Kwartalnik Geologiczny, t. 35, nr 1, 1991 r., str. 37–56

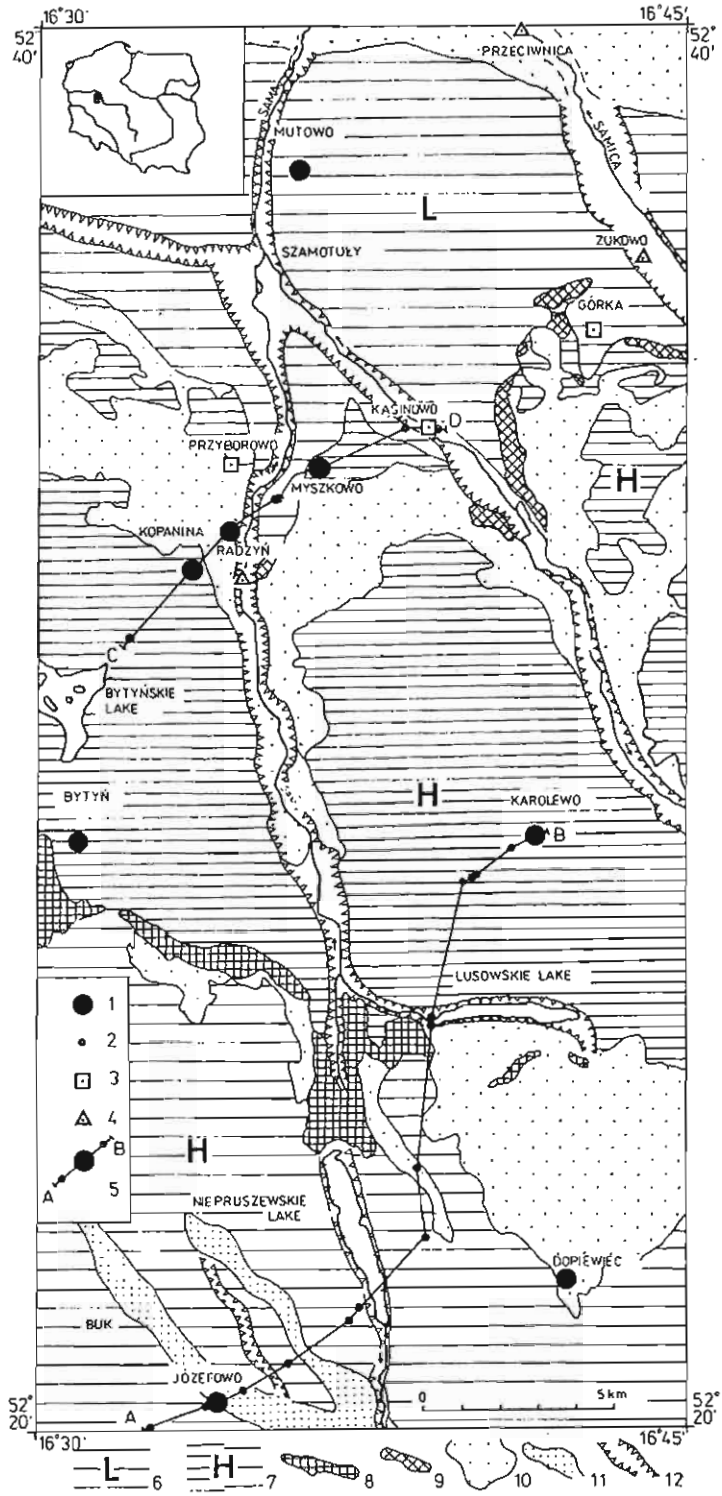
Waldemar GOGOŁEK

The Quaternary of Szamotuły and Buk region (Wielkopolska Lowland)

The purpose of this paper is to present stratigraphy of the Quaternary of Szamotuły and Buk region, middle part of the Wielkopolska Lowland. The paper presents geomorphology, configuration, Pliocene and Miocene sediments of subquaternary surface. Pleistocene sediments are represented by tills, flivioglacial and ice–dammed lake deposits. Deposits of South Polish, Odra, Warta and Baltic glaciations in Pleistocene sediments are also described.

INTRODUCTION

The paper compiles rich set of archival data, including results of about 300 borehole profiles and geological mapping conducted on Szamotuły and Buk sheets of the *Detailed Geological Map of Poland* in the scale of 1:50 000. The borehole samples were examined using palynological method by H.Winter and B.Słodkowska, litho-logic-petrographical method by K.Choma-Moryl et al. and by D.Krzyszkowski and J.Czerwonka, thermoluminescence (TL) dating method by J.Butrym and radiocarbon dating method by M.F.Pazdur. The described area is localized in NE part of the Poznań Lake District, Poznań vicinity. The progress in geological studies allows to make some changes in stratigraphy of the Quaternary of this area presented so far (W.Gogołek, 1990, in print).


16°30'
16°45'
52° 40'
52° 20'
PRZECIWNICA
SAMA
SAMICA
MUTOWO
L
SZAMOTUŁY
ŻUKOWO
GÓRKA
KĄSINOWO
D
PRZYBOROWO
MYSZKOWO
H
KOPANINA
RADZYŃ
C
BYTYŃSKIE LAKE
BYTYŃ
H
KAROLEWO
B
LUSOWSKIE LAKE
1
2
3
4
B
A
5
H
NIEPRUSZEWSKIE LAKE
DOPIEWIEC
BUK
JÓZEFOWO
A
0
5km
L 6
H 7
8
9
10
11
12

GEOMORPHOLOGY

Two moraine plateau levels are the basic morphological elements of the region (Fig. 1). The higher one (80–108 m a.s.l.) — undulated and partly flat moraine plateau is developed in the south part and occupies more than a half of the region. The lower (70–75 m a.s.l.) flat moraine plateau (Szamotuły Plain) is developed in the north. Plateau levels are sharply separated by an edge structure, with a mound of push-up moraine developed on the edge. In the north the Szamotuły Plain is declining towards fluvioglacial terraces surface of the Noteć—Warta ice-marginal valley. Plateau areas are cut with many subglacial channels. At present they are utilized by large number of rivers and streams. Depressions of plateau areas, mainly along the glacial channels, are covered with fluvioglacial sediments. The south part of the area is cut evenly with a parallel zone of maximal range of the Poznań Phase, Leszno-Pommeranian Stadial of the Baltic Glaciation. The SE part of the area is additionally diversified by many kame mounds and by Buk—Mosina channel–esker form set. Further details of geomorphology of the region are presented in works by T.Bartkowski (1962) and W.Gogołek (in press).

SUBQUATERNARY SURFACE — MORPHOLOGY AND SEDIMENTS

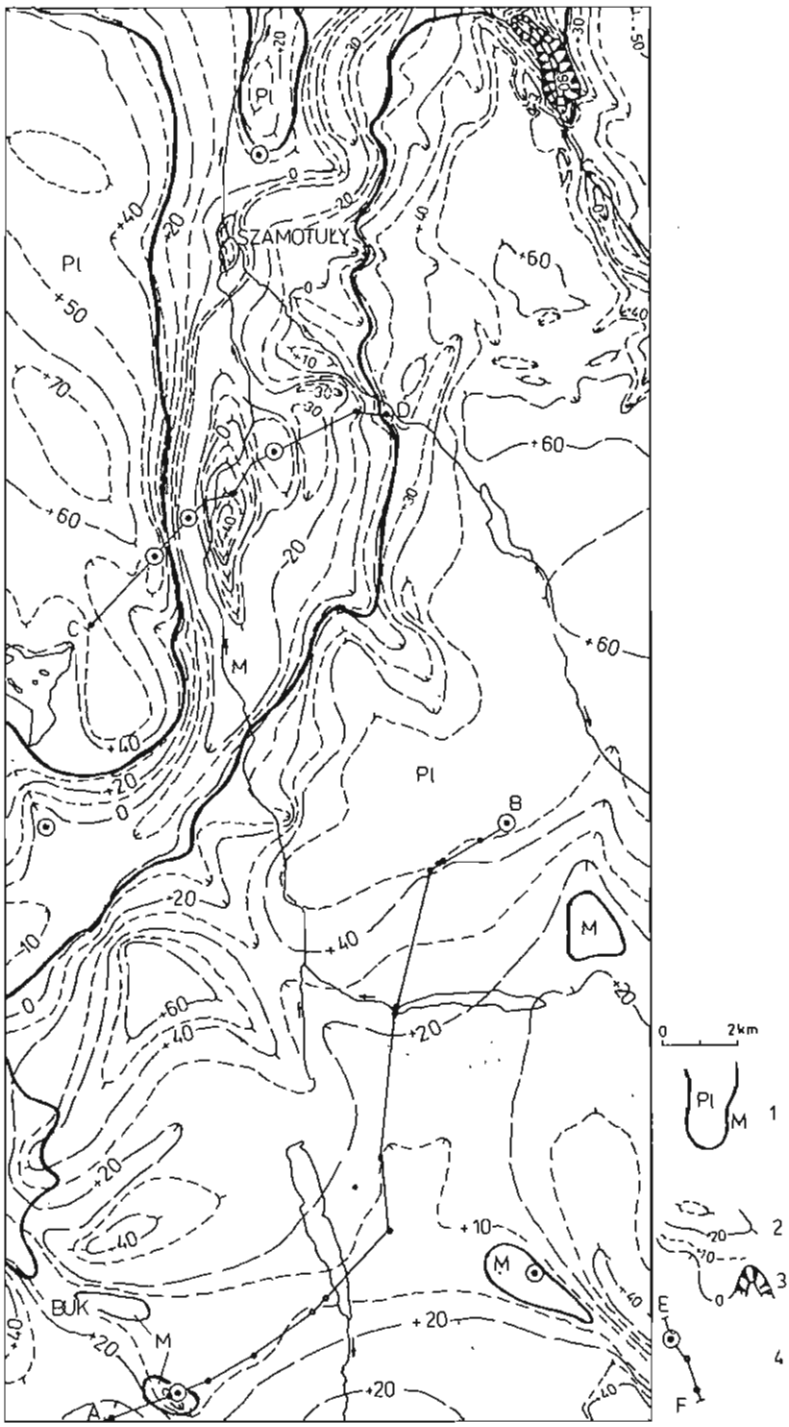
Quaternary substrate is formed by Miocene and Pliocene sediments (Fig. 2). Subquaternary surface is diversified, with large denivelations ranging above 160 m, denivelations of the present surface are reaching almost 70 m. Primary subquaternary surface after Pliocene sedimentation period reached probably about 50 m a.s.l. Higher level surfaces were probably due to glaciotectonical deformations uplifted and lower level surfaces were denudated, eroded and egzarated. Pliocene sediments were in some places completely removed. The Neogene sediments are cut with deep burreid valley (channel) of Sama — dominant morphological element of this region.

Fig. 1. Location and geomorphological sketch of described area

1 – investigation boreholes; 2 – boreholes situated along the line of geologic sections; 3 – sites of ice-dammed lake sediments of the Leszno-Pommeranian Stadial examined by TL age dating; 4 — sites of Holocene sediments examined by ^{14}C age dating method; 5 – lines of geological sections; 6 — flat moraine plateau — lower level; 7 – flat and undulated moraine plateau — higher level; 8 – geomorphological forms of marginal zone of the Poznań Phase; 9 – push-up moraines; 10 – fluvioglacial plains; 11 – Buk—Mosina eskers; 12 – subglacial channels

Szkic lokalizacyjno-geomorfologiczny

1 – otwory badawcze; 2 – otwory wiertnicze wzdłuż linii przekrojów; 3 – stanowiska datowania metodą TL osadów zastoiskowych stadiału leszczyńsko-pomorskiego; 4 – stanowiska datowanych metodą ^{14}C osadów holocenu; 5 – linie przekrojów geologiczych; 6 – wysoczyzna morenowa płaska — poziom niższy; 7 – wysoczyzna morenowa falista i płaska — poziom wyższy; 8 – formy strefy marginalnej fazy poznańskiej; 9 – pagórki moren spiętrzonych; 10 – równiny wodnolodowcowe; 11 – ozy bukowsko-mosińskie; 12 – rynny subglacjalne


SZAMOTUŁY
BUK
Pl
M
A
B
C
D
E
F
0 2km
1
2
3
4

It extends from north to south. In the north it's axis deviates eastwards and in the south-westwards. It is 1–2 km width, maximum 5 km in Radzyń—Kąsinowo area. The valley bottom is generally flat and declines from about 5 m a.s.l. (Bytyń area) to about 35 m b.s.l. in the N and about 15 m b.s.l. in SW part. In the NE part of the area subglacial burried channel of Samica is developed. It was formed above the Tertiary graben (Szamotuły Graben). The north part this channel is developed as a deep compound genesis (partly tectonical) depression. The deepest point of the subquaternary surface — 91.4 m b.s.l. and the biggest thickness of the Quaternary deposits ranging 151.4 m are noted from the above depression. The remaining part of the channel is not as deep, it's bottom rises up to 15–30 m a.s.l. Due to lack of studies of Pleistocene sediments the date of forming of the channel is difficult to determine. In SW part of the area a synclinal depression in the Pliocene surface is developed. The bottom of this depression is 10–30 m a.s. l. Pliocene was here strongly reduced — mainly to few meters in thickness, locally total reduction is noted. Present surface refers to this depression.

Miocene outcrops on subquaternary surface are reffering to the extent of glacial channels zones developed below 10–20 m a.s.l., locally lower than 30 m a.s.l. or even 15 m b.s.l. In many places Tertiary formations, often with Pleistocene sediments, are glaciotectonicaly deformated. This remark is mainly concerning the marginal zones of glacial valleys (channels).

MIOCENE

Miocene sediments are made up of: sands, lignites, silts and clays up to 110–150 m thickness noted in Szamotuły Graben. As the main subject of the study is to present the Quaternary, geological sections are presenting only the top of the Miocene formation. Miocene sediments were examined using palynological method by B.Słodkowska. Spores and pollen spectra indicate, that miocene sediments were formed during warm VIII phase *Cyrillaceapollenites exactus* of upper part of Middle Miocene, IX phase *Tsuga — Ericaeae* of the uppermost part of the Middle Miocene and after Lower Miocene.

In the lithological description of the Miocene top 2 horizons are observed. The Upper horizon – "upper carbon serie" forms a constant lithological horizon. One or two not large thickness (2–3 m) lignite deposits with grey, brown and black clays in the top and calciumless fine grained sands and grey or brown silts below are present

Fig. 2. Geological sketch (without Quaternary deposits)

1 – geologic boundaries symbols: M – Miocene, Pl – Pliocene; 2 – top isohypes of sediments older than the Quaternary in m a.s.l.; 3 – edges; 4 – geologic sections with boreholes location

Szkic geologiczny (bez utworów czwartorzędowych)

1 – granice warstw geologicznych, symbole oznaczają wiek utworów: M – miocen, Pl – pliocen; 2 – izohipsy stropu utworów starszych od czwartorzędu w m n.p.m.; 3 – krawędzie; 4 – linie przekrojów z otworami wiertniczymi

in this horizon. This 10–20 m thickness serie probably corresponds to the lower part of Upper Miocene. The Lower horizon made up of "upper sands and silts serie" consists of totally calciumless fine grained quartz sands, silts and sandy clays, 20–25 m in thickness. It was probably formed in the upper part of Middle Miocene and lowermost part of Upper Miocene.

PLIOCENE

The Pliocene deposits are represented by grey-green, blue and grey clays, in some places dusty and sandy, locally with sand and calciumless silt intercalations. The Pliocene top consists mainly of spotted or partly spotted clays, yellow-green, rusty--green, brick-red and cherry, calciumless, locally light yellow with calcium carbonate coatings and concretions, highly calcareous. In the floor of Pliocene, darker clays with carbonized plant remains and even with thin lignite lenticles occur.

Palynologic analysis of the Pliocene samples were done by B.Słodkowska and H.Winter. Spores and pollen complexes indicate Middle or Lower Pliocene, possibly Upper Miocene age. The Tertiary of this area was precisely described by Z.Walkiewicz (1984).

STRATIGRAPHY OF THE QUATERNARY SEDIMENTS

According to lithological and petrographical studies, spatial analysis of numerous geological sections and TL datings, 8 glacial horizons accompanied by a range of fluvioglacial and ice-dammed lake series are distinguished in this serie. The thickness of whole Quaternary complex varies from about 10–20 m within Quaternary substrate uplifts to 100–150 m in the channels zone (Figs 3–5).

PLEISTOCENE

In the major part of the area subsequent glacial horizons are lying directly one on another, and are only locally separated by different genesis series. Fluvioglacial and ice-dammed lake series are occurring mainly in burried channels of Sama and Samica. Below the moraine horizons sediments and burried channel series description will be presented.

On this area a continuous horizon of tills (gB_1) is developed. It is characterized by homogenous lithological and petrographical features and thickness up to 14 m. Lack of this horizon is observed only locally in Józefów site. This horizon is composed of light-brown and dark-grey, strongly sandy, partly dusty and calcareous (7–12% $CaCO_3$) tills. The values of petrographical coefficients are: O/K~1.10; K/W~1.10;

A/B~0.90[1]. The most frequent local rocks occurring in this tills are the limestones, sandstones and quartz. Heavy minerals are represented by garnets ≥ amphiboles. The TL dating result of this horizon varies from 15.2±3 to 21±3 thousand years BP.

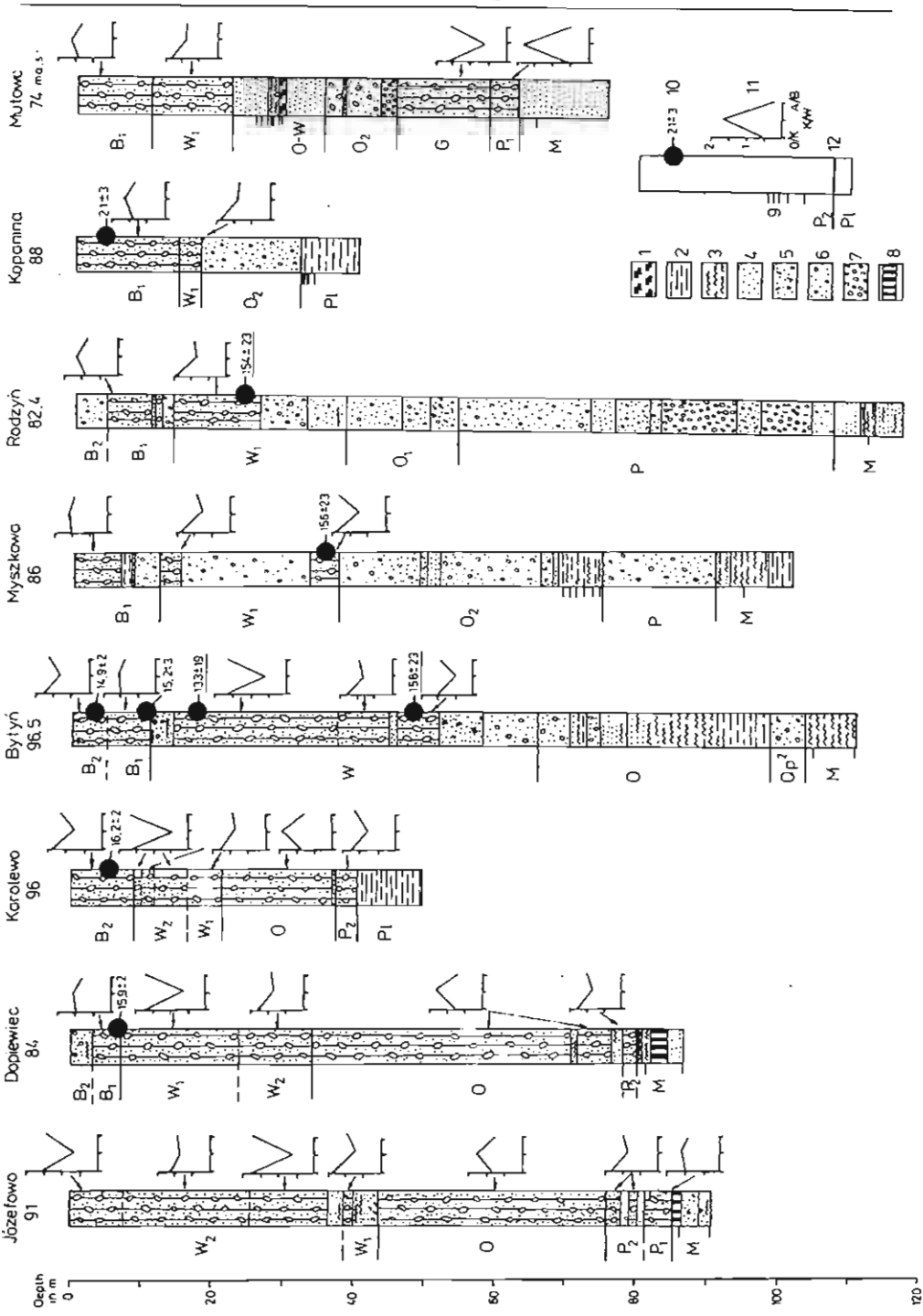
Locally, in Bytyń and Karolewo, higher till horizon (gB_2) is observed. Thickness of this local horizon reaches 9 m. It is composed of brown and grey, sandy tills. The values of petrographical coefficients are: O/K~1.30; K/W~0.85; A/B~1.10. Typical local rocks of this tills are mudstones M_2, limestones and quartz. In heavy mineral assemblage amphiboles ≥ garnets are dominant. The TL dating indicates 14.9±2 and 16.2±2 thousand years BP. The two highest till horizons found in expositures in Konin vicinity are characterized by almost the same lithological and petrographical features. This diversity is observed only locally in the nearest (few kilometers width) zone of the maximal extent of Poznań Phase.

The next glacial horizon (gW_1) reaching 12 m in thickness is observed in the whole investigated area. It's top is located 60–70 m a.s.l. The horizon is composed of dark-grey, sporadically brown tills, dusty, sandy in some places, calcareous (6–16.5% $CaCO_3$). Values of petrographical coefficients are: O/K~1.25; K/W~0.90; A/B ~0.95. The main local rocks are flints quartz, limestones, sandstones and marls. In heavy mineral assemblage garnets ≥ amphiboles are predominant. Locally in the floor of this horizon glacial erratics of older moraine horizons are found. The results of TL dating of this horizon varies from 154±23 to 158±23 thousand years BP.

In the south part of this area a 20 m thickness glacial horizon (gW_2) separating tills of the gB_1 and gW_1 horizons is recognized. The top of this horizon is located 75–90 m a.s.l. and locally it can be observed on the surface in Józefów vicinity. It is composed of dark-grey calcareous (6–10% $CaCO_3$), sandy and dusty tills. The values of petrographical coefficients are : O/K 1.70; K/W 0.60; A/B 1.60. Dominant local rocks are: mudstones M_1, quartz and sandstones. The heavy mineral assemblage is represented by amphiboles ≥ garnets. Locally this horizon forms with gW_1 horizon alternate layers of different lithological and petrographical characteristic. The above mentioned alternation indicates the presence of glaciotectonical deformations. The TL dating of this horizon indicates 133±19 thousand years BP.

Under gW_1 horizon another — 50 m thickness till horizon is noted (gO). In the south part of the area it is developed in form of massive cover, in the north part it fills probably parts of Sama burried channel (valley). The top of this horizon is found 50–70 m a.s.l. It is composed of grey-black and dark-grey, dusty and clayey, partly sandy, calcareous (6–9% $CaCO_3$) tills. Sporadically fragments of lignite, inserts of Pliocene clays and sand interbeds are found. The values of petrographical coefficients of this horizon are: O/K~0.80; K/W~1.35; A/B~0.70. A big variety of local rocks is noted, the most frequent are quartz, flints, limestones, sandstones and lignite. The heavy mineral assemblage is mainly presented by amphiboles and garnets in almost the same proportions.

[1]See expl. notes Fig. 3


Mutowo
74 m a.s.l.
Koparnia
88
Rodzyń
82,4
Myszkowo
86
Bytyń
96,5
Karolewo
96
Dopiewiec
84
Józefowo
91
Depth in m
0
20
40
60
80
100
120
1
2
3
4
5
6
7
8
9
10
11
12
P2
P1

In Mutowo another till horizon (gG) different in lithology and petrography was locally noted. The top of this up to 15 m thick horizon is found 30 m a.s.l. It is presented by dark-grey, clayey-dusty tills. The values of petrographical coefficients are: O/K~1.79; K/W~0.59; A/B~1.59. The local rock group dominant in this horizon are sandstones accompanied by marls, quartz and mudstones M_2. In heavy mineral assemblage garnet sharply dominates amphibole.

The following, lower till horizon (gP_2) forms 2–10 m thickness horizon. In the south part of the area it is a continuous horizon overlying directly Tertiary substrate. The top of this horizon is found 5–15 m a.s.l., locally 60 m altitude is also noted. It is presented by dark-grey, dusty tills, partly strongly sandy with admixture of smeared Pliocene clays and lignite fragments. The values of petrographical coefficients are: O/K~1.25; K/W~0.85, A/B~1.10. The main local rocks are limestones, quartz, sandstones, partly with high content of lignite fragments. The heavy mineral assemblage is mainly composed of garnets≠amphiboles>>pyroxene >epidote. Calcareous contents is lower than noted from the higher horizons (5% $CaCO_3$).

Locally in Józefów and Mutowo vicinity 4 m thickness tills horizon (gP_1) is noted. They are deposited in the deepest depression of Quaternary substrate. Their top occurs 12–16 m a.s.l. They are presented by dark-grey strongly sandy, calcareous tills with 4.4–6.3% $CaCO_3$ contents. The values of petrographical coefficients are: O/K ~1.00); K/W~ 1.07, A/B~ 0.90. The dominant local rocks are lignites, quartz, limestones and flints. In heavy mineral assemblage dominate amphiboles≠garnets. The lower Mutowo horizon indicates different values of petrographical coefficients (O/K ~ 0.58; K/W ~ 1.88; A/B~0.48) than the Józefów horizon. It is probably due to partial desintegration of the horizon. The contents of local rock association, northern rock association and heavy minerals are similar.

Fig. 3. List of boreholes drilled — Szamotuły and Buk Sheet, *Detailed Geological Map of Poland* in the scale of 1:50 000

1 – peats; 2 – clays; 3 – silts; 4 – sands; 5 – humus sands with plants detritus; 6 – sands with gravels; 7 – gravels; 8 – brown coal; 9 – sampling sites for palynological determinations; 10 – sampling sites for TL age dating (results given in thousand years BP); 11 – graphics of petrografical coeffieients: O – total of sedimentary rocks, K – total of crystallinic rocks, W – total of calcareous rocks, A – total of weather proof rocks, B – total of weather unproof rocks (Scandinavian origin group); 12 – stratigraphy: M – Miocene, Pl – Pliocene, P, G – South Polish Glaciations, O – Odra Glaciation, W – Warta Glaciation, B – Leszno-Pommeranian Stadial of the Baltic Glaciation

Zestawienie otworów wiertniczych wykonanych dla ark. Szamotuły i Buk *Szczegółowej Mapy Geologicznej Polski* 1:50 000

1 – torfy; 2 – iły; 3 – mułki; 4 – piaski; 5 – piaski z detrytusem roślinnym; 6 – piaski ze żwirami; 7 – żwiry; 8 – węgiel brunatny; 9, 10 – miejsca pobrania próbek: 9 – do badań palinologicznych, 10 – do badań wieku metodą TL (wyniki datowań podano w tys. lat BP); 11 – graficzny obraz współczynników petrograficznych, symbole literowe oznaczają sumę: O – skał osadowych, K – skał krystalicznych, W – skał węglanowych, A – skał nieodpornych na wietrzenie, B – skał odpornych (w grupie skał skandynawskich); 12 – granice stratygraficzne: M – miocen, Pl – pliocen, P, G – zlodowacenia południowopolskie, O – zlodowacenie odry, W – zlodowacenie warty, B – stadiał leszczyńsko-pomorski zlodowacenia bałtyckiego

The till complex gB_1 is overlayed by sandr cover, esker and kame formations, lake and fluvial deposits. Thickness of fluvioglacial deposits (fgB_2) reaches 10 m. They are presented by vari-grained sands, calcareous (3.4–7.1% $CaCO_3$), slightly rounded (index of roundness R=0.92–1.25). In heavy mineral association garnets dominate amphiboles. In numerous expositures traces of periglacial processes are noted as well as beds of gravels and thin interbeds of silty-clayay sediments indicating the local changes condition of sedimentation.

Below the gB_1 till horizon ice-dammed horizon (zB) is noted. It is composed of dusty sands, silts and silty clays, grey and grey-brown, calcareous, partly with sharp warved bedding. Locally it is composed of clays. The contact of clays and overlaying tills as well as the mirrored structures observed in the sediment indicate the presence of glaciotectonical deformations. Slight roundness of quartz grains (R~2.28) and high calcareous of the sediment (10.3% $CaCO_3$) are the factors indicating the sedimentation near the ice sheet. Ice-dammed lake sediments are filling the glacial channel reaching up to 10 m thickness. Locally the top of serie is denudated. This sediment (up to 3 m thickness) is also noted in shallow depressions in morainic plateau of the Warta Glaciation. The heavy mineral assemblage is presented hy garnet dominating the amphibole. TL dating of ice-dammed lake deposits collected by mechanical boring in Przyborów, Górka and Kąsinowo varies from 20±3 – 23±3 thousand years BP.

The ice-dammed lake horizon zB or directly tills horizon gB_1 is underlain by fluvioglacial sands and gravels (fgB_1). These sediments accumulated in glacial channels zone but locally are also distributed beyond them. The thickness of the sediments in the channels reaches 20 m, outside the channel 10–12 m. The sediments are composed of vari-grained sands with up to 4 cm diametered gravels, light-grey, interbedded by gravels and pebbels up to 7 cm in diameter. The heavy mineral assemblage of the sediment is similar to the same assemblage noted in till horizon gB_1 above (garnets ≥ amphiboles). This sediment presents a calcareous, slightly rounded sediment (R~1.1).

In the burried channel of Sama, the till horizon gW_1 is underlain by fluvioglacial sediments serie (fgW). Its thickness reaches 20 m and the top declines from about 60–70 m in the north to about 45 m a.s.l. in the south. They are composed of sands and gravel up to 15 mm in diameter, interbedded by silts and clays locally in the bottom, indicating changes of sedimentation conditions. Index of roundness varies from 0.70 to 1.06. In the heavy mineral assemblage garnets dominate the amphiboles.

In Mutowo the till horizon gW_1 in marginal part of burried channel of Sama is underlain by a complex of 16 m thickness limnic sediments (liO–W). It is presented by fine and vari-grained sands interleyed by grey silts and black-brown peats. The sediment is slightly rounded, index of roundness ($\overline{R}$=1.08) and calcareous (4.9% $CaCO_3$). Among the heavy minerals association amphibole slightly dominates the garnet. The contents of this association is similar to the till horizon gO and is sharply different from the heavy mineral contents of the till horizons gW_1 and gG. The pollen

spectra obtained from a part of this series are indicating the development of boreal plants with warming tendency. The above mentioned characteristics indicates that the sediment may represent the interstadial period or a part of interglacial period.

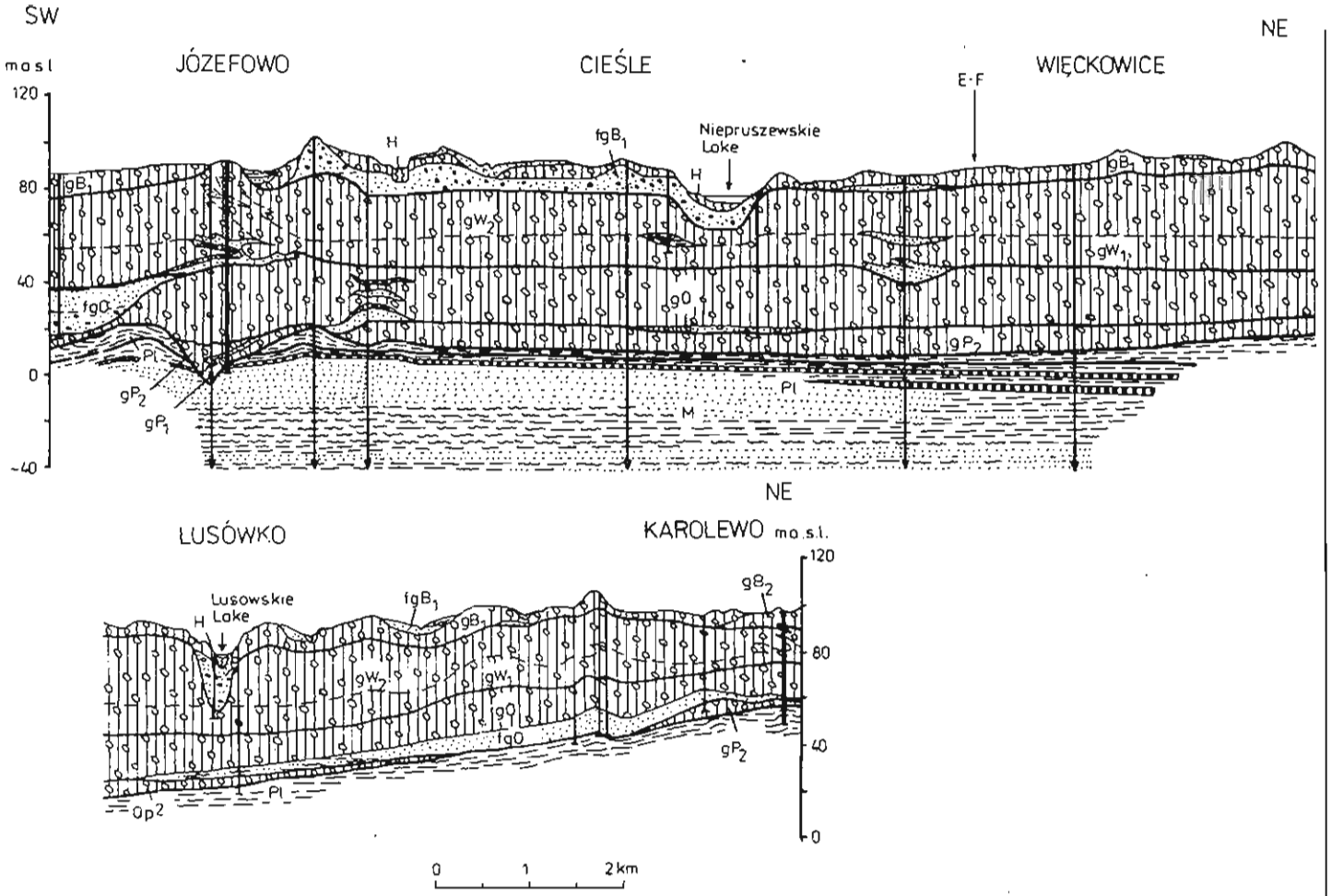
In the Sama channel, the morainic till horizon (gW_1) is overlaid by fluvioglacial sediments (fgO_2) with heavy minerals association related to till horizon gO. Locally these sediments occur also above the till horizon gO. They are composed of up to 15–20 m thickness vari-grained sands with gravels, locally of dusty sands. In heavy minerals association amphiboles dominate garnets. The sediment is slightly rounded (R~1.10).

The fgO_2 series and partly the till horizon gO are underlain by a fluvioglacial sediments series (fgO_1). The top of this series reaches 20–30 m a.s.l., in the Myszków vicinity top level of about 50 m a.s.l. is noted. The series up to 30 m is composed of vari-grained sands with gravel, grey, locally with addition of lignite fragments. Partly interbeddings of silty, grey-green sands and black plant detritus stripes and wood fragments are noted. This indicates periodic transformation of braided river sediments into reservoir sedimentation. The index of roundness of the sediment varies from R=0.81 to 1.11. Heavy minerals association contents refers to clay horizon gO with dominant amphibole and garnet. Their percentage contribution is similar.

The fluvioglacial series fgO_t is underlain by ice-dammed lake sediment (zO) thickness up to 26 m. It's top is 20–40 m a. s.l. Locally it is found to overlie directly Pliocene substrate. It is composed of grey silts with varied sandy and clayay additions, brown with organic dust additions at the top. Partly grey varved clays are found, with partially strongly mirrored structures. Carbonate contents is 9–12%. The value of index of roundness R varies from 2.03 at the bottom to 0.79 at the top. Heavy minerals association is presented by amphibole and garnet and is analogous to the heavy mineral association observed in fluvioglacial serie fgO_1 and moraine horizon gO. Palynological analysis of the samples indicate the presence of mixed pollen spectra with participation of Quaternary and Tertiary sporomorphs, Mesozoic spores and marine plankton.

The lowermost fluvioglacial series (fgP) accumulated in the Sama burried channel bottom is up to 53.5 m thickness. It's top varies from 37.5 m in Radzyń vicinity to 0.0 m a.s.l. in Bytyń locality. The series consists of vari-grained sands with additions of gravel and up to 200 mm in diameter pebbles, locally with thin interbeddings (up to 10 cm) of carbon substance and lignite (?), probably it is a material rinsed from Tertiary substrate. Index of roundness varies from R=0.87 to 1.10. In heavy mineral association garnet distinctly dominates amphibole. Differences in amphibole-garnet ratio within this series varies between 0.27 and 0.87. This may indicate, that this series has heterogenous age and may include sediments from more than one glaciation. Maybe in the future due to development of investigations on lowermost glacial and interglacial series, subdivision of this series will be possible.

The facts presented above allow to determine the age of each Pleistocene complex, presumable in case of older complexes.


SW
NE
m a s l
JÓZEFOWO
CIEŚLE
WIĘCKOWICE
E-F
Niepruszewskie Lake
120
80
40
0
-40
H
fgB1
gB1
gW2
gW1
gO
fgO
Pl
gP2
gP1
M
LUSÓWKO
KAROLEWO m.a.s.l.
NE
Lusowskie Lake
gB2
Op2
0
1
2km

The uppermost complex is composed of two till horizons (gB_2 and gB_1), two series of fluvioglacial sediments (fgB_2 and fgB_1), the higher one with surface forms (kame, esker, accumulative moraine, etc.) and of ice-dammed lake series (zB). According to TL dating (14.9±2 – 23.0±3 thousand years BP) and lithologic-petrographical convergence, it is probable that this complex originated in Leszno-Pommeranian Stadial of the Baltic Glaciation. In the sites in Konin vicinity two distinct glacial horizons with almost the same as noted from the tills petrographical coefficient are present. Tills from Konin sites are overlying the fluvial series dated 42.0–22.23 thousand years BP. This dating indicates their forming during the last stadial of Baltic Glaciation. The dignity of both till horizons and their mutual relations need further studies. The Bytyń borehole is the only place in Wielkopolska, where both till horizons are found together. TL datings results from both horizons are almost the same.

The next lithologic-petrographic complex is formed by two moraine horizons (gW_2 and gW_1) and fluvioglacial series (fgW). With regard to error range of the TL method, the age of both horizons is almost similar. Horizon gW_2 133±19 thousand years BP, gW_1 horizon 154–158±23 thousand years. It can therefore be stated that the 2 moraine horizons were formed during the Warta Glaciation sediments, but on the other hand we can not precise whether they are presenting two different stadials or only one facially diversified glacial horizon. In Konin vicinity, tills with lithologic-petrographical features similar to gW_2 horizon were observed and they occur there in form of two horizons of tills with identical petrography of the 10–5 mm fraction, separated by fluvioglacial sediments. They are treated as Warta Stadial (Glaciation) equivalent. According to J.Rzechowski (W.Stankowski, 1976), petrographical coefficients of Konin vicinity tills: O/K 1.11; K/W 0.94; A/B 1.01 are almost the same as in gW_1. This horizon is described by W.Stankowski as Warta horizon.

The age of remaining Pleistocene complexes, due to lack of proper TL dating, can be determined only on the basis of mutual spatial relations, comparing it with neighbouring areas and their dignity, expressed by the quality and thickness of deposited sediments.

The following complex forms in this region together with two series of fluvioglacial sediments (fgO_2 and fgO_1) and with series ice-dammed lake sediments (zO) the most thick till horizon (gO). The heavy minerals content of fluvioglacial and ice-dammed lake sediments are comparable in to till horizon gO and are forming despite partial destruction, the most thick Pleistocene complex. The thickness of till horizon gO reaches 50 m and the total thickness of fluvioglacial and ice-dammed lake

Fig. 4. Geological cross-section A–B

H – Holocene; rest: letters given left to the symbol indicate genesis of the sediment: g – tills, fg – fluvioglacial sediments, z – ice-dammed lake sediments, li – lacustrine sediments see expl. notes Fig. 3

Przekrój geologiczny A–B

H: holocen; litery z lewej strony symbolu oznaczającego wiek określają genezę osadu: g – gliny zwałowe, fg – osady wodnolodowcowe, z – osady zastoiskowe, li – osady jeziorne; pozostałe objaśnienia jak na fig. 3

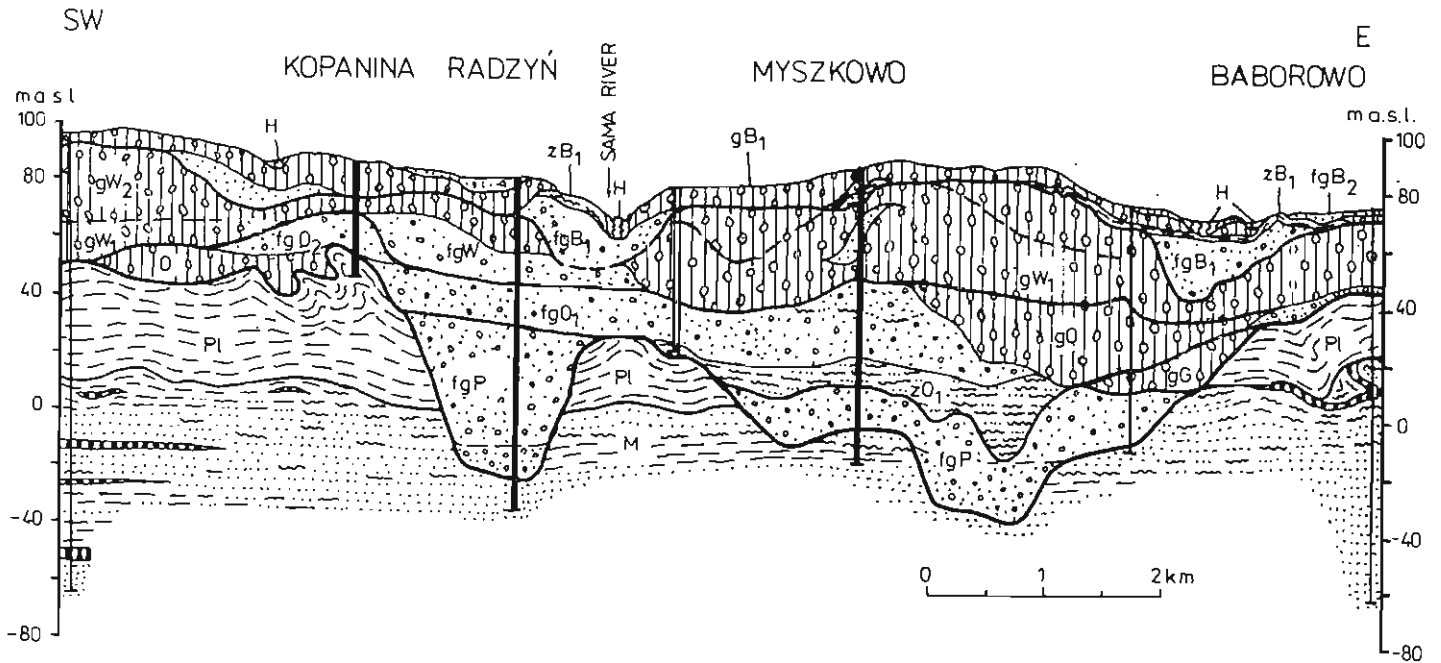


Fig. 5. Geological cross-section C – D
Explanations — see Fig. 3, 4
Przekrój geologiczny C – D
Objaśnienia jak dla fig. 3, 4

sediments series exceeds 40 m. Position of ice-dammed lake series zO and fluvioglacial fgO_1 sediments indicates, that they were formed during trangeression period. The position of fluvioglacial sediments fgO_2 indicate their forming during Odra Glaciation recession. So expressed dignity of this complex may correspond to Odra Glaciation (maximum stadial of Middle-Polish Glaciation). The same stratigraphical order of the tills, analogous to gO horizon, was implemented for neighbouring areas (B.Witek, J.A.Czerwonka, 1976; W.Stankowski, 1976)

Lacustrine sediments series (liO–W) with it's contents of the heavy minerals association refers to till horizon gO. The position of this serie between horizon of Warta tills (gW_1) in the top and a serie of Odra fluvioglacial sediments (fgO_2) indicates, that it was probably formed during interglacial period after Odra Glaciation or in interstadial period of this glaciation.

The lowermost complex of Pleistocene sediment is presented by three till horizons (gG, gP_2, gP_1) and a thick series of fluvioglacial sediments (fgP). The till (gP_2) refers to the tills noted in Konin sites, where it is considered to be related with South-Polish Glaciation. In older reports for map-sheets located south of this region the period of deposition of analogous tills was determined to younger stadial of this glaciation (B.Witek, J.A.Czerwonka, 1976). From Józefów and Mutowo region different type of till (gP_1) is reported. In Józefów it strictly underlies the till gP_2, and is separated by 1 m thickness horizon of fluvioglacial deposits. The till horizon (gP_1) from Józefów strictly refers with petrographical coefficients values to litotype II of South-Polish Glaciation till (O/K~1.00; K/W~1.10; A/B~0.80) pointed out by J.Rzechowski (1977). Tills considered by B.Witek and J. A. Czerwonka (1976) to be related with older stadial of South-Polish Glaciation have petrographical coefficients very similar to the petrographical coefficients of lower till horizon (gP_1) from Mutowo and to coefficients of South-Polish tills from Rybocice region (S.Skompski, 1988). Probably the horizon gP_1 from Józefów and Mutowo are presenting the same older stadial of South-Polish Glaciation. Quantity differences in petrographical contents may result from different weathering grade. Due to small spatial extent of this horizon and distinct traces of glaciotectonical deformations in profile of lowest Pleistocene complex (tills gP_2, gP_1 and separating and interbedding sandy series) in Józefów borehole, precise determination of stratigraphy requires further discussion and studies.

The till horizon (gG) noted in Mutowo lies between fluvioglacial series fgO_2 in top and till horizon gP_1 in the floor. This horizon is determined by petrographical coefficients and heavy minerals association. This coefficients are comparable with coefficients mentioned in the literature (J.Rzechowski, 1977; J.E.Mojski, 1985) for tills related to Wilga Glaciation. The attention was paid by the author in lithologic-petrographical study made for Szamotuły sheet (K.Choma-Moryl et al.). In new stratigraphic schemas the Wilga Glaciation terminates South-Polish Glaciations (J.E.Mojski, 1985). Lack of data on spatial extent of tills of this type and lack of

glaciation horizons with similar lithologic-petrographical features in Western Poland makes further studies and discussions necessary.

HOLOCENE

The youngest sediments cover a big part of the region and are presented mainly by muds, gyttja, limnic chalk and peats. The sediments are reaching the biggest thickness (5–8 m) in glacial channel, valleys, limnic bassins and depressions. Three samples of ^{14}C dating were obtained. The first one was obtained from gyttja bottom overlayed by peats in ancient limnic bassin in Żukowo vicinity. The result 10 350±150 years BP determines probably the begining of Holocene organic sedimentation, limit between Younger Dryas and Preboreal. The second dating (5380±130 years BP) obtained from bottom of peats filling the Sama valley in Radzyń, determines the end of climatical optimum of Holocene. One of the youngest sediments was stated within Samica flood plain terrace near Przeciwnica (Fig. 1). The sample for dating was obtained from peats in sandy muds. The result obtained indicates the age of 790±70 years BP.

CONCLUSIONS

As a result of new data and new investigations, a more detailed stratigraphy of the Quaternary of Szamotuły and Buk region is presented.

The report gives the charakteristics of 3 till horizons formed probably during the South-Polish Glaciation period. The order and position of these horizons, especially the position of the gP_1 and gG horizons as well as the position of fluvioglacial series is still not clear enough and needs further discussions and investigations.

Report includes the characteristics of the sediments of Odra Glaciation composed of series of fluvioglacial and lake-dammed sediments and of 1 till horizon as well as characteristics of the sediments of Warta Glaciation presented by 2 till horizons. Further investigations must be conducted to precise if these sediments are presenting different stadials or the same glacial horizon.

From the horizon of sediments formed during Leszno-Pommeranian Stadial of the Baltic Glaciation 2 horizons varying in lithology and petrography have been described. They are only locally noted from a narrow zone on the back of the maximal extent of Poznań Phase of this stadial. Their relation and position needs further investigations.

In Mutowo lake deposits were noted. Probably they were formed during interglacial period after the Odra Glaciation or in the interstadial period of this glaciation. The pollen spectra analyses do not precise their age.

Numerous and big in intervals breaks in sedimentation (corresponding to interstadial and interglacial period) indicate the intensivity of destruction processes re-

lated with tectonical uplifting of the middle part of Wielkopolska Lowland and with local neotectonic processes.

Acknowledgement. I would like to thank doc. dr S.Skompski and dr J.Rzechowski of the State Geological Institute Warsaw, Poland for a helpful review and discussion.

Translated by A. Strzelecka

Zakład Kartografii Geologicznej
Państwowego Instytutu Geologicznego
Warszawa, ul. Rakowiecka 4
Received:27.02.1991

REFFERENCES

BARTKOWSKI T. (1962) – Próba kartograficznego ujęcia geomorfologii okolic Buka, Szamotuł i Skoków. Pr. Kom. Geogr.-Geol. Wydz. Mat.-Przyr. Pozn. Tow. Przyj. Nauk, 3, z.3.

GOGOŁEK W. (1990) – Szczegółowa mapa geologiczna Polski, ark. Szamotuły 1:50 000. (in Polish only).

GOGOŁEK W. (in print) – Objaśnienia do Szczegółowej mapy geologicznej Polski w skali 1:50 000, ark. Szamotuły. Państw. Inst. Geol. Warszawa.

MOJSKI J.E. (1985) – Quaternary. Geology of Poland; vol. 1. Stratigraphy, part 3b, Cainozoic. Inst. Geol. Warszawa.

SKOMPSKI S. (1988) – Objaśnienia do Szczegółowej mapy geologicznej Polski w skali 1:50 000, ark. Rybocice. Państw. Inst. Geol. Warszawa.

STANKOWSKI W. (1976) – Homogenity–heterogenity of Glacial Tills in Kleczew Plain near Konin. Zesz. Nauk. UAM., Ser. Geogr., nr 12, p. 238.

RZECHOWSKI J. (1977) – Main lithotypes of tills in the Central Polish area. Biul. Inst. Geol., 305, p.31–42.

WALKIEWICZ Z. (1984) – Trzeciorzęd na obszarze Wielkopolski. UAM, Ser. Geol., nr 10.

WITEK B., CZERWONKA J. A. (1976) – Granulometrical and petrographical studies on tills of Southern Poland. Zesz. Nauk. UAM, Ser. Geogr., nr 12, p.123–127.

Waldemar GOGOŁEK

CZWARTORZĘD OKOLIC SZAMOTUŁ I BUKA (NIZINA WIELKOPOLSKA)

Streszczenie

Podstawą podziału stratygraficznego czwartorzędu była analiza materiałów archiwalnych, wyniki kartowania geologicznego na obszarze ponad 600 km^2, badania palinologiczne (H. Winter, B. Słodkowska),

litologiczno-petrograficzne (K. Choma-Moryl i in., D. Krzyszkowski, J. Czerwonka) oraz datowania TL (J. Butrym) i ^{14}C (M.F. Pazdur).

Obszar tworzą dwa pozuimy wysoczyznowe: niższy (70–75 m n.p.m.) i wyższy (80–108 m n.p.m.) urozmaicony licznymi pagórkami moren, kemów i ozów. Wysoczyzny rozcinają liczne rynny subglacjalne. Przez południową część obszaru przebiega równoleżnikowa strefa maksymalnego zasięgu fazy poznańskiej stadiału leszczyńsko-pomorskiego zlodowacenia bałtyckiego (fig. 1).

Na powierzchni podczwartorzędowej (fig. 2) zbudowanej głównie z utworów pliocenu stwierdzono wychodnie miocenu. Stropową część miocenu tworzą piaski, węgiel brunatny, mułki i iły powstałe prawdopodobnie w górnej części miocenu środkowego i dolnej części miocenu górnego. Pliocen to głównie iły szaro-zielone, niebieskie, szare i pstre. Wyniki badań palinologicznych wskazują, że w otworach badawczych nawiercono osady środkowego lub dolnego pliocenu. Deniwelacje powierzchni podczwartorzędowej dochodzą do 160 m. Pierwotna powierzchnia, po zakończeniu sedymentacji plioceńskiej, wznosiła się na wysokość około 50 m n.p.m. W morfologii dominują głębokie rynny (doliny) kopalne Samy i Samicy.

Wśród utworów plejstocenu wyróżniono 8 poziomów glin zwałowych i szereg serii wodnolodowcowych i zastoiskowych, które prawdopodobnie należą do 4 odmiennych kompleksów odpowiadających różnym piętrom plejstocenu (fig. 3–5).

Do najwyższego kompleksu zaliczono dwa poziomy glin: gB2 i gB1 wraz z nawiązującymi do niego zespołem minerałów ciężkich seriami wodnolodowcowymi fgB2, fgB1 i zastoiskową zB. Dla poziomu gB1 współczynniki petrograficzne wynoszą: O/K~1,10, K/W~1,10, A/B~0,90, a dla poziomu gB2 O/K~1,30, K/W~0,85, A/B~1,10. W poziomie dolnym gB1 w zespole minerałów ciężkich przeważają granaty ≥ amfibole, a w poziomie górnym gB2 amfibole ≥ granaty. Zróżnicowanie glin tego kompleksu stwierdzono tylko w wąskiej strefie na zapleczu maksymalnego zasięgu fazy poznańskiej. Datowania TL uzyskane z tych osadów zawierają się w granicach od 14,9 ±2 do 23± 3 tys. lat BP. Kompleks ten powstał w czasie stadiału leszczyńsko-pomorskiego zlodowacenia bałtyckiego.

Kolejny kompleks tworzą dwa poziomy glin gW1 i gW2 oraz seria wodnolodowcowa fgW. Współczynniki petrograficzne wynoszą: O/K~1,70, K/W~0,60, A/B~1,60 (dla poziomu gW2) i O/K~1,25, K/W~0,90, A/B~0,90 (dla gW1). W zespole minerałów ciężkich w poziomie gW2 przeważają amfibole ≥ granaty, a w poziomie gW1 i serii wodnolodowcowej fgW granaty ≥ amfibole. Dla utworów tego kompleksu uzyskano datowania TL w granicach od 133±19 do 154—158 ±23 tys. lat BP. Kompleks ten powstał w okresie zlodowacenia warty.

Następny kompleks tworzą: poziom glin gO, 50 m miąższości, serie wodnolodowcowe fO1, fO2 i seria zastoiskowa zO. W zbliżonych do siebie zespołach minerałów ciężkich przeważają amfibole ≥ granaty. Współczynniki petrograficzne dla glin gO wynoszą: O/K~0,80, K/W~1,35, A/B~0,70. Przypuszczalnie ten najbardziej miąższy kompleks powstał w okresie zlodowacenia odry.

W Mutowie stwierdzono serię osadów jeziornych liO-W złożoną z piasków drobno- i różnoziarnistych z przewarstwieniami mułków i torfów. Seria ta nawiązuje składem zespołu minerałów ciężkich do poziomu glin odrzańskich gO. Przypuszczalnie seria ta powstała w okresie interglacjalnym po zlodowaceniu odry lub w okresie interstadialnym w czasie tego zlodowacenia.Stwierdzone spektra pyłkowe nie dają podstaw do jednoznacznego określenia wieku tej serii.

Najniższy, mało miąższy i nieciągły kompleks tworzą trzy poziomy glin zwałowych gG, gP2 i gP1 oraz seria osadów wodnolodowcowych fgP, nawiązująca do nich składem zespołu minerałów ciężkich. Współczynniki petrograficzne dla tych poziomów wynoszą: O/K~1,00, K/W~1,07, A/B~0,90 (dla gP1 w Józefowie), O/K~0,58, K/W~1,88, A/B~0,48 (dla gP1 w Mutowie różnica prawdopodobnie wynika ze zmian wywołanych wietrzeniem), O/K~1,25, K/W~0,80, A/B~1,10 (dla poziomu gP2) i O/K~1,79, K/W~0,59, A/B~1,59 (dla poziomu gG). W poziomie gG w zespole minerałów ciężkich granat wyraźnie przeważa nad amfibolem, a w poziomach gP1 i gP2 dominują granaty i amfibole w zbliżonych proporcjach i zmiennej przewadze. Autorzy opracowania litologiczno-petrograficznego (K. Choma-Moryl i in.) sugerują, że poziom gG nawiązuje cechami petrograficznymi do glin zlodowacenia wilgi. Natomiast gliny poziomów gP1 i gP2 wykazują cechy zbliżone do poziomów lodowcowych stwierdzonych w odkrywkach konińskich i rejonie Rybocic (S. Skompski, 1988) a zaliczonych tam do zlodowacenia południowopolskiego.

Ranga i wzajemne relacje pomiędzy poszczególnymi poziomami glacjalnymi (gB1–gB2, gW1–gW2, gG, gP1–gP2) wymagają dalszej dyskusji i badań.

Dla osadów holoceńskich reprezentowanych tu głównie przez namuły piaszczyste, gytie, kredę jeziorną i torfy uzyskano szereg datowań ^{14}C. Data 10 359±150 lat BP wyznacza początek organicznej akumulacji holoceńskiej, uzyskano ją ze spągu gytii wypełniających niecką jeziorną w Żukowie. Ze spągu torfów wypełniających dolinę Samy pod Radzyniem uzyskano datę 5380±130 lat BP; wyznacza ona schyłek optimum

klimatycznego holocenu. Osady tarasu zalewowego doliny Samicy pod Przeciwnicą powstały niemal współcześnie (790±70 lat BP).

Liczne luki stratygraficzne, obejmujące długie okresy (głównie interstadialne i interglacjalne) plejstocenu, świadczą o intensywności procesów niszczących. Prawdopodobnie intensywność ta miała związek z wielkopromiennym wypiętrzaniem środkowej części Wielkopolski w plejstocenie i lokalnie z nasileniem procesów neotektonicznych.