during cold climatic conditions with boreal forest, and the pollen succession is not sufficiently complete to determine the age of deposits. The geological situation, however, suggests that these deposits may belong to the Eemian, as well.