

THE STRATIGRAPHY OF QUATERNARY DEPOSITS IN THE AREA OF KLECZEW IN THE LIGHT OF LITHOSTRATIGRAPHIC AND RADIOMETRIC DATING

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Abstract. The stratigraphy of the Quaternary series in the Konin region comprises pre-Pleistocene sediments and four complexes of sediments from the cold stages of the Pleistocene (glacials) and three complexes from the warm stages of the Pleistocene (interglacials). The best known sediments are those of the last cold stage, of which the most extensive radiocarbon dating are available. The dating complement the results of geological studies. Seventeen samples of fluvioglacial and glacier ice sediments of the North Polish cold stage, and three samples taken from the roof segments of the layers of till coming from the Middle Polish cold stage were dated using the TL technique. Unfortunately, the results were totally contradictory to the findings of the geological and radiocarbon studies.



1. INTRODUCTION

According to our current knowledge, the stratigraphy of the Quaternary series of the region of Konin comprises pre-Pleistocene sediments, and according to author's meaning (Stankowski, 1996a, b) four complexes of sediments from the cold stages of the Pleistocene (glacials) and three complexes from the warm stages of the Pleistocene (interglacials). This statement has been gained through a study of more than 3000 profiles of drillings which penetrated into late Tertiary sediments, and the mapping walls of five open pits of the Brown Coal Mine "Konin," which have been investigated over many years. The credibility of the documentation of the stratigraphic components of the Quaternary varies considerably (see Fig. 1). Earlier studies (Stankowski and Krzyszkowski, 1991, Stankowski *et al.*, 1995a, b) assumed the same construction of the Konin region Quaternary series.

2. SITES AND SEDIMENTS

The pre-Pleistocene sediments (Q_{pp} , see Fig. 1) were identified mainly by means of drillings, and to a smaller degree, of study of the open pits walls. The sediments of the oldest cold stage of the Pleistocene (Q_1) were classified in the same way. The oldest till include slightly bipartite layers. Such till appears occasionally at the bottoms of the deep erosion cuts in the Tertiary sediments. A group of very peculiar sediments consisting of brown coal incrustated with numerous Scandinavian stones and gravels may originate from the same period.

All of these sediments have been located at the boundary of the Tertiary and Quaternary rocks in an open pit near Mikorzyn. From a macrostructural point of view, they are subglacial sediments.

In the region of Konin, there are no fossil organic interglacial sediments between the till layer of the oldest cold stage (Q_1) and the sediments of the South Polish cold stage (Q_2). There are only not continuous and thin pathes of sands and gravels. The postulate that the sediments of the two earliest glacials are separated by the sand-and-gravel "interglacial" formations which occur between them is merely a hypothesis.

The main component of the Quaternary series of the region of Konin are layers of grey and bipartite till, of an average depth of 25 m, locally exceeding 50 m; these come from the South Polish period (Q_2). This statement contradicts previous stratigraphic interpretation. The literature of the subject dated the said till to the Middle Polish period. The new dating may be corroborated by the presence of deep evorsive scours in this till, filled by fine sands, silt and clays (e.g. in the area of Budziszlaw Kościelny, as well as Mikorzyn organic layer situated deeper than the Eemian one), which apparently developed during the *sensu lato* great interglacial (Q_{2-3}). This interpretation can be corroborated by the data from complementary sites of drilling (Koło, Budki Stare and Zagaj and very probable Ruszkowo, Stankowski *et al.*, 1995a, b), where organic sediments were identified. For a long time, the well-known and strongly discussed site in Marantów (Borówko-Dłużakowa, 1967, 1969; Tobolski, 1991) has been considered the most conclusive evidence. The pro-

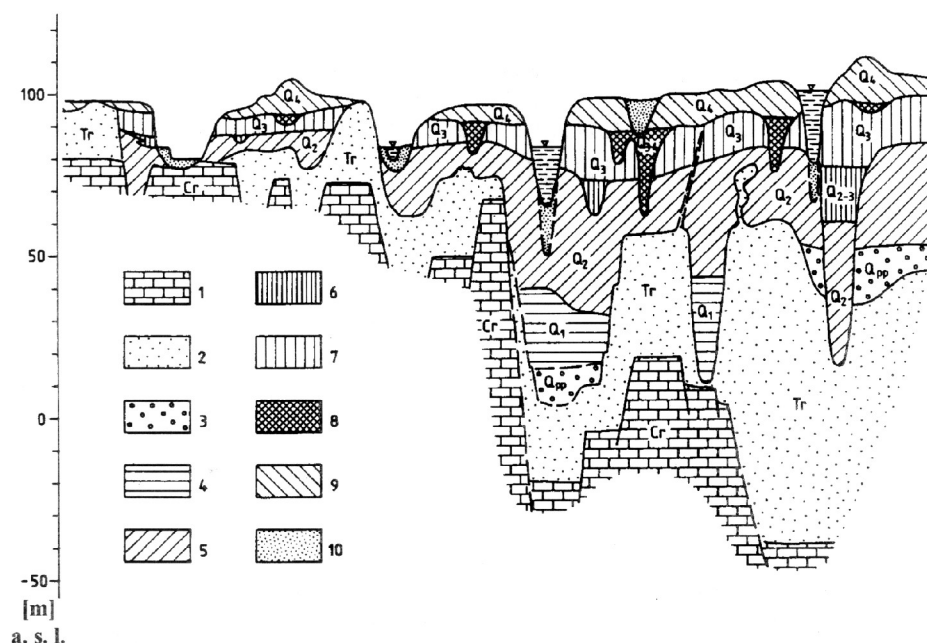


Fig. 1. A synthetic presentation of the stratigraphy of Quaternary series of the region Konin:

1 – Cretaceous rocks, 2 – Tertiary rocks, 3 – preglacial deposits, 4 – deposits of the earliest glacial, 5 – deposits of the South Polish glacial, 6 – deposits of the great interglacial, 7 – deposits of the Middle Polish glacial, 8 – deposits of the Eemian interglacial, 9 – deposits of the North Polish (Vistulian) glacial, 10 – post-Vistulian deposits.

file collected there, at the site which arouses controversies in spite of the abundant paleobotanical material, obviously comes from the “Zbójno interglacial” (Lindner and Brykczyńska, 1980; Tobolski, 1991) i.e. from the *sensu lato* great interglacial.

The paleosurface of the South Polish glacial series, described based on laterally dispersed, albeit fairly numerous data, has many characteristics of post-glacial relief: the varying lithological properties of the till, the fluvioglacial sands and gravels, the stagnant-water sediments and the organic sediments, as well as the quality of the relief featuring marked activities: eversion channels, meltwater channels, river valleys and extensive depressions outside catchment areas.

Within the discussed area, the Middle Polish cold stage of the Pleistocene (Q_3) has left a glacial series of a thickness of a dozen or so meters (never more than 20 m), of a weakly marked bipartite quality. Usually it is a single layer of massive till. Above the till, there is a discontinuous cover of sand-and-gravel sediments, most probably dating to the cataglacial phase.

The paleosurface of the Middle Polish series of the Pleistocene is well defined. In fact, we are dealing with a fossil lakeland landscape with many meltwater channels, bodies of stagnant water and small river valleys. During the last twenty five years, many Eemian interglacial sites featuring gyttja and peat have been discovered and described through direct studies (Józwin 76 and 84, Kazimierz, Władysławów and Mikorzyn, and most recently two sites at Kleczew N: 1995 and 1997;

see Stankowska and Stankowski, 1976; Tobolski, 1991; Kozydra and Skompski, 1995, 1996). Upon a scrutiny of the records of previous drilling, another four Eemian profiles were identified, one of which was drilled anew. Palynological tests were carried out at that site, confirming that the sediments originate from the Eemian period ($Q_{3,4}$).

The glacial series of the last cold stage of the Pleistocene (Q_4), of a thickness of 4–6 m, occasionally up to 10–12 m, is generally bipartite. Its lower segment consists of fluvial and lake-plain deposits with layers of periglacial structures and organic intercalations dating to various periods (Stankowska and Stankowski, 1979, 1991; Pazdur *et al.*, 1981; Tobolski, 1991). The radiocarbon dating of these organic sediments range from more than 46,000 through ca. 43,000 and 45,000 to ca. 22,000 BP (the sites: Władysławów, Adamów, Konin S (Konin Przydziałki), Kleczew N, Sławoszewek, Anielew and Maliniec). The upper segment of the sediments of the last Pleistocene cold stage consists of thin layers of sandy till, of a general thickness no more than 3 m, markedly bipartite. In extensive areas, the till determines the relief. In many locations the till is overlain by fluvioglacial deposits dating to the time of the last ice sheets recession of the Poznań phase.

Characteristic of the recent morphology of the area are chains of deep up to several dozen meters subglacial evulsive channels. The original subglacial scours were filled to a large degree with late-glacial and Holocene sediments, whose layers were often very thick

(for example at the sites Maliniec, Słaboludź and Kleczew N). Radiocarbon dating is available for these sediments as well, the earliest one being *ca.* 17,700 BP.

During many years of geological study of the Konin region, a number of Pleistocene stratigraphic units were identified. All of them were also observed during the geological mapping for the sheet "Kleczew" of the Detailed Geological Map of Poland on a scale of 1:50,000).

The most exhaustive lithostratigraphic and paleobotanical evidence of the region of Konin, and in particular of the area of Kleczew, pertains to the sediments of the last two Pleistocene cold stages and of the warm stage which occurred between them. The paleobotanic synthesis of period from Eem interglacial to recent time presented Tobolski (1991). This synthesis takes under account the profiles Maliniec, Kazimierz, Pątnów 76 and 84, and Władysławów, which Tobolski examined in collaboration with the author of the present report. The latest paleobotanical and malacological data concerning two important Eemian sites which have been discovered (Ruszkówek and Mikorzyn), are discussed in Kozydra and Skompski 1995, 1996. The sites Mikorzyn and Sławoszewek were elaborated palinologically by Nita (1999) as well as dating in thermoluminescence method by Bluszcz (1999, see Stankowski *et al.*, 1999).

3. RADIOMETRIC DATING

A number of both ^{14}C and thermoluminescence (TL) datings are available for the area in question (Stankowski and Stankowska, 1979, 1987, 1991; Pazdur *et al.*, 1981; Stankowski, 1989; Bluszcz *et al.*, 1991; Stankowski *et al.*, 1999). The most recent radiometric

datings were obtained in the course of the geological mapping for the sheet "Kleczew" of the DGMP. The radiocarbon dating, listed in Table 1, is compatible with the results of lithostratigraphic studies.

Samples of fluvioglacial and glacier ice sediments of the North Polish cold stage, and three samples taken from the upper layer of till coming from the Middle Polish cold stage were dated using the TL technique. Two series of samples, collected in the years 1994 and 1995, were dated. The results are summarised in Table 2. Unfortunately, they are totally contradictory to the findings of the geological and radiocarbon studies. Surprising is the inverted dating of the superposed sediments; furthermore, two series of dates show no regularities other than the time of the laboratory tests.

4. CONCLUSIONS

The results of lithostratigraphic studies of Eem interglacial and North Polish glacial sediments are comparative with the radiocarbon dating. However the thermoluminescence dating have turned out to be unreliable. This is yet another piece of evidence of how essential it is to remain prudent when quoting the results of luminescence dating, especially when the latter base on limited corpora of data, in the case of both water sediments and even more so of sediments being the effect accumulation of glacier ice.

Table 1. Results of ^{14}C dating. The dating was carried out during the geological mapping, the sheet "Kleczew" of the detailed Geological Map of Poland on the scale 1:50,000. It was financed by the Polish Geological Institute.

Stratigraphy	Site	Sediments	TL Age [ka]		Lab. No.
			Measurement series		
			1994	1995	
Recession of the Poznań phase	Smolniki Powidzkie	Fluvioglacial sands		94.8±14.2	UG-2357
				142.9±21.4	UG-2358
				161.3±24.2	UG-2359
	Anastazewo			106.9±16.0	UG-2350
				93.7±14.1	UG-2351
	Kleczew S-1	Fluvioglacial sands	47.6 7. 50.7 7.		UG-1958 UG-1984
Poznań phase	Doły	Fluvioglacial sands		133.8±20.1	UG-2352
				158.2±23.7	UG-2353
				160.6±24.1	UG-2354
				131.5±19.7	UG-2355
				198.1±29.7	UG-2356
	Kleczew S-1	Tills	60.9±9.0 86.5±13.0		UG-1976 UG-1977
Poznań and/or Leszno phase	Kleczew S-1	Tills	59.7±8.9 67.2±10.1 67.9±10.5		UG-1980 UG-1981 UG-1987
			69.8±10.5 82.0±12.3 72.6±10.9		UG-1979 UG-1982 UG-1983

Table 2. Results of TL dating. The dating was carried out during the geological mapping, sheet "Kleczew" of the detailed Geological Map of Poland on the scale 1:50,000. It was financed by the Polish Geological Institute.

Stratigraphy	Site	Sediments	¹⁴ C Age [BP]	Lab. No.
Holocene and late Vistulian	Staboludź 1b	a piece of wood from the floor of peat over lake chalk	5900 ± 60	Gd-3867
		light-brown peated gyttja	7080 ± 70	Gd-7681
		detrital gyttja (brown)	9510 ± 80	Gd-7692
		strongly decomposed peat	11,080 ± 50	Gd-7801
	Kleczew N-4	strongly decomposed peat (floor)	6760 ± 60	Gd-11274
		detrital gyttja (floor)	17,700 ± 800	Gd-9604
Plenivistulian	Stawoszewek (the road)	deformed organic sand (a thin discontinuous layer under clay and fluvioglacial sand)	> 26400	Gd-9603
	Anielewo	organic sand (a thin discontinuous intercalation)	41,700 ± 140 > 49,000	Gd-7636 Gd-11189
	Klecze	organic sand: a packet filling a frost wedge	43,300 ± 1100 > 43,700	Gd-11207 Gd-7690

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