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Palaeogeography of the Upper Carboniferous coal-bearing deposits in NE part of the Intra-Sudetic Depression

Development of palaeogeography of the coal-bearing productive deposits of the Upper Carboniferous (the Wałbrzych and the Žacler Formations) is presented. Main parameters characterizing the coal-bearing series (thickness, coal-bearing potential, content of coarse-grained material) have been analysed. Resulting from this analysis the possible palaeogeographic situation from the lowest Namurian to the Lower Westphalian C is presented on six figures. Sedimentation of the productive series displayed a fluvial character.

INTRODUCTION

An attempt to present the palaeogeographic development of the Upper Carboniferous coal-bearing deposits in the NE part of the Intra-Sudetic Depression is the aim of the present paper. A set of palaeogeographic maps was assembled, aiming at presentation of the sedimentary development of the area and selecting the zones of dominance of channel or overbank facies. Data for map construction came from the analysis of borehole profiles, mining material and field work (pits) conducted in the area of the depression. The degree of geological understanding is variable, but is best in the area of hard coal exploitation, i.e. between Borówno and Głuszyca (the Wałbrzych region) and between Ludwikowice and Bożków (the Nowa Ruda region).

Palaeogeography of the deposits of the Wałbrzych and Žacler Formations is discussed in the present paper. It should be stressed here that the accepted lithostratigraphic division is not adequate to the formal demands. It is, however, frequently applied in the depression area — on the Polish side, in the 1:25 000 scale map legends, on the Czech side, in the monograph by R. Tásler *et al.* (1979, for example "odolovske souvrstvi").

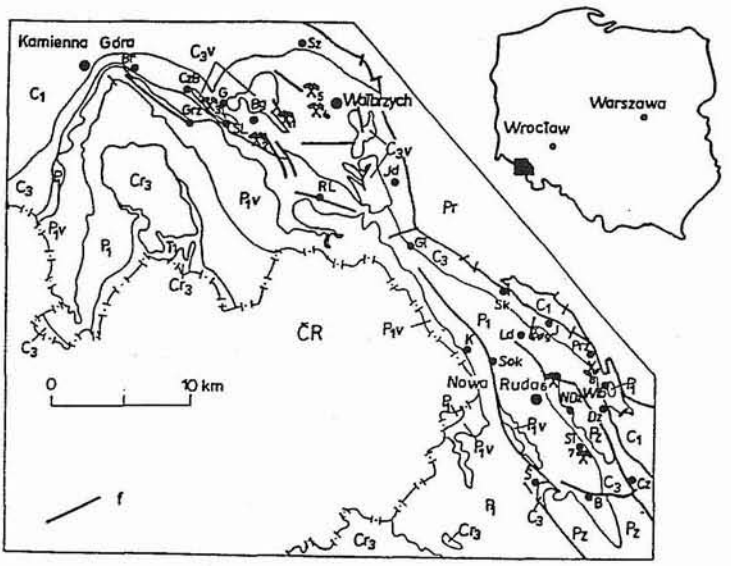

Fig. 1. Geological sketch-map of the Polish part of the Intra-Sudetic Depression
Pr — Precambrian — gneisses; Pz — Lower Palaeozoic — phyllites, amphibolites, gabbros; C_1 — Lower Carboniferous — conglomerates, sandstones; Upper Carboniferous: C_3 — conglomerates, sandstones, mudstones, siltstones, hard-coal seams, C_3v — rhyolites, trachybasalts; Lower Permian: P_1 — sandstones, conglomerates, mudstones, P_1v — rhyolites, trachybasalts; T_1 — Lower Triassic — sandstones; Cr_3 — Upper Cretaceous — sandstones; f — faults; Bg — Boguszów, Br — Borówno, B — Bożków, CzB — Czarny Bór, Cz — Czerwieńczyce, Dz — Dzikowiec, NDz — Nowy Dzikowiec, Gł — Głuszyca, G — Gorce, Grz — Grzędy, Jd — Jedlina Zdrój, J — Jugów, K — Krajanów, Ld — Ludwikowice, Prz — Przygórze, RL — Rybnica Leśna, S — Ścinawka Średnia, Sł — Słupiec, Sk — Sokolec, Sok — Sokolica, SL — Stary Lesieniec, Sz — Szczawno, Wlb — Wolibórz; Victoria mine: 1 — Victoria field, 2 — Barbara field, 3 — Witold field; 4 — Wałbrzych mine; 5 — Julia mine (late Thorez); Nowa Ruda mine: 6 — Piast field, 7 — Słupiec field, 8 — Bolesław field, 9 — Wacław field

Szkic geologiczny polskiej części depresji śródsudeckiej
Pr — prekambr — gnejsy; Pz — starszy paleozoik — fyllity, amfibolity, gabro; C_1 — karbon dolny — zlepieńce, piaskowce; karbon górny: C_3 — zlepieńce, piaskowce, mułowce, iłowce, węgiel kamienny, C_3v — ryolity, trachybazalty; perm dolny: P_1 — piaskowce, zlepieńce, mułowce, P_1v — ryolity, trachybazalty; T_1 — dolny trias — piaskowce; Cr_3 — górna kreda — piaskowce; f — uskoki; kopalnia Victoria: 1 — pole Victoria, 2 — pole Barbara, 3 — pole Witold; 4 — kopalnia Wałbrzych; 5 — kopalnia Julia (dawniej Thorez); kopalnia Nowa Ruda: 6 — pole Piast, 7 — pole Słupiec, 8 — pole Bolesław, 9 — pole Wacław

BACKGROUND GEOLOGY

STRATIGRAPHY

According to hitherto existing opinions, development of the coal-bearing deposits in the north-eastern part of the Intra-Sudetic Depression was joined with several basins (e.g., the Wałbrzych Basin, the Jugów – Nowa Ruda Basin). Detailed sedimentological studies conducted in the last years in the Wałbrzych region have proved that the sedimentation was of river origin (W. Nemec, 1984; K. Mastalerz, 1990). According to that statement, the

Table 1

Stratigraphy and synonymy of coal seams from the Upper Carboniferous productive deposits in the NE part of the Intra-Sudetic Depression

Age				Deposits		Synonymy of seams			
						Wałbrzych region	Nowa Ruda region		
							Wacław field	Piast field	Słupiec field
Carboniferous	Upper	Westphalian	C	Glinik Formation					
			B	Žacler Formation (Žacler Beds)	upper part	from 301 to 322	301 302 304	301 302 304	301 302 303 304 305 306 307 308
			A		lower part	from 423 to 448	405 406 407 408 409 410 412 413 414 415	405 410/1 410/2 412 413 415/1 415/2 415/3 to 425	409 410 411 412 413 414 415
		Namurian	C	Biały Kamień Beds		549 550			
			B	Wałbrzych Formation (Wałbrzych Beds)	Nowa Ruda region Erzgebirge phase?	from 655 to 680	Erzgebirge phase?		
			A				from 601 to 632		
	Lower	Visean		Sudetic phase					
				Szczawno Formation					

formation of coal seams is connected with the existance of alluvial plains where peat-bogs developed. Localization of the peat-bogs displayed multifold change in time together with

changes of the run of the river channels separated by interfluves which underwent denudation. More detailed information on lithology and stratigraphy of the coal-bearing deposits is given in the part on evolution of the sedimentary basin and in Table 1.

SYNONYMY OF SEAMS

A short discussion on synonymy of the seams has a complementary significance to the stratigraphic table (Table 1).

The numbers of the seams were introduced in the 70'. An appropriate correlation of the seams done that time was mostly based on data from working and abandoned mines. The last twenty years have brought an increase in the amount of information due to numerous boreholes drilled along the dip of the coal-bearing series. This fact, together with new stratigraphic studies (especially numerous determinations of macroflora in the boreholes examined by I. Lipiarski) as well as results of the palaeogeographic analysis conducted by the present paper's authors (A. Bossowski, A. Ihnatowicz, 1991), suggest that modification of the obligatory synonymy of the seams is necessary. In the opinion of the present authors, that synonymy should be as it is shown in Table 1.

It should be emphasized here that a strict correlation of the seams will never be possible due to the relationship of coal-seam sedimentation with different river systems, i.e. seams in the Wałbrzych and the Nowa Ruda regions which do not have exactly the same character are equally numbered.

TECTONICS

Tectonic understanding of the Intra-Sudetic Depression is not uniform, being best in the areas of hard-coal exploitation.

Results from hitherto conducted studies indicate that main faults display mostly NW–SE directions, also close to W–E in the Wałbrzych region (comp. with Fig. 1). In general, there are normal faults with a displacement from tens to several hundred meters (e.g. the Krajanów – Ścinawka Fault). They dip from 90 to 30°. Results from the cartographic works of the present authors in the Jedlina Zdrój vicinity indicate that strong faulting is probably typical for the whole area of the depression. That situation complicates the correlation of the lithostratigraphic levels between different points.

Dips of strata are, in general, equal to 20°, locally reaching 50–90° in the neighbourhood of the rhyolite intrusions near Wałbrzych, and 40–50° in the area between Głuszyca and Ludwikowice.

METHODOLOGY

The fluvial or, occasionally, lacustrine character of these deposits is generally known. The aim of the palaeogeographic reconstruction, therefore, was to find zones displaying a dominance of channel deposits, areas of alluvial plains, denudation areas, alluvial fans, and lakes as well as to determine dominant directions of transport of the coarse-grained material,

all for the determined time interval. To reach those aims — for particular fragments of the Upper Carboniferous profile — numerous maps at the same scale but from different times were compared. The mutual comparison resulted in significant palaeogeographic conclusions. Three factors were analysed, namely: variations in thickness, content of coarse-grained material and coal-bearing potential. In many cases, because of difficulties in determination of the proper thickness following strong dislocation of the series, maps were composed for small, undisturbed intervals and were the basis for the longer-term maps using the method of a positive superposition. This means, therefore, that more maps were studied than is suggested by the palaeogeographic schemes presented in the paper (Figs. 2–7).

Typical types of dependence between different parameters were taken into account when drawing palaeogeographic conclusions, namely:

— elongated zones displaying big thickness and a high content of coarse-grained material or significant conglomerate percentage and low coal-bearing potential, which correspond to areas dominated by channel deposition;

— zones, adjacent to those above mentioned ones, displaying medium thickness, low content of the coarse-grained material, high coal-bearing potential or high percentage of mudstones and claystones, which may correspond to alluvial plains;

— zones characterized by low coal-bearing potential, great thickness and a lot of coarse-grained material, and in which the last two parameters sharply decrease in the same direction may correspond to alluvial fan;

— zones displaying low thickness, low coal-bearing potential and low content of coarse-grained material (high amounts of mudstone and claystone) which may correspond to partly flooded areas (lakes, dammed lakes).

The determination used, as "low or high thickness", "low coal-bearing potential" etc. generally have a totally relative character and refer only to the variation of the parameters present in the area analysed and the temporal fragment of the profile discussed.

EVOLUTION OF THE SEDIMENTARY BASINS

Evolution of the sedimentary basins is indicated by the palaeogeographic schemes of this Upper Carboniferous period (Figs. 2–7). Studied materials come mainly from two regions of Wałbrzych and Nowa Ruda where coal exploitation has been conducted for many years. That is why the description shown below will be presented for both regions separately although it is not excluded that in some time intervals (e.g., at the end of the Westphalian B) those regions formed one sedimentary basin (comp. with Fig. 7).

THE WAŁBRZYCH REGION

THE WAŁBRZYCH FORMATION — THE WAŁBRZYCH BEDS

Deposits of the Wałbrzych Formation, displaying thickness up to 320 m are represented in the most typical sequence by mudstone-sandstone deposits, with light-grey conglomerates built mainly from quartz and quartzites (so-called quartz conglomerates) at the

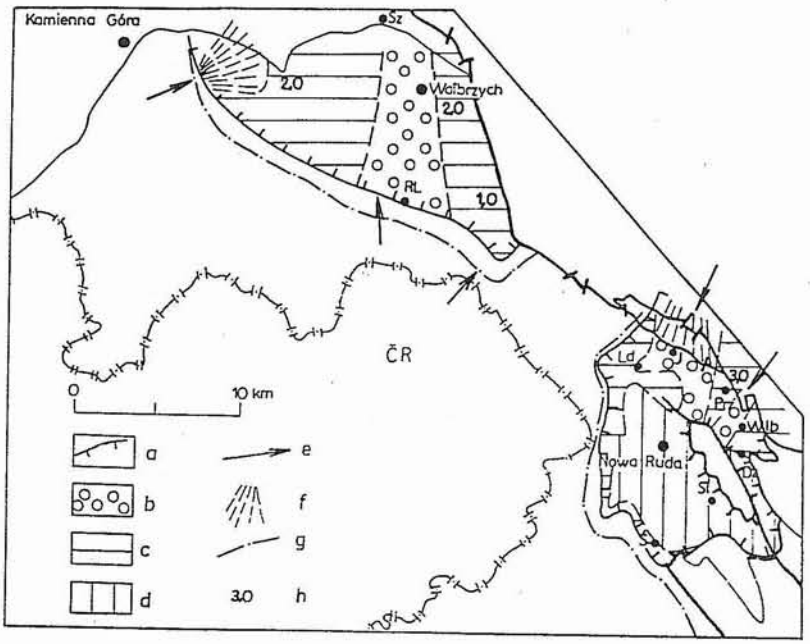

Fig. 2. Palaeogeographic sketch-map, Lower Namurian A, Wałbrzych Formation
a — present extent of deposits; b — zones of prevailing channel deposition; c — zones of prevailing extra-channel deposition; d — zones of prevailing lacustrine deposition; e — main transport directions of coarse material; f — alluvial fans; g — primary extent of deposits occurrence; h — mean coal amount in meters; other explanations as in Fig. 1
Szkic paleogeograficzny, dolny namur A, formacja wałbrzyska
a — dzisiejszy zasięg osadów; b — strefy o przewadze sedymentacji korytowej; c — strefy o przewadze sedymentacji pozakorytowej; d — strefy o przewadze sedymentacji jeziornej; e — kierunki transportu materiału gruboklastycznego; f — stożki napływowe; g — pierwotny zasięg występowania osadów; h — średnia węglonośność w metrach; pozostałe objaśnienia jak na fig. 1

bottom, and by a series of mudstones and claystones with coal seams at the top. Twenty-six seams have been stated in maximum (numbers of 655–680, Tab. 1).

Tectonic movements of the Sudetic phase, which preceded sedimentation under description, occurred in two stages according to informations from the last few years, especially from borehole data.

In the first stage of movements, in the Upper but not the uppermost Visean, general uplift of the north-eastern part of the Intra-Sudetic Depression occurred. It resulted in regression of the Upper Visean sea and a change of depositional character from marine to fluvial or lacustrine. So-called "transition beds" of thickness reaching 100 m are the deposits from that time. Those deposits do not generally contain coal, but they are more similar to the superimposed coal-bearing series than to the Lower Carboniferous Culm from Szczawno. They have been found in some boreholes in the Wałbrzych region underlying the lowest coal seams of the Wałbrzych Beds. According to H. Teisseyre (1961), the presence of those deposits was the proof for a lack of a distinct

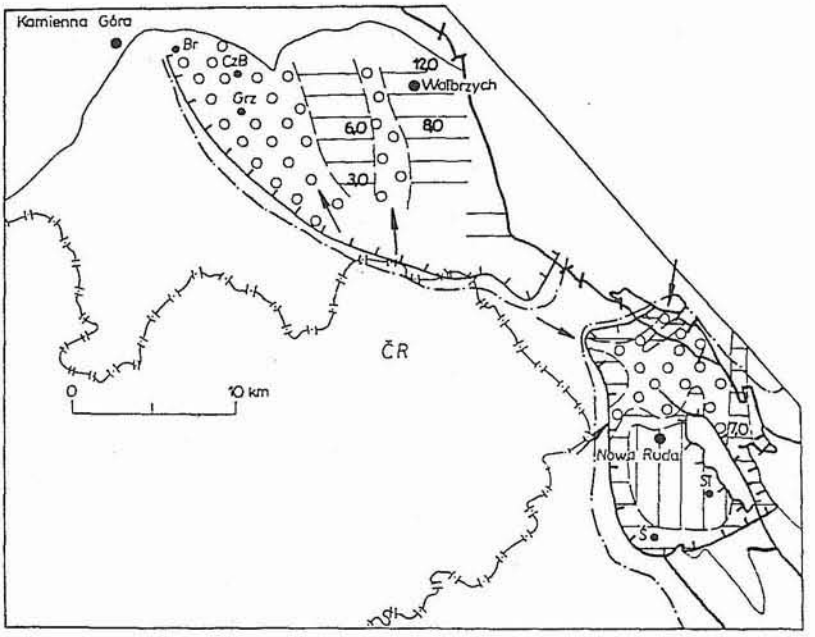

Fig. 3. Palaeogeographic sketch-map, Upper Namurian A/Lower Namurian B, Wałbrzych Formation
Explanations as in Figs. 1 and 2
Szkic paleogeograficzny, namur górny A/namur dolny B, formacja wałbrzyska
Objaśnienia jak na fig. 1 i 2

discordance due to the Sudetic phase. In reality, such a discordance may occur in the lower parts of the sequence between the transition beds and the typical Lower Carboniferous deposits.

The second stage of the Sudetic phase occurred in the Lower Namurian. It was characterized by the occurrence of vertical movements which produced variable relief in the area (Fig. 8). The movements discussed, resulted in the formation of the series of quartz conglomerates the area studied during the lowermost Namurian.

Phytogenic sedimentation began along the already formed river valleys after the end of the tectonic movements. The situation at this time is presented in Fig. 2. A meridional zone with channel deposits of a width of about 5 km spreading from the Rybnica Leśna vicinity in the south towards Szczawno Zdrój in the north has been reconstructed. Sedimentary material was transported generally from the south. There occurs a distinct increase in the coal-bearing potential towards the north in both sides of this zone. The extent of primary sedimentation in this direction, however, as well as in the area north-east and east of Wałbrzych is not known. In the southern and western parts it was probably limited to the palaeoslope of the not totally eroded, so-called, southern massif, the presence of which in the Upper Devonian and the Lower Carboniferous has been frequently mentioned (D. Pawlik, 1939; A. K. Teisseyre, 1968; T. Gunia, 1968).

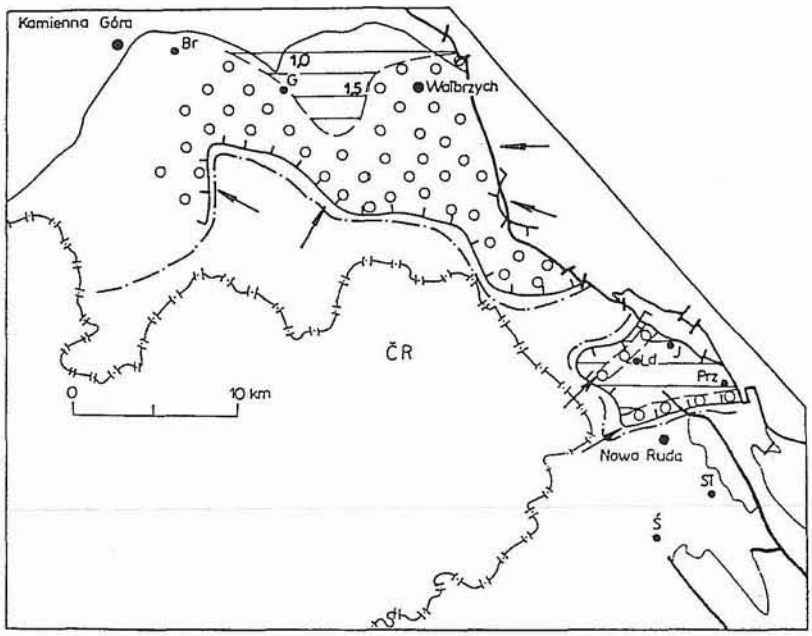

Fig. 4. Palaeogeographic sketch-map, NamurianC/ Westphalian A, Biały Kamień Beds
Explanations as in Figs. 1 and 2
Szkic paleogeograficzny, namur C/westfal A, warstwy z Białego Kamienia
Objaśnienia jak na fig. 1 i 2

The palaeogeographic situation in the upper part of the Lower Namurian is presented in Fig. 3. For this period of time, a zone of dominance of the channel deposits has been reconstructed displaying a similar orientation as the lower part of the Wałbrzych Formation, but narrower. Simultaneously, there presumably was a large supply of coarse-grained material from NW and W. Coal seams were not observed in the boreholes in the Borówno – Czarny Bór – Grzędy region unlike the sandy-conglomerate sediments similar to the quartz conglomerates from the lower part of the Namurian.

In the Upper and the uppermost Namurian, there occurred re-juvenation of the relief (an increase in energy of material transport) which has been referred to as the Erzgebirge phase by many authors. Other authors, however, deny the existence of such a phase pointing to the absence of the so-called macrofloral jump between the Namurian and the Westphalian (T. Górecka, 1968) as well as to the similar palaeogeographic situation in the period of deposition of the Wałbrzych and Biały Kamień Beds in the Wałbrzych region (W. Nemec, 1984).

THE ŻACLER FORMATION — THE BIAŁY KAMIEŃ BEDS

These deposits display thickness reaching 300 m and are represented in their bottom part by conglomerates overlain by conglomerates and sandstones with few interlayers of mudstones and claystones containing locally two coal seams (seams nos. 549 and 550 from

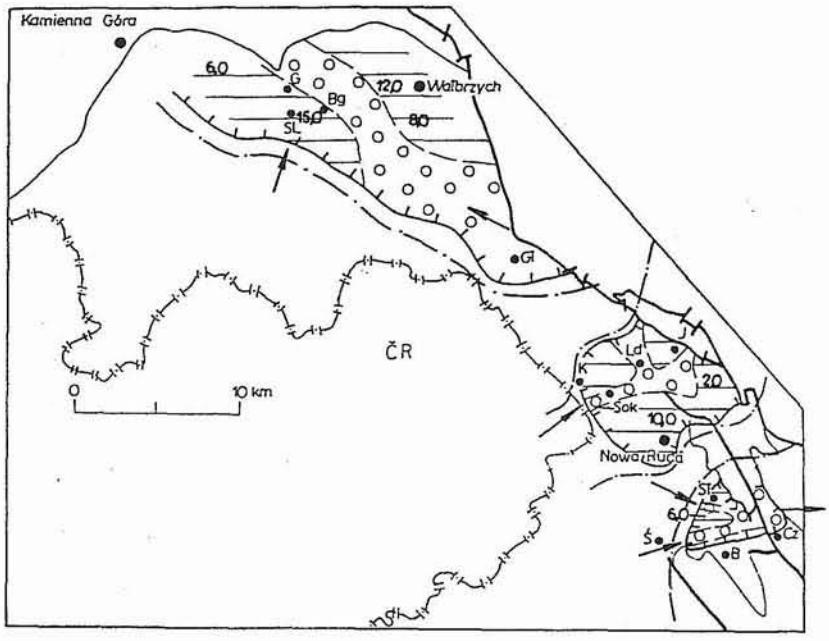

Fig. 5. Palaeogeographic sketch-map, Lower Westphalian A, Žacler Formation, lower part
Explanations as in Figs. 1 and 2
Szkic paleogeograficzny, westfal dolny A, formacja żaclerska, część dolna
Objaśnienia jak na fig. 1 i 2

the Wałbrzych and Borówno vicinity). When compared with the previous period (comp. with Fig. 3), sedimentation distinctly extended towards the west (Fig. 4). It is impossible to select a zone with a predominance of the channel deposits. Quite possibly — the area comprises numerous alluvial fans formed towards the north from the re-uplifted hypothetical southern massif (Fig. 8). The extent of primary sedimentation towards the north, north-east and west is not known. Undoubtedly sedimentation entered the structure units adjacent to the Intra-Sudetic Basin.

THE ŽACLER FORMATION — THE ŽACLER BEDS

These deposits belong to the Westphalian A and B and to the lowermost Westphalian C (A. Górecka-Nowak, 1992) and display thickness reaching 950 m. In their lower part, they are built of sandstones, conglomerates, mudstones and claystones with coal seams (seams nos. 423–448). In the upper part, there occur mainly sandstones and conglomerates interbedded by thin mudstones and claystones with coal (seams nos. 301–322). In the western part of the region discussed, i.e., between Kamienna Góra and Czarny Bór, this sequence has been disturbed due to the presence of mudstones and claystones with thin coal seams both in the lower and the upper parts.

The lower part of the deposits described (the Lower Westphalian A) was formed in similar conditions to those of Biały Kamień Beds but with a lower transport

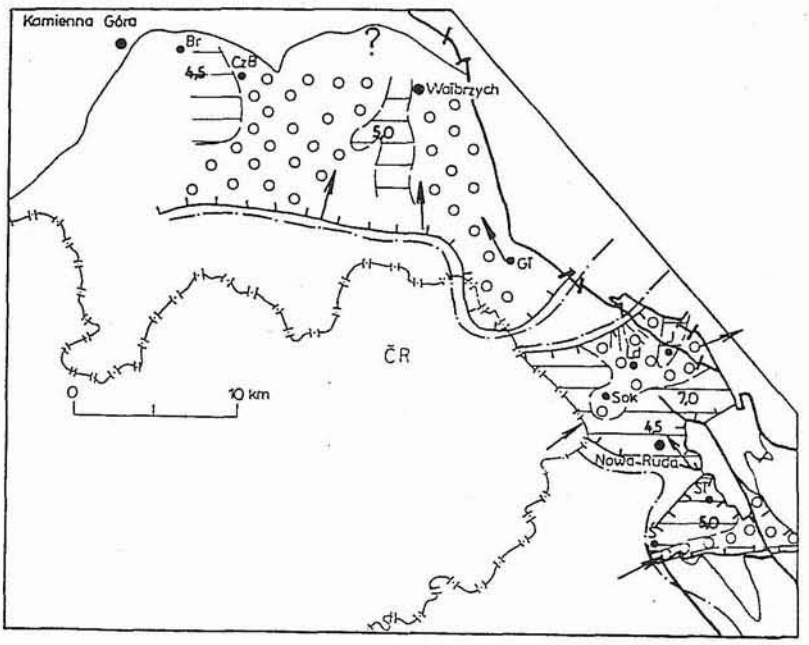

Fig. 6. Palaeogeographic sketch-map, Upper Westphalian A, Žacler Formation, lower part
Explanations as in Figs. 1 and 2
Szkic paleogeograficzny, westfal górny A, formacja żaclerska, część dolna
Objaśnienia jak na fig. 1 i 2

energy. Based on the thickness of coal seams in boreholes from the Rybnica Leśna and Unisław Śląski, the primary extent of sedimentation toward the south was presumably somewhat larger than the Biały Kamień Beds. A faint zone displaying predominance of channel deposits may be distinguished between Głuszyca and Czarny Bór (Fig. 5). South-west of this zone (the Boguszów – Gorce – Stary Lesieniec region), the best conditions for peat-bog development occurred.

A palaeogeographic situation similar to that in the Lower Westphalian A (comp. with Figs. 4 and 6) occurred in the period of formation of the upper coal seams in the lower part of the Žacler Formation (Upper Westphalian A). Only the zone with the most intensive supply of coarse-grained material moved towards the south-west.

The upper part of the Žacler Formation (the Westphalian B and C) was formed in conditions of repeated increase in the energy of material transport. Denudation of a part of the scarp separating the area discussed from the Nowa Ruda region probably occurred at this time. The best conditions for peat-bog formation were present between Czarny Bór and Borówno. That area was only slightly covered by the coarse-grained material transported generally from the south and the south-east. In the sequences of boreholes situated north of this region, the boundary between the Westphalian A and B is nearly not seen, being very distinct in the deposits of the other places. Also in the region

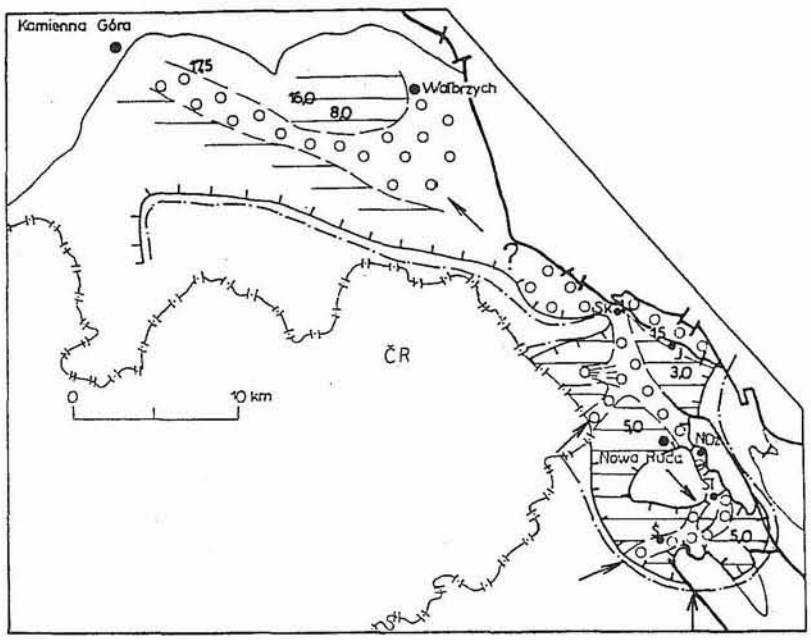

Fig. 7. Palaeogeographic sketch-map, Westphalian B/Lower Westphalian C, Žacler Formation, upper part
Explanations as in Figs. 1 and 2
Szkic paleogeograficzny, westfal B/dolny westfal C, formacja żaclerska, część górna
Objaśnienia jak na fig. 1 i 2

of Borówno and Czarny Bór the age of the uppermost part of the Žacler Beds has been demonstrated as Westphalian C (A. Górecka-Nowak, 1992).

Based on the palaeogeographical reconstruction presented above, it seems to be possible that in this region the time-span of conditions favourable for the formation of the peat-bogs was the longest (Fig. 7).

THE NOWA RUDA REGION

THE WAŁBRZYCH FORMATION — THE WAŁBRZYCH BEDS

Deposits of the Wałbrzych Formation of thickness reaching 350 m are represented in their bottom part by a series of argillites, kaolinite and siderite shales in the area south of Nowa Ruda, and conglomerates and quartz-gabbro sandstones in the east (between Ludwikowice and Dzikowiec).

The upper part of those deposits in the western part was probably formed as an argillite-shale series, but was eroded before formation of the coal-bearing series of the Žacler Beds. In the eastern part, there occur fine-grained sandstones, mudstones and claystones which contain up to 32 coal seams exploited in the Bolesław mine (Fig. 1).

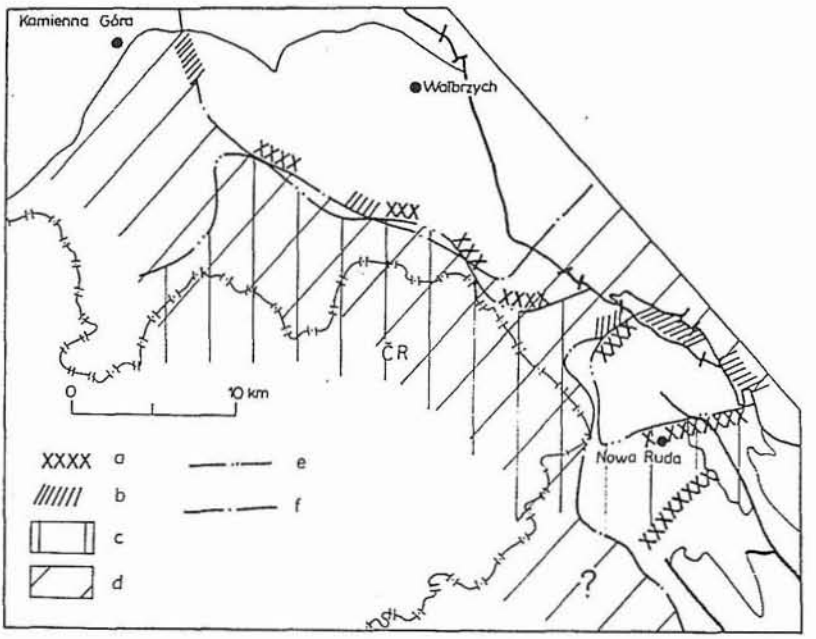

Fig. 8. Sketch-map of tectonic development of the NE part of the Intra-Sudetic Depression during lower part of Upper Carboniferous
a — significant movement during Góry Kruszcowe phase; b — significant movement during Sudety phase; c — uplifted area resulted from Góry Kruszcowe phase; d — uplifted area resulted from Sudety phase; e — extent of deposits after Góry Kruszcowe phase (see Fig. 2); f — extent of deposits after Sudety phase (see Fig. 4)
Szkic rozwoju tektonicznego NE części depresji śródsudeckiej w niższej części karbonu górnego
a — strefy mobilne fazy Gór Kruszcowych; b — strefy mobilne fazy sudeckiej; c — obszary wypiętrzone w wyniku ruchów fazy Gór Kruszcowych; d — obszary wypiętrzone w wyniku ruchów fazy sudeckiej; e — zasięg występowania osadów bezpośrednio po ruchach fazy Gór Kruszcowych (por. fig. 2); f — zasięg występowania osadów bezpośrednio po ruchach fazy sudeckiej (por. fig. 4)

In the first phase of the Sudetic movements of the Variscan orogeny in the U p p e r V i s e a n , due to regression, numerous lakes were formed in the area underlain mainly by basic rocks (gabbros, diabases, amphibolites and serpentinites). Products of the chemical weathering of those rocks, such as argillites, bauxites, kaolinite shales (refractory shales) and siderite shales, were formed in these lakes. The age of the deposits was evidenced as the boundary of the Namurian and Visean (I. Lipiarski, 1973; A. Bossowski, S. Jachowicz, 1987). Some volcanic events are connected with that period. T. Kapuściński (1968) was the first who suggested the possibility of altered volcanic glass present during the formation of the shales. That hypothesis seemed to be surprizing then since the age of the shale series was generally accepted as Lower Westphalian. Later petrologic studies of I. Lipiarski on the samples from the argillites and refractory shales from the Słupiec field in the Nowa Ruda mine, and the studies of K. Radlicz (1989) from a borehole in Dzikowiec, supported the theory on existence of pyroclastic material in these deposits.

High relief formed during the second stage of tectonic movements of the Sudetic phase. Quartz-gabbro conglomerates were formed in the eastern part of the area discussed. The deposits formed as big fans from NW, NE and E towards the south and the west, exhibited a facies transition into the argillite-shale series (the Nowa Ruda – Słupiec region) or into the coal-bearing deposits (the Jugów – Dzikowiec region). In the second case, the boundary between the conglomerate series and the coal-bearing deposits is diachronous, i.e. it moves towards the bottom of the sequence in the south direction. The highest coal-bearing potential, therefore, is observed between Przygórze and Wolibórz. The primary extent of the deposits of the Wałbrzych Formation towards the south and south-west is not known. To the north and the south, however, the sedimentary basin probably reached the uplifted Góry Sowie Block and the geomorphologic scarps probably built of basic rocks and occurring north of Ludwikowice (comp. with Fig. 2).

In the upper part of the Lower Namurian, the energy of transport of the coarse material possibly decreased. Lacustrine sedimentation probably still continued between Nowa Ruda – Ścinawka and Słupiec (Fig. 3). Although sediments representing the upper part of the Namurian A were not documented within the argillite-shale series there, there is also no proof for existence of coal-bearing series of that age. The lithologic character of the lowermost series of the Žacler Beds in the Nowa Ruda – Słupiec region suggests that the local material (altered gabbros and diabases) was of significant importance in the formation of the beds. The possibility of covering of the argillite-shale series with the Namurian coal-bearing deposits is very unlikely.

The above mentioned movements of the Erzgebirge phase, denied by different authors, seem to be distinct in the Nowa Ruda area. Such a conclusion can be drawn from a comparison of the palaeogeography in the Namurian and Westphalian. In the Namurian, the areas of Nowa Ruda and Słupiec were integrated, while in the Lower Westphalian they were separated by a distinct scarp displaying a NE–SW trend, i.e., from the southern region of Nowa Ruda towards Ścinawka (Figs. 4–6). The extent of the Biały Kamień Beds is also completely different from that of the Wałbrzych Beds (comp. with Figs. 2, 3, 4).

THE ŽACLER FORMATION — THE BIAŁY KAMIEŃ BEDS

These deposits, of thickness rarely exceeding 50 m, are mainly represented by conglomerates and sandstones. Based on the character of the deposits observed both in the region of abandoned coal mines in Ludwikowice and Jugów and in the borehole sequences, two distinct zones displaying a dominance of the channel deposits occur (Fig. 4). Alimentation of the material came from the south-west. There is no proof up to now for the formation of these sediments in the Słupiec region. The extent of primary sedimentation of the Biały Kamień Beds was probably limited only to the region of Ludwikowice – Jugów and Przygórze. It is, however, impossible to reconstruct at present that extent towards the north-east, i.e. towards the Góry Sowie Block.

THE ŽACLER FORMATION — THE ŽACLER BEDS

The coal-bearing deposits of the Žacler Formation in the Nowa Ruda region were connected with two river systems called earlier basins. The first system spreads from the

Krajanów vicinity in SW to Jugów in NE (the Jugów – Nowa Ruda Basin), the second occurs between Słupiec and Ścinawka (the Słupiec Basin). The so-called Nowy Dzikowiec Basin has also been distinguished between Nowa Ruda and Słupiec (e.g., S. Bubnoff, 1931), but according to data from boreholes, the existance of such a basin is not confirmed.

Thickness of the deposits connected with the Jugów – Nowa Ruda system reaches 400 m. The deposits are distinctly dual. In the lower part, mainly mudstones and claystones with coal seams occur (seams nos. 405–425); in the upper part, sandstones and conglomerates are dominant with only four coal seams (nos. 301–304) present.

In the Słupiec – Ścinawka Średnia region, similar deposits occur. The Žacler Beds, however, display there a distinct thickness reduction in comparison to the Jugów – Nowa Ruda area (the maximum thickness reaches 130 m) which refers mainly to the upper part of the deposits described. Coal seams nos. 409–417 and 301–308 occur in the lower and the upper parts, respectively.

In the area of Jugów – Nowa Ruda, in the lower part of the Westphalian A, a zone with channel deposits spreading from the Krajanów vicinity in SW towards Jugów in NE can be distinguished. In the Ludwikowice region, that zone was supplied by clastic material from NW (presumably, an alluvial fan). In the interval between Krajanów and Nowa Ruda (along the channel zone), the material was transported from the south-west. K. Dziedzic (1971) drew the same conclusion.

The best conditions for a peat-bog formation were in the western part of the present Piast field (between Nowa Ruda and Sokolica). Presence of the adjacent alimentation areas, built of gabbro and its weathering products, was an additional factor which could be favourable for formation of thick coal seams (e.g., a set of seams no. 415). Periodic supplies of such material, either totally dissolved or in the form of a fine-grained clayish suspension, disturbed growth of the peat-bogs only to a small degree in the climatic conditions of that time.

Results from the reconstruction of the palaeogeography for the lower part of the Westphalian (Fig. 5) indicate that sedimentation could have developed first in the area between Ludwikowice and Jugów. According to the approximate correlation proposed at the beginning of the 70-ies, however, a completely different conclusion can be drawn since the highest of the coal seams numbers (the oldest ones) occur in the boreholes placed in the western continuation of the Piast field. It seems that the occurrence of a lower number of coal seams in the Ludwikowice – Jugów region (the oldest one no. 415) results mainly from the high energy of material transport, which, in turn, led to worse conditions for peat-bog formation in comparison to the region west of Nowa Ruda. The present paper's authors are of the opinion that the lowest coal seams west of the Piast field cannot be older than seam no. 415 in the field of the abandoned Wacław mine. Primary sedimentation of the deposits described probably extended further eastwards and entered the present Góry Sowie Block.

In the area of Słupiec – Ścinawka Średnia, in the lower part of the Westphalian A, there formed a zone dominated by channel deposits which displays a nearly parallel extent through the southern part of the Słupiec field in the Nowa Ruda mine. The material was transported from the west from Ścinawka Średnia and from the north from a scarp separating the area under discussion from the Jugów – Nowa Ruda region. Further transport occurred to the east towards Czerwieńczyce (Fig. 5). A reconstruction of the palaeogeography of the area south of the channel zone mentioned (the Bożków

region) is impossible due to the total, post-Westphalian erosion of the coal-bearing deposits there.

The lowest coal seams (nos. 414 and 415) are well developed, which may result from a proximity of the source areas built of the gabbro and diabase weathering products as in the case of the Jugów – Nowa Ruda area.

The main zone displaying a dominance of channel deposits may be observed between Sokolica and Jugów in the lithologic interval of upper coal seams of the lower part of the Žacler Formation (the Upper Westphalian A) in the Jugów – Nowa Ruda region. As in the earlier period, there occurred here a strong supply of coarse-grained material from the north-west from the morphological scarp between Głuszyca and Ludwikowice which had existed since the Namurian. Generally, an increase in the transport energy can be observed there resulting in the formation of a second, smaller zone of channel deposits in the eastern part of the Piast field.

In the Słupiec – Ścinawka Średnia region, directions of the material supply are observed similar to those in the earlier period, as well as more significant transport from the north, i.e. from the scarp separating the area discussed from the Jugów – Nowa Ruda region (Fig. 6).

A significant increase in energy of transport occurred during development of the deposits of the upper part of the Žacler Formation (Westphalian B and C). It resulted in partial denudation of the scarp separating the Jugów – Nowa Ruda and Słupiec – Ścinawka Średnia regions discussed above. There occurred a general change in transport direction from the west to the north, with some parts of the channel deposit zones preserved (Fig. 6). Following that change in the Sokolec region, phytogenic sedimentation entered the distinct morphological scarp present up to then (coal seams nos. 301–304 in the not working Kazimierz dip-heading in Sokolec). Also, the presence of the uppermost coal seam (no. 301) near Nowy Dzikowiec indicates an interruption of the scarp which up to that time had separated the river system of Jugów – Nowa Ruda and Słupiec – Ścinawka Średnia. Based on borehole data, there is no reason for distinguishing a so-called Nowy Dzikowiec Basin as a totally separated fluvial system.

CONCLUSIONS

The following conclusions can be drawn from the discussion on the development of the sedimentation of the Upper Carboniferous deposits (without the uppermost part):

1. Thickness, coal-bearing potential and content of coarse-grained material point mainly to a fluvial character of sedimentation. As for the Wałbrzych region, the palaeogeographic reconstruction presented is (to a great extent) convergent with data from sedimentologic studies (W. Nemec, 1984; K. Mastalerz, 1990).

2. Tectonic movements of the Sudetic phase occurred in two stages: the first in the uppermost Visean, and the second, after a short sedimentation period, in the lowermost Namurian. The second tectonic stage was followed by creation of two separated sedimentation territories, i.e., the Wałbrzych and the Nowa Ruda areas. They were separated by a scarp which could have remained from the so-called southern massif described by many authors. Presence of numerous alluvial fans in the neighbourhood of that scarp suggests

that the area was active through the whole Namurian and the Lower Westphalian and displayed a constant tendency of uplift.

3. Movements of the Erzgebirge phase (the significance of which is denied or minimized by many authors) occurred in the area studied, their variable influence on the later palaeogeography was probably due to the differing lithologies of the basement of the Upper Carboniferous. The influence of these movements is, therefore, most clear in the Nowa Ruda region, where the basement was built of rigid rock masses (gabbros, diabases, amphibolites, serpentinites). In the uppermost Namurian or the lowermost Westphalian between Nowa Ruda and Słupiec a distinct scarp was formed, displaying an uplift tendency through the whole Westphalian.

4. Starting from the Westphalian B, rapid denudation of the scarps began to the connect the separated fluvial systems, especially in the Nowa Ruda region. A conjunction of the Wałbrzych and Nowa Ruda regions could have formed then, too.

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PALEOGEOGRAFIA UTWORÓW WĘGLONOŚNYCH GÓRNEGO KARBONU W NE CZĘŚCI DEPRESJI ŚRÓDSUDECKIEJ

Streszczenie

W artykule przedstawiono historię rozwoju budowy geologicznej w NE części depresji śródsudeckiej od przełomu wizenu i namuru po początek westfalu C. Podstawą do jej odtworzenia była rekonstrukcja paleogeografii. W wyniku analizy zróżnicowania miąższości, zawartości materiału gruboklastycznego i węglonośności zestawiono 6 szkiców, na których kolejno pokazano obraz paleogeograficzny namuru A, najniższego namuru B, najwyższego namuru, najniższego westfalu, westfalu A, westfalu B oraz najniższego westfalu C. Dane do opracowania szkiców uzyskano zarówno z materiałów kopalnianych, jak i z otworów wiertniczych wykonanych na przedłużeniu po upadzie istniejących złóż.

Stwierdzono, że istniały dwa etapy ruchów fazy sudeckiej orogenezy waryscyjskiej. W pierwszym etapie, w wyższym (ale nie najwyższym) wizenie doszło do wypiętrzenia całej północno-wschodniej części depresji śródsudeckiej i wycofania się morza górnowizeńskiego. W miejsce osadów morskich powstawały osady rzeczne lub jeziorne. W okolicach Wałbrzycha były to bezwęglowe utwory piaszczysto-zlepieńcowo-mułowcowe, a w okolicy Nowej Rudy argility, boksyty, łupki kaolinitowe i syderytyczne.

Drugi etap ruchów fazy sudeckiej nastąpił w najniższym namurze. Doprowadziły one do wyodrębnienia dwóch obszarów sedymentacji fitogenicznej (dwóch systemów rzecznych): na północy — rejonu Wałbrzycha, na południu — rejonu Jugowa – Przygórza – Woliborza. Obszary te były rozdzielone dużym progiem morfologicznym. Przez cały namur A i przynajmniej niższy namur B powstawały utwory węglonośne formacji wałbrzyskiej. W wyższym namurze wystąpiły przypuszczalnie ruchy fazy Gór Kruszcowych, których oddziaływanie w rejonie noworudzkim było bardziej widoczne niż w okolicach Wałbrzycha.

W rejonie wałbrzyskim utwory najwyższego namuru i najniższego westfalu — warstwy z Białego Kamienia — tworzyły się w podobnych warunkach paleogeograficznych jak utwory dolnonamurskie, z tą różnicą, że nastąpiło rozszerzenie sedymentacji ku zachodowi. W okolicach Nowej Rudy sedymentacja warstw z Białego Kamienia zachodziła na niewielkim obszarze między Ludwikowicami – Nową Rudą a Przygórzem.

Na początku westfalu w okolicach Nowej Rudy wzdłuż linii Nowy Dzikowiec – Ścinawka Górna utworzył się próg morfologiczny, w wyniku czego wyodrębniły się dwa systemy rzeczne: na północy — system Jugowa – Nowej Rudy, a na południu — system Słupca – Ścinawki Średniej. Z systemami tymi związana była sedymentacja węglonośnych osadów formacji żaclerskiej (westfal A — najniższy westfal C). W tym samym czasie w okolicach Wałbrzycha główne strefy osadów korytowych wraz z przylegającymi do nich obszarami równi aluwialnych z torfowiskami ciągnęły się od okolic Jedliny Zdroju na południowym wschodzie w kierunku Borówna na północnym zachodzie.

Pod koniec westfalu B wskutek postępującej erozji doszło do częściowej denudacji progów morfologicznych oddzielających rejony wałbrzyski i noworudzki oraz okolice Jugowa – Nowej Rudy i Słupca – Ścinawki Średniej.