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# The comparison of microfacies character of Westphalian A and B coals in Upper Silesian and Lublin Coal Basins

The microfacies character of coal seams belonging to Westphalian A and B lithostratigraphic units from Upper Silesian and Lublin Basins was established according to results of microlithotype analises. The comparison of microlithotype composition of analysed coals from both basins suggests that they have developed in similar facies conditions generally characterized by intensive subsidence, high groundwater level and limited oxygen supply. The presence of dark, spotty vitrinite often associated with syngenetic pyrite as well as abundant, partially decomposed exinite in Lublin coals suggest more anacorobic conditions comparing to those from Upper Silesian Basin. The domination of clarite type as well as high vitrite content in both Orzesze and Lublin Beds suggest possibility of their utilization in liquifaction processes.

## INTRODUCTION

Upper Silesian and Lublin Carboniferous sediments have originated at the same time and they display some facies and floral-microfloral similarities as well as differences which cast some light on conditions of their sedimentation. Attention should be especially paid to Upper Silesian Siltstone Series and Lublin Beds. They are similar in age (Fig. 1) as well as in lithology, and microlithotype petrographic investigations allow to compare microfacies development of seams from siltstone facies from both basins. Detailed petrographic investigations of coals from the Upper Silesian Basin resulted in distinguishing several microfacial coal seam types (K. Kruszewska, 1983). These are as follows:

I. Basic type (vitrite-trimacerite) where vitrite, trimacerite or vitrinertite exceeds 15% of total composition. Other microlithotypes occur in amounts 0–14%.

II. Vitrite type which consists mostly of vitrite (exceeding 15% of total coal sample composition). Other microlithotypes groups occur in amounts less than 15%.

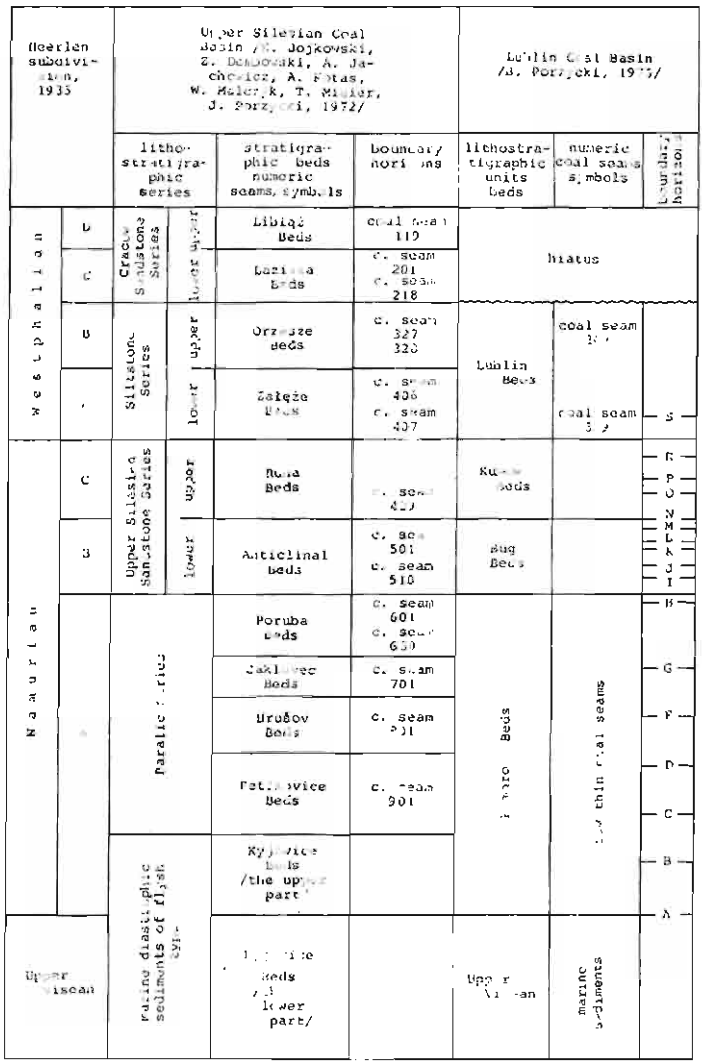



Fig. 1. The comparison of stratigraphic subdivisions of carboniferous in Upper Silesian and Lublin Basins

Porównanie podziałów stratygraficznych karbonu w Zagłębiu Górnośląskim i Lubelskim

III. Vitrite-clarite type where apart of vitrite, trimacerite, vitrinertite, also clarite occurs in amounts exceeding 15% of total coal composition.

IV. Inertite-durite type with inertite or durite (or both of them) exceeding 15%. They are usually associated with vitrite, trimacerite or vitrinertite.

V. Mixed type also exceeding 15% of total composition where clarite, durite, and inertite occur in amounts exceeding 15%.

VI. Carbominerite type – where microlithotype group composition is associated with significant amounts (15%) of carbominerite or minerite.

## LITHOSTRATIGRAPHY OF LUBLIN BASIN

In Lublin Basin Carboniferous sediments began to form in Middle Visean to continue with breaks till the Westphalian C (J. Porzycki, 1977). The Visean is known from the major part of the Basin, excluding its northern margin. Its thickness vary from nul in northern part up to 180–230 km in Lublin–Tynowce region. It is mainly developed in marine facies – limestones marls and claystones. Marine sediments are overlain by terrestial ones which contain thin coal seams, mainly in lower part of the sequence. In some areas weathered diabases were found. The top of Visean sediments in Lublin Basin is defined by the base of so called "limestone A" (Fig. 1).

K o m a r o w s k i e B e d s develop over the top of limestone A up to the top of marine horizon with *Posidonia* (Ł. Musiał, M. Tabor, 1977) or base siltstone-sandstone series with white mica agglomerations (J. Porzycki, 1977). Its thickness varies from few meters in Łuków–Międzyrzecze region up to 480 m in south-western part of the Basin. The sequence consists of thick claystone-siltstone series separated by sandstones, limestone layers as well as thin coal seams. The domination of marine sediments is regressing from the floor towards the top of the profile.

B u ż a ń s k i e B e d s start above *Posidonia* horizon (Ł. Musiał, M. Tabor, 1977) or the base of siltstone-sandstone series (J. Porzycki, 1977) to the top of limestone N and they represent continuation of Komarowskie Beds. The thickness of this seguence varies from 30–40 m in northern part of the Basin up to 220 m in its southern part. Lower part of the lithological profile consists of siltstone-sandstone layers laminated with abundant mica and middle and upper parts – of clay-sandstone sediments divided by limestone layers and coal seams.

K u m ó w B e d s develop from top of limestone N up to the base of sandstone-siltstone series below *Dunbarella* marine horizon, varying from 100–130 m in thickness in Central Coal Region and southern part of the Basin up to more than 350 m in the western part (Lublin–Dęblin). In lower and upper parts of the sequence predominate sandstones. Their total thickness reaches 40–65% of the whole seqtence. The middle part of the sequence is dominated by claystone-siltstone sediments with 13 thin coal seams of variable quality.

L u b l i n B e d s. These are the most important coal-bearing strata in the Lublin Basin, widely spread over the whole Basin. Lublin Beds are lacking only in few areas, like Rejowiec, Wierzbica–Chełm, Kock and Trawniki, in an effect of pre-Jurassic erossion. Contemporary thickness and horizontal development of Lublin Beds was stimulated by orogenetic activity during Asturian phase (Hercynian orogeny). There is stratigraphic conformity between Kumów and Lublin Beds but the latter are developed in different facies. They are characterized by frequent coal seams and they form the most important coal-bearing sequence of the Carboniferous profile.

The upper part of Lublin Beds is not precisely defined yet (A. Zdanowski, 1978). So far it is agreed to put this boundary in the proximity of seam no. 369/331. The known thickness of this sequence varies from few meters at the basin margin up to 300–400 m in axial part of Cyców syncline. The total thickness of Lublin Beds and younger sediments estimated in axial part of Stoczek–Dorohucza syncline reaches 800 m (A. Zdanowski, 1978). Lithologically Lublin Beds are composed of claystone-siltstone complexes with coal seams and thin

sandstone layers. Lublin Beds contain some 20–40 coal seams and thin layers (0.05–3.90 m thick). Coal seams thicker than 2.50 m are in minority. The total thickness of coal seams varies from 13.90 to 26.90 m and their average thickness is approximately 0.67 m. 6–17 coal seams are of economic thickness (0.80 m) and their average thickness is about 1.20 m. The most complete profile of Lublin Beds is recognized in Central Coal Region where 24 coal seams of economic value were identified (J. Porzycki, 1976).

Geological structure in this region is complicated and horizontal development of coal seams irregular. Only few coal seams can be considered as good horizons for correlation.

## MICROFACIES CHARACTERISTICS OF COAL SEAMS FROM LUBLIN BEDS

Coal seams from Lublin Basin belonging from stratigraphic point of view to Westphalian A and B have been analysed so far in three areas: Central Region, Ostrów Region and Chełm Region. The microfacies character in these regions is uniform. Detailed characteristics are given below.

### CENTRAL REGION

Twenty coal seams numbered from 391 to 369 were analyzed. They belong to following types:

III. Clarite type with varieties: vitrite-clarite, vitrite-clarite-trimacerite.

I. Basic type, vitrite-trimacerite variety.

VI. Carbominerite type with varieties: vitrite, clarite and vitrite-trimacerite connected.

IV. Intertite-durite type – durite subtype, durite-trimacerite variety.

This coal seams succession can be subdivided into two parts:

– lower (from 391 up to seam 379) which is almost exclusively composed of clarite type (Table 1); within this sequence almost pure clarite type is changing towards the upper part (seams 382 to 379) into carbominerite-clarite type (Table 1);

– the upper part of the succession is characterized by predomination of basic type (vitrite-trimacerite) with clarite type occurring occasionally (Table 1).

Apart of those two types, one example of carbominerite type, and single example of durite subtype were identified. The change of microfacies character of coal seams can indicate the change of facies environment towards subaquatic sedimentation which resulted in duroclarite formation.

### CHEŁM REGION

Coal seam succession was recognized in three boreholes. All together 33 unidentified coal seams have been analysed. Results of microlithotype analysis shows that the main microfacies type which occurs with stricking regularity is clarite type. Basic type (vitrite-trimacerite or vitrite-primary vitrinertite) is of minor importance. Only one sample of durite subtype have been identified. Inertite subtype was not identified and only one sample of mixed type was fixed up. Vitrite type was not identified at all. The microfacies features indicate predominance of monotonous subaquatic deposition during coal seams formation.

Table 1

**The distribution of microfacies varieties in coal seams from Central Region (Lublin Basin)**

| Seam number | Type varieties | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *V* | *V Ct* | *V Ct Tr* | *V Ct Cm(m)* | *V Ct Tr Cm(m)* | *V Cm(m)* | *V Tr Cm(m)* | *V Tr* | *V Vt* | *V Tr Vt* | *Tr Vt* | *V Tr Cm(m)* | *V Vt Cm(m)* | *V Vt Tr Cm(m)* | *V Dt* | *Dt Vt Tr* | *V Tr Dt* | *Tr Dt* |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 10a | 11 | 12 | 13 | 14 | 14a | 15 | 16 |
| 369 | | | | | | | | △ | | | | | | | | | | |
| 372 | | | | | | | | △ | | | | | | | | | | |
| 374 | | × | | | | | | | | | | | | | | | | |
| 375/1 – 2 | | | | | | | V | △ | | | | | | | | | ● | |
| 376 | | × | | | | | | △ | | | | | | | | | | |
| 377/1 | | | | | | | | △ | | | | | | | | | | |
| 377/2 | | | | | | | | △ | | | | | | | | | | |
| 378 | | × | | | | | | | | | | | | | | | | |
| 379 | | | | | | V | | △ | | | | | | | | | | |
| 380 | | | | V | | | | | | | | | | | | | | |
| 380/2 | | | | V | | | | | | | | | | | | | | |
| 381/1 | | | | | V | | | | | | | | | | | | | |
| 381/2 | | | × | | | | | | | | | | | | | | | |
| 382 | | | × | V | | | | | | | | | | | | | | |
| 384 | | | × | | | | | | | | | | | | | | | |
| 385/1 | | × | × | | | | | | | | | | | | | | | |
| 385/2 | | × | × | | | | | | | | | | | | | | | |
| 387 | | | × | | | | | | | | | | | | | | | |
| 389 | | × | | | | | | | | | | | | | | | | |
| 391 | | | | | | V | | | | | | | | | | | | |

*V* – vitrite (witryt); *It* – inertite (inertyt); *Ct* – clarite (klaryt); *Vt* – vitrinertite (witrynertyt); *Dt* – durite (duryt); *Tr* – trimacerite (trimaceryt); *Cm* – carbominerite (karbomineryt); *m* – minerite (mineryt); △ – varieties of basic type – I (odmiany typu podstawowego – I); × – varieties of types – vitrite – II and clarite – III (odmiany typów: witrytowego – II i klarytowego – III); ● varieties of inertite-durite type (odmiany typu intertytowo-durytowego); ∧ – mixed type (typ mieszany); V – carbominerite type – clarite-vitrite connected variety (typ karbominerytowy – odmiana klarytowo-witrytowa); ▲ – carbominerite typ – vitrite-trimacerite connected variety (typ karbominerytowy – odmiana witrytowo-trimacerytowa); + – carbominerite type – inertite (durite) – clarite connected variety (typ karbominerytowy – odmiana inertytowo-durytowo-klarytowa); O – carbominerite type – minerite variety (typ karbominerytowy – odmiana minerytowa); I – others (inne)

Table 2

**The distribution of microfacies varieties in coal seams from Chełm Region (Lublin Basin)**

| Seam depth (m) | Type varieties | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | V | V Ct | V Ct Tr | V Ct Cm(m) | V Ct Tr Cm(m) | V Cm(m) | V Tr Cm(m) | V Tr | V Vt | V Tr Vt | Tr Vt | V Tr Cm(m) | V Vt Cm(m) | V Vt Tr Cm(m) | V Dt | Dt Vt Tr | V Tr Dt | Tr Dt | Cm(m) |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 10a | 11 | 12 | 13 | 14 | 14a | 15 | 16 | 32 |
| 703,50 – 703,00 | | | | | | | | △ | | | | | | | | | | | |
| 714,40 – 715,50 | | | | | | | | | | △ | | | | | | | | | |
| 714,8 – 715.6 | | × | | | | | | | | | | | | | | | | | |
| 716,40 – 718,20 | | | × | | | | | | | | | | | | | | | | |
| 721,6 – 721.9 | | | × | | | | | | | | | | | | | | | | |
| 728,50 – 729,60 | | | | | V | | | | | △ | | | | | | | | | |
| 730,3 – 730,70 | | | | | V | | | | | △ | | | | | | | | | |
| 731,2 – 731,8 | | | | | | | | | | △ | | | | | | | | | |
| 731,70 – 732,45 | | | × | | | | | | | | | | | | | | | | |
| 737,0 – 738,1 | | | × | | | | | | | | | | | | | | | | |
| 740,8 – 741,5 | | | | | | | | | | | | | | | | | | | ○ |
| 744,5 – 745,0 | | | × | | | | | | | | | | | | | | | | |
| 752,30 – 754,10 | | | × | | | | | | | | | | | | | | | | |
| 753,8 – 754,6 | | × | | | | | | | | | | | | | | | | | |
| 755,2 – 756,0 | | | × | | | | | | | | | | | | | | | | |
| 761.8 – 762,6 | | × | × | | | | | | | | | | | | | | | | |
| 763,8 – 764,6 | | | × | | | | | | | | | | | | | | | | |
| 766,8 – 768,0 | | | × | | | | | | | | | | | | | | | | |
| 769,0 – 769,6 | | | | | | | | △ | | | | | | | | | | | |
| 773,4 – 774,3 | | | × | | | | | | | | | | | | | | | | |
| 780,0 – 781,9 | | × | | | | | | | | | | | | | | | | | |
| 784,9 – 785,1 | | | × | | | | | | | | | | | | | | | | |
| 790,5 – 791,4 | | | × | | | | | | | | | | | | | | | | |
| 792,3 – 793,3 | | | × | | | | | | | | | | | | | | | | |
| 819,7 – 820,7 | | × | | | | | | | | | | | | | | | | | |
| 822,2 – 822,9 | | | | | | | | | | | | | | | | | ● | | |
| 831,4 – 831,85 | | | × | | | | | | | | | | | | | | | | |
| 838,8 – 839,4 | | | × | | | | | | | | | | | | | | | | |
| 846,0 – 847,70 | | × | | | | | | | | | | | | | | | | | |
| 856,4 – 856,8 | | | × | | | | | | | | | | | | | | | | |
| 858,65 – 859.10 | | | | V | | | | | | | | | | | | | | | |
| 863,1 – 863,5 | | × | | | | | | | | | | | | | | | | | |
| 881,3 – 881,5 | | × | | | | | | | | | | | | | | | | | |

Explanations as given in Table 1

### OSTRÓW REGION

The third region of microfacies investigations, situated in northern part of the basin was recognized by boreholes. Coal seams from two boreholes have been analyzed. All together 43 samples from unidentified coal seams from the depth: 683.5 m up to 1005.4 m, were analysed. Results of this analysis shown in Table 3 reveal that these coals are composed almost exclusively of clarite type III. Carbominerite type connected with clarite was also identified in four samples and only one sample of basic type (vitrite-trimacerite) was identified. Inertite-durite type is absent. This uniformity of microfacies type indicates very stable conditions throughout the whole succession.

In this part of the basin predominance of forest swamps with well developed calamitean reeds on their edges as well as subaquatic conditions for clarite formation were the main sources providing organic matter for coal seams formation.

### GENERAL REMARKS

Characteristic microfacies features of Lublin Basin coals belonging to Lublin Beds were as follows:

– total absence of vitrite type II;

– significant predominance of clarite type III, especially in Ostrów and Chełm regions;

– clarite type is in upper part of succcssion accompanied by basic type I. Among all of so far analyzed samples only two (one in coal seam 375/1 – 2 and one in thin unidentified seam from Chełm region) samples were characterized by durite subtype. Inertite subtype has not been yet identified in Lublin coals.

Microfacies character of mentioned coals suggests rich moisture and short dry periods of peat oxidation. Abundance of clarite and degree of exinite desintegration suggest that they formed in subaquatic conditions, often close to anaeorobic ones, especially in cases where clarite consists additionally of some amounts of syngenetic fine-grained pyrite.

## UPPER SILESIAN BASIN

### SILTSTONE SERIES – GENERAL CHARAKTERISTIC

Stratigraphically, this series is divided into lower part (Załęże Beds – Westphalian A) and the upper (Orzesze Beds – Westphalian B). Sediments of the Siltstone Series are distributed mainly in Central and eastern part of the basin. The series is also known from Chwałowice and Bytom troughs as well as Dąbrowa Region. In Cieszyn Region, the upper part of the series was eroded before the onset of Mesozoic sedimentation. In Central Trough, Łaziska, Lędziny, Jaworzno, Silesia, and Spytkowice areas, siltstone series sediments are overlain by younger Łaziska Beds (Westphalian C). The thickness of the series grows from the east towards west.

Lithologically the series consist of monotonous claystone, siltstones fine-grained quartz-micaceous sandstones and abundant, mostly thin irregular coal seams. Syderitic and tufogenic (tonstein) horizons are of minor importance although significant for correlation. Development of the series in the main regions of the Basin is characterized below.

Tabela 3

**The distribution of microfacies varieties in coal seams from Ostrów Region (Lublin Basin)**

| Seam depth | Type varieties | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | V | V Cl | V Cl Tr | V Cl Cm(m) | V Cl Tr Cm(m) | V Cm(m) | V Tr Cm(m) | V Tr | V Vt | V Tr Vt | Tr Vt | V Tr Cm(m) | V Vt Cm(m) | V Vt Tr Cm(m) | V Dt | Dt Vt Tr |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 10a | 11 | 12 | 13 | 14 | 14a |
| 683,5 – 684,0 | | | × | | | | | | | | | | | | | |
| 718,2 – 719,0 | | | | | | | △ | | | | | | | | | |
| 727,2 – 727,8 | | | | | ▲ | | | | | | | | | | | |
| 732,1 – 732,6 | | | × | | | | | | | | | | | | | |
| 738,5 – 739,2 | | | × | | | | | | | | | | | | | |
| 747,2 – 747,95 | | | × | | | | | | | | | | | | | |
| 750,2 – 750,8 | | | × | | | | | | | | | | | | | |
| 760,6 – 764,6 | | | × | | | | | | | | | | | | | |
| 766,2 – 766,6 | | | | | ▲ | | | | | | | | | | | |
| 767,6 – 768,05 | | | × | | | | | | | | | | | | | |
| 779,1 – 780,4 | | | × | | | | | | | | | | | | | |
| 789,6 – 791,1 | | | × | | | | | | | | | | | | | |
| 792,8 – 798,4 | | | × | | | | | | | | | | | | | |
| 802,6 – 803,5 | | | × | | | | | | | | | | | | | |
| 802,8 – 803,4 | | | × | | | | | | | | | | | | | |
| 808,4 – 808,85 | | | × | | | | | | | | | | | | | |
| 821,8 | | | | | | ▲ | | | | | | | | | | |
| 822,5 – 823,6 | | | × | | | | | | | | | | | | | |
| 824,5 – 821,6 | | | × | | | | | | | | | | | | | |
| 829,1 – 829,7 | | | × | | | | | | | | | | | | | |
| 831,4 – 832,4 | | × | | | | | | | | | | | | | | |
| 836,4 – 837,25 | | | × | | | | | | | | | | | | | |
| 851,5 – 852,9 | | | × | | | | | | | | | | | | | |
| 852,6 – 853,3 | | | × | | | | | | | | | | | | | |
| 853,65 – 855,7 | | | × | | | | | | | | | | | | | |
| 866,0 – 868,2 | | | × | | | | | | | | | | | | | |
| 867,8 – 868,5 | | | × | | | | | | | | | | | | | |
| 879,0 – 880,3 | | | × | | | | | | | | | | | | | |
| 886,4 – 887,4 | | | × | | | | | | | | | | | | | |
| 888,2 – 889,1 | | | × | | | | | | | | | | | | | |
| 903,1 – 904,3 | | | × | | | | | | | | | | | | | |

| Seam depth | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 10a | 11 | 12 | 13 | 14 | 14a |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 906,5 – 907,8 | | | × | | | | | | | | | | | | | |
| 906,9 – 908,6 | | | × | | | | | | | | | | | | | |
| 920,3 – 921,4 | | × | | | | | | | | | | | | | | |
| 929,9 – 930,2 | | | × | | | | | | | | | | | | | |
| 930,4 – 930,6 | | | × | | | | | | | | | | | | | |
| 935,4 – 936,2 | | | × | | | | | | | | | | | | | |
| 939,2 – 940,5 | | | × | | | | | | | | | | | | | |
| 954,2 – 955,6 | | | × | | | | | | | | | | | | | |
| 976,2 – 977,9 | | | × | | | | | | | | | | | | | |
| 985,2 – 985,7 | | | | V | | | | | | | | | | | | |
| 989,55 – 989,95 | | | | V | | | | | | | | | | | | |
| 994,9 – 995,4 | | | × | | | | | | | | | | | | | |
| 1004,2 – 1005,4 | | | × | | | | | | | | | | | | | |
| 1041,1 – 1041,9 | | × | | | | | | | | | | | | | | |

Explanations as given in Table 1

## CENTRAL TROUGH

In this area, sediments of the above series are recognized in Silesia, Brzeszcze, partially Piast and Ziemowit Mines as well as in boreholes situated between Brzeszcze, Silesia and Ziemowit Mines. The whole sequence of the series is here represented and overlain by continously developed younger Łaziska Beds. Their thickness grows systematicaly towards west from 520 m in Jaworzno – Oświęcim region up to 1300 m in Kobiór area. Lithologically it consists of aleuritic-pellitic sediments with abundant syderitic concretions. Sandstones are in minority and they are usually composed of fine-grained quartz. They are more common in upper part of this series.

## WESTERN REGION

Siltstone Series is known from Jastrzębie, Borynia, Pniówek, Żory, Warszowice – Pawłowice, Dębieńsko and Ornontowice Mines and areas recognized by boreholes as far as southern limb of the Main Anticline.

Lithologically this series is characterized by reduced share of coarse-clastic sediments (about 13% of sandstone of total sequence) and predominance of claystones and siltstones (72% of total thickness). The share of coals is about 4% of total thickness. In coal seams roofs occur often as coaly shales. The classic profile of Załęże Beds in Western Region is developed in Warszowice – Pawłowice region in sandstone clayish with significant claystone domination. Claystones are greyish with variable but usually high share of detritic organic matter as well as layers and concretions of clayish syderite. Sandstones are grey and light grey, sometimes coarse-grained. Three tuffite horizons were also identified in neighbourhood of seams no 325, 351 and 354. Coal seams are abundant and of variable thickness. The total thickness of the series vary from 205 up to 1058 m.

### CIESZYN REGION

Siltstone Series in this region is overlain by younger Miocene sediments. The whole profile is recognized in Brzozówka, Zebrzydowice and Pruchna coalfields. Sandstones are subordinate here (13% of total thickness), similarly as in regions mentioned above. Usually they are fine- or medium-grained, compact, sometimes laminated by coaly material or mica.

The series is dominated by siltstones (36–55% of total thickness), usually coarse-grained and of variable texture. Sometimes they contain well preserved fossilised plants, usually desintegrated and impossible to identify. Claystones (26% of total thickness) are dark-grey and slightly lamineted. They contain abundant macroflora normally well preserved. The coal seams are usually rather thin (0.75–1.20 m thick). Only those in the lower part of profile are thick (some of them are even more than 4.0 m thick). In this region two coalfields are of some importance:

#### BRZOZÓWKA–KACZYCE COALFIED (RECENTLY ZMP MINE)

The series is represented by Załęże Beds (Westphalian A). The upper part of these beds is reduced and only few seams (352–364) occur in northern and central part of the coalfield. Coal seams 401 to 406/2 (lower part of Załęże Beds) are known from the whole coalfield area and the sequence is fully developed. Lithologically they are developed as siltstones and claystones with abundant sideritic concretions and insignificant bands of fine-grained sandstones. Coal seams no 404/3 and 404/4 contain natural coke.

#### ZEBRZYDOWICE COALFIELD

Załęże Beds occur in south-east part of this coalfield in borehole IG 53 where seams no 363 and 364 were identified. They appear as dark-grey siltstones and claystones with abundant sideritic concretions and rather thick fine-grained sandstones. Abundant coal seams are of variable thickness (from few centimeters up to 3 m).

### SOUTHERN SLOPE OF MAIN ANTICLINE

Siltstone Series was here covered by more intense research works than in other parts of the Basin. The total thickness of this series decreases towards east: from 1400 m in Orzesze, 1300–1100 m in S part of Boże Dary coalfield to 700 m in Wesoła (Lenin) coalfield, up to 430 m in part of Komuna Paryska Mine and finally 240 m in Sobieski (Jaworzno) Mine. The series also becomes thinner towards north but due to strong erosion it is impossible to estimate its real thickness now. Lithologically the series consist as everywhere of aleuritic-pellitic complexes with sandstone layers and coal seams.

Dark-grey and grey claystones with abundant macroflora play an important role but they often pass into siltstones characterized by variable textures. Sandstones (about 20% of total profile thickness) are fine- and medium-grained with abundant quartz and thin laminae of coaly material and mica. Coal seams are common. In Mikołów coalfield Siltstone Series is represented by complete sequence of Załęże and Orzesze Beds. Załęże Beds (lower and upper) are represented by claystone-siltstone complexes dominated by claystones, with several

Table 4

**The distribution of microfacies varieties in coal seams from Dąbrowa Region (Upper Silesian Coal Basin)**

| Seam number | Type varieties | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | V | V Ct | V Ct Tr | V Ct Cm(m) | V Ct Tr Cm(m) | V Cm (m) | V Tr | V Vt | V Tr Vt | V Tr Cm(m) | V Vt Cm(m) | V Vt Tr Cm(m) | V It | Dt Vt Tr | V Tr Dt | Tr Dt | It Dt Tr | V It Dt Tr | It Tr | V It Tr | V It Ct | V It Dt | V It Vt Dt | V Dt Tr Cm(m) | V It Cm(m) | V It Tr Cm(m) | V Ct It | V Ct Dt | V Ct Dt Tr | (m) |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 352/1 | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 352/2 | | | | v | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 356 | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 358/1 | × | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 358/2 | | | × | | | | | | | | | | | | ● | | | | | | | | | | | | | | | |
| 401 | | | | | | | Δ | | | | | | | | | | | | | | | | | | | | | | | |
| 401/2 | | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 402/1 | | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 402/2 | | | × | | | | Δ | | | | | | | | | | | | | | | | | | | | | | | |
| 402/3 | | | | | | | Δ | | | | | | | | | | | | | | | | | | | | | | | |
| 403 | | | | v | | v | | | | ▲ | | | | | | | | | | | | | | | | | | | | |
| 403/1 | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 403/2 | | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 403/3 | | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 404 | | | × | | | | | | | | | | | | | | ● | | | | | | | | | | | | | o |
| 404/2 | | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 404/4 | | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 404/5 | | | | | | v | | | | | | | | | | | | | | | | | | | | | | | | |
| 405/1 | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | |
| 405/2 | | | × | | | | | | | | | | | | ● | ● | | | | | | | | | | | | | | |
| 406 | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | | |

Explanations as given in Table 1

coal seams and layers. Fine- and medium-grained sandstones are characteristic for basal part of the sequence where they are accompanied by coarse-grained sandstones and even conglomerates. Orzesze Beds are characterized by claystone--sandstone complex dominated by grey or greyish claystones, sometimes with sand admixture as well as coalificated stem fragments and appendixes. Clayish siderites were also found. Sandstones occur as thin layers sometimes markedly dark-grey, fine-grained, compact, with silica-clayish groundmass.

### DĄBROWA REGION

Siltstone Series is developed in rather limited area. It was found in eastern part of Sosnowiec Mine, also in Klimontów, Mortimer–Porąbka, Kazimierz Juliusz Mines. Towards the north, it reaches the area of Będzin–Zagórze Mine. Towards south it is limited by Main Anticline elevation where it was eroded.

Lithologically it is claystone-sandstone complex of rocks with varying share of sandstones. The latter, usually fine- or medium-grained, form intercalations in claystones with coal seams and sideritic concretions. Plant fossils are common especially in top parts of coal seams. Coal seams are rather thin; their average thickness doesn't exceed 1.4 m.

## MICROFACIES CHARACTERISTIC OF SILTSTONE SERIES COAL SEAMS IN UPPER SILESIAN COAL BASIN

Microfacies investigations of Siltstone Series coal seams were carried on in most of areas where these seams occur: Western Region, Chwałowice Trough, Main Anticline, Dąbrowa Region, Central Trough.

### WESTERN REGION

Coal seams of Siltstone Series were analyzed from microfacies point of view in following areas: Warszowice–Pawłowice, Bzie–Dębina, XXX-lecia PRL, Manifest Lipcowy. Borynia, Jastrzębie, Zebrzydowice, Kaczyce. It is the best recognized region with fully developed profile of Załęże Beds (Westphalian A).

Microfacies development of seams in this region is typical for the model profile of Załęże Beds in the whole Basin (K. Kruszewska, 1983). The most characteristic features of these seams are:

– regular occurrence of basic type I, vitrite type II and clarite type III, carbominerite type VI;

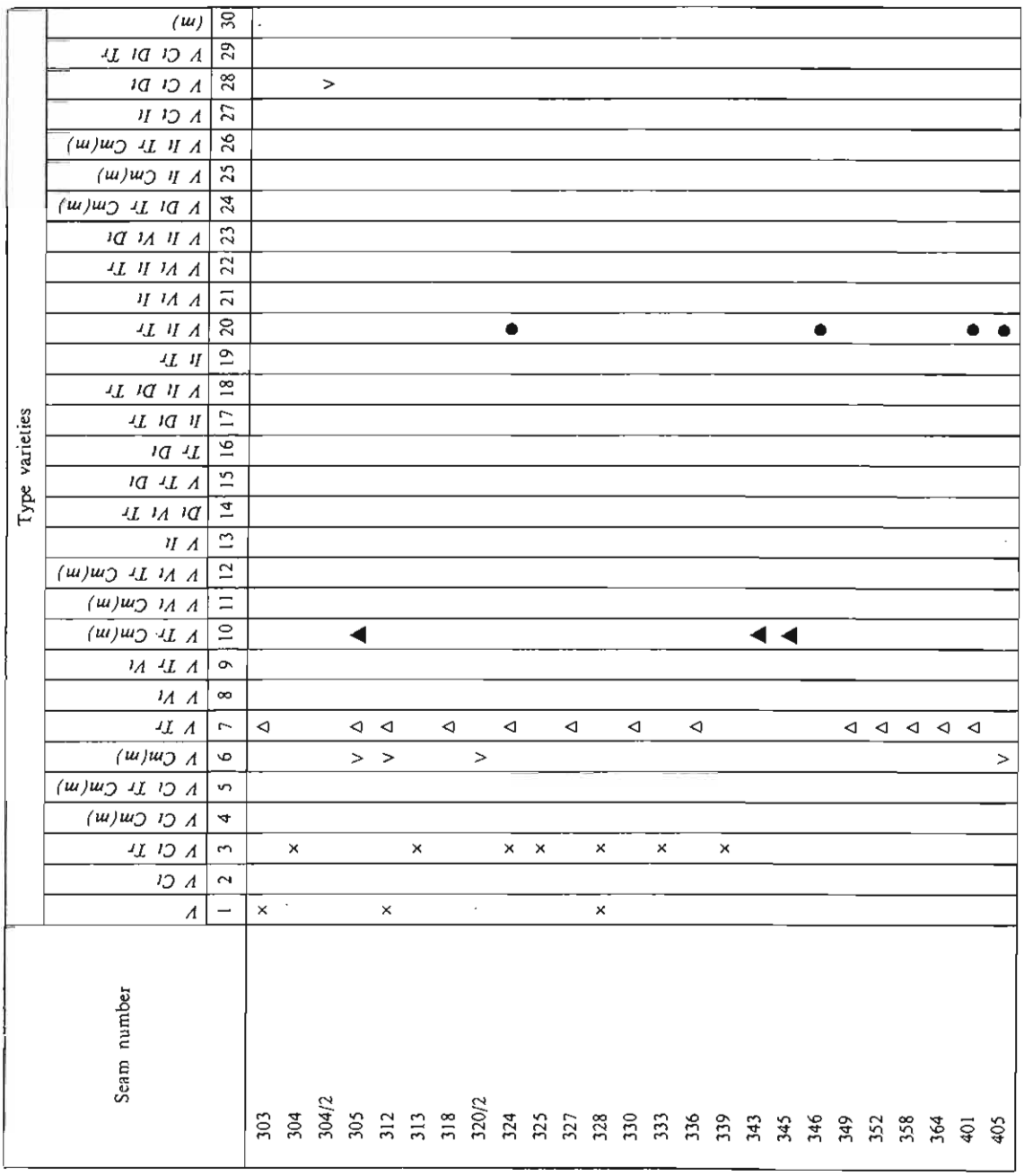
– gradually decreasing occurrence of inertite-durite type;

– durite subtype was identified only in one sample from 357/2 seam. Above seam 336/1 (Table 6) basic type becomes irregular in occurrence.

### CHWAŁOWICE TROUGH

Coal seams belonging to Siltstone Series are exposed in Chwałowice and Jankowice Mines and range from seam 406 in Jankowice Mine up to 327/5 in Chwałowice Mine (Table 7).

The microfacies development of seams is very characteristic and it coincides with their macrofacial features. Microfloral assemblages are different in this




Explanations as given in Table 1

area from those from other contemporary regions in the Basin (K. Kruszewska et al., 1977).

Basic type is the most regularly distributed here (Table 7). The clarite type becomes noticable from 402 coal seam, characterized by that type. Vitrite II type was identified only in one seam 403/1. The most characteristic is here the total lack of inertite-durite type in all analyzed samples. Maceral analyses (K. Kruszewska et al., 1977) show that coals from Chwałowice Trough usually contain more vitrinite and less inertite than other contemporary coal seams in Upper Silesian Coal Basin. They are also generally richer in spores of *Lycospora* sp. and poorer in *Densosporites* sp. sp. and *Anulatosporites* sp. sp. than other coals of Siltstone Series. There also exists a significant coincidence between maceral groups microfacial composition in coal seams and lithological character of accompanying rocks (K. Kruszewska et al., 1977).

## MAIN ANTICLINE

The coal seam succession analyzed in this region is far less complete than that in Western Region. Only fourteen seams were analyzed (from 358/1 up to 328). Very characteristic feature of these seams is strongly reduced occurrence (to one seam only) of clarite type and complete lack of vitrite type.

As in other regions, basic type dominates and durite subtype was identified in three cases (Table 8), similarly as carbominerite type. This may suggest frequent changes from forest swamp conditions to subaquatic ones which were favourable for formation of duroclarite.

## DĄBROWA REGION

The seams of Siltstone Series belong to the lower part of Załęże Beds (from seam 406 up to 352/1). Their microfacies character is similar to the general one (K. Kruszewska, 1983) but the development of basic type is hardly marked here and vitrite type seems rare. The variable coal seams composition suggests that they have developed in rather subaquatic conditions. Some areas of swamps were temporarely exposed above the water level and sediments affected by oxidation processes. To prove this hypothesis further detailed investigations are required.

## CENTRAL TROUGH

The last region where coal seams were investigated is Central Trough. This is the only area where both Orzesze and Załęże Beds were analysed and although the succession is less complete than in western part of Central Trough, coal seams give a good opportunity for analysis of the whole Siltstone Series profile.

The most typical are here omnipresence of basic type and limited occurrences of inertite subtype (durite subtype is totally lacking). Clarite subtype occurs only in the upper part of the profile (from seam 339 towards the top). Vitrite subtype occurs exclusively in Orzesze Beds. It was not yet recognized in Załęże Beds in this part of the Basin. Such microfacies character suggests fairly stable facies conditions during formation of the coal seams.

Table 6

**The distribution of microfacies varieties in coal seams from Western Region (Upper Silesian Coal Basin)**

| Seam number | Type varieties | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | V | V Cl | V Cl Tr | V Cl Cm(m) | V Cl Tr Cm(m) | V Cm(m) | V Tr | V Vt | V Tr Vt | V Tr Cm(m) | V Vt Cm(m) | V Vt Tr Cm(m) | V It | Dt Vt Tr | V Tr Dt | Tr Dt | It Dt Tr | V It Dt Tr | It Tr | V It Tr | V Vt It | V Vt It Tr | V It Vt Dt | V Dt Tr Cm(m) | V It Cm(m) | V It Tr Cm(m) | V Cl It | V Cl Dt | V Cl Dt Tr | (m) |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 326/3 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 327 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 328/3 | △ | | | | | V | | | | | | | | | | | | | | | | | | | | | | | |
| 329/3 | | | | | V | | | | | | | | | | | | | | | | | | | | | | | | |
| 329/4 | | | | V | | | | | | | | | | | | | | | | | | | | | | | | | |
| 330 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 330/1 | × | × | | | | V | | | | | | | | | | | | | | | | | | | | | | | |
| 330/2 | | × | × | | | V | | | | | | | | | | | | | | | | | | | | | | | |
| 330/3 | | | × | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 331/1 | | | × | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 331/2 | | | | V | | | | | | | | | | | | | | | | | | | | | | | | | |
| 332/1 | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 332/2 | × | × | × | | | | | | | | | | O | | | | | | | | | | | | | | | | |
| 333/1 | × | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 333/2 | × | × | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 333/3 | × | × | | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 334/1 | × | | | | | V | | | | | | | | | | | | | | | | | | | | | | | |
| 334/2 | | | | | | | △ | | | ▲ | | | | | | | | | | | | | | | | | | | |
| 335/1 | × | × | × | V | | V | | | | | | | | | | | | | | | | | | | | | | | |
| 335/2 | × | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 336/1 | | × | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 336/2 | × | × | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 336/3 | × | | | | | | | | | ▲ | | | | | | | | | | | | | | | | | | | |
| 336/4 | × | | | | | V | | | | | | | | | | | | | | | | | | | | | | | |
| 338/1 | × | | | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 338/2 | × | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 338/3 | | × | × | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 340/1 | × | × | | | | V | | | | ▲ | | | | | | | | | | | | | | | | | | | |
| 340/2 | × | × | | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 342/1 | | | × | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 342/1 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 344/1 | × | | × | | | | △ | | | ▲ | | | | | | | | | | | | | | | | | | | |
| 344/2 | × | | × | | | | △ | | | | | | | | | | | | | | | | | | | | ^ | | |
| 344/3 | × | × | | | | V | △ | | | | | | | | | | | | | | | | | | | | ı | | |
| 344/4 | | × | × | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 345 | | × | × | | | V | | | | | | | | | | | | | | | | | | | | | | | |
| 346/1 | × | × | | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 346/2 | | × | × | V | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 346/3 | | | | | | | △ | | | | | | | | | | | | | | ● | | | | | | | | |
| 346/4 | × | | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 347 | | | | | | | | | | ▲ | | | | | | | | | | | | | | | | | | | |
| 348/1 | | | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 348/2 | × | | | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 349 | | | | | | V | | | | | | | | | | | | | | | | | | | | | | | |
| 349/1 | × | | | | | V | △ | | | | | | O | | | | | | | | | | | | | | | | |
| 349/2 | × | × | | | | V | △ | | | ▲ | | | | | | | | | | | | | | | | | | | |
| 349/3 | × | × | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 349/4 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 349/5 | × | | | | | | △ | | | | | | | | | | | | | | ● | | | | | | | | |
| 350/1 | × | × | × | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 351 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 351/1 | | × | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 351/2 | × | × | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 351/3 | × | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 352 | × | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 352/1 | × | × | | | | | △ | | △ | | | | | | | | | | | | ● | | | | | | | | |
| 352/2 | × | | | | | | △ | | | | | | O | | | | | | | | | | | | | | | | |
| 353 | | × | | | | V | △ | | △ | | | | | | | | | | | | | | | | | | | | |
| 353/1 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 354 | | | × | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 354/1 | | | | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 354/2 | × | | | | | | △ | △ | | ▲ | | | | | | | | | | | | | | | | | | | |
| 355 | × | | | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 355/1 | | × | | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 355/2 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 356 | | × | | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 356/1 | × | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 356/2 | × | | | | | V | △ | | | ▲ | | | | | | | | | | | | | | | | | | | |
| 357 | | | × | | | V | △ | | | ▲ | | | | | | | | | | | | | | | | | | | |
| 357/1 | × | | × | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 357/2 | × | | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 358 | | | | | | | △ | | | ▲ | | | | | | | | | | | | | | | | | | | |
| 358/1 | | × | × | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 358/2 | × | × | × | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 358/2 – 3 | | | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 358/3 | × | | | | | | | | | ▲ | | | | | | | | | | | | | | | | | | | |
| 359 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 259/1 | × | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 359/2 | | × | | | | V | △ | | | ▲ | | | O | | | | | | | | | | | | | | | | |
| 359/3 | × | × | × | | | | △ | | | ▲ | | | | | | | | | | | ● | | | | | | | | |
| 360 | × | | | | | V | △ | | △ | | ▲ | | | | | | | | | | | | | | | | + | | |
| 360/1 | × | | × | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 360/2 | | | | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 360/3 | | | × | | | V | | | | | | | | | | | | | | | | | | | | | | | |
| 361 | × | × | × | | | V | △ | △ | | ▲ | | | | | | | | | | | | | | | | | | | |
| 362 | × | | | | | V | △ | | | | ▲ | | | | | | | | | | | | | | | | + | | |
| 362/1 | × | | | | | V | △ | | | ▲ | | | | | | | | | | | ● | | | | | | | | |
| 362/2 | × | | | | | V | △ | | | | | | | | | | | | | | ● | | | | | | | | |
| 363 | × | | | | | V | △ | | | | | | | | | | | | | | ● | | ● | | | | | | |
| 363/1 | | × | × | | | V | △ | | | | | | O | | | | | | | | | | | | | | | | |
| 363/2 | × | | | | | | △ | | | | | | O | | | | | | | | | | | | | | | | |
| 364 | | × | | | | V | △ | | | | | | | | | | | | | | | | | | | | | | |
| 364/1 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 367 | | | | | | V | | | | | | | | | | | | | | | | | | | | | | | |
| 401 | | | | | | V | △ | △ | △ | | | | | | | | | | | | ● | | | | | | | | |
| 401/1 | × | × | | | | | △ | | △ | | | | | | | | | | | | | | | | | | | | |
| 401/2 | | | | | | | △ | | | ▲ | | | | | | | | | | | | | ● | | | | | | |
| 402 | | × | | | | V | △ | | | ▲ | | | | | | | | | | | ● | | | | | | | | |
| 402/1 | × | × | × | | | V | △ | | | | | | | | | | | | | | | ● | | | | | | | |
| 402/2 | × | | × | | | | △ | △ | | | | | | | | | | | | | | ● | | | | | | | |
| 403 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 403/1 | × | × | × | | | V | △ | △ | | ▲ | | | | | | | | | | | | | | | | | | | |
| 403/2 | × | | × | | | V | △ | | | ▲ | | | | | | | | | | ● | | | | | | | | | |
| 403/3 | × | | | | | | △ | △ | | | | | | | | | | | | | | | | | | | | | |
| 403/4 | | | | | | V | △ | | | ▲ | | | | | | | | | | | | | | | | | | | |
| 404/1 | × | | | | | | △ | | | ▲ | ▲ | | O | | | | | | | | ● | | | | | | | | |
| 404/2 | × | | × | | | V | △ | △ | | ▲ | | | | | | | | | | | ● | | | | | | | | |
| 404/2 – 3 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 404/3 | × | × | | | | V | △ | | | | | ▲ | O | | | | | | | | ● | | | | | | | | |
| 404/3 – 4 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |
| 404/4 | × | × | | | | | △ | | | ▲ | | | | | | | | | | | | | | | | | | | |
| 405 | | | | | | | △ | △ | | | | | | | | | | | | | | | | | | | | | |
| 405/1 | × | | × | | | V | △ | △ | △ | | | | O | | | | | | | | ● | ● | ● | ● | ● | | | | |
| 405/2 | × | | | | | | △ | | | | | | | | | | | | | ● | | | ● | ● | | | | | |
| 405/3 | | | | | | | △ | | | | | | | | | | | | ● | | | | | | | | | | |
| 406 | | | | | | | | | | | | | | | | | | | | | ● | | | ● | | | | | |
| 406/1 | | | × | | | V | △ | | △ | ▲ | | | | | | | | | | | ● | | ● | | | | | | |
| 406/2 | | | | | | V | △ | | △ | ▲ | | | | | | | | | | | | ● | ● | | | | | | |
| 406/3 – 4 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | |

Explanations as given in Table 1

Table 7

**The distribution of microfacies varieties in coal seams from Chwalowice Trough (Upper Silesian Coal Basin)**

| Seam number | Type varieties | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *V* | *V Ct* | *V Ct Tr* | *V Ct Cm(m)* | *V Ct Tr Cm(m)* | *V Cm(m)* | *V Tr* | *V Vt* | *V Tr Vt* | *V Tr Cm(m)* | *V Vt Cm(m)* | *V Vt Tr Cm(m)* | *V It* | *Dt Vt Tr* | *V Tr Dt* | *Tr Dt* | *It Dt Tr* | *V It Dt Tr* | *It Tr* | *V It Tr* | *V Vt It* | *V Vt It Tr* | *V It Vt Dt* | *V Dt Tr Cm(m)* | *V It Cm(m)* | *V It Tr Cm(m)* | *V Ct It* | *V Ct Dt* | *V Ct Dt Tr* | *(m)* |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 327/5 | | | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 345/1 – 2 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 349 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 351/2 | | | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 356 | | | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 359 | | | | | | V | | | | | | | | | | | | | | | | | | | | | | | |
| 360 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 360/1 | | | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 360/2 | | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 362 | | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 364/2 | | × | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 401/1 | | | × | | | V | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 401/2 | | | × | | | V | △ | | | ▲ | | | | | | | | | | | | | | | | | | | | |
| 401/3 | | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 402 | | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 402/1 | | × | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 402/2 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 403/1 | | | | | | | △ | | | ▲ | | | | | | | | | | | | | | | | | | | | |
| 403/2 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 403/3 | | | | | | | △ | | | ▲ | | | | | | | | | | | | | | | | | | | | |
| 404 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 404/1 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 404/2 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 404/3 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 404/4 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 404/5 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 404/9 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 405 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 405/2 | | | × | | | | | | | | | | | | | | | | | | | | | | | | | | | |
| 405/4 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 405/5 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 406 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |

Explanations as given in Table 1

Table 8

**The distribution of microfacies varieties in coal seams from Main Anticline Region (Upper Silesian Coal Basin)**

| Seam number | Type varieties | | | | | | | | | | | | | | | | | | | | | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | *V* | *V Ct* | *V Ct Tr* | *V Ct Cm(m)* | *V Ct Tr Cm(m)* | *V Cm(m)* | *V Tr* | *V Vt* | *V Tr Vt* | *V Tr Cm(m)* | *V Vt Cm(m)* | *V Vt Tr Cm(m)* | *V It* | *Dt Vt Tr* | *V Tr Dt* | *Tr Dt* | *It Dt Tr* | *V It Dt Tr* | *It Tr* | *V It Tr* | *V Vt It* | *V Vt It Tr* | *V It Vt Dt* | *V Dt Tr Cm(m)* | *V It Cm(m)* | *V It Tr Cm(m)* | *V Ct It* | *V Ct Dt* | *V Ct Dt Tr* | *(m)* |
| | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 | 13 | 14 | 15 | 16 | 17 | 18 | 19 | 20 | 21 | 22 | 23 | 24 | 25 | 26 | 27 | 28 | 29 | 30 |
| 328 | | | | | | | | | | ▲ | | | | | | | | | | | | | | | | | | | | |
| 341 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 349 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 351/1 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 358 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 358/1 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 364 | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | |
| 364/1 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 401 | | | | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 402 | | | × | | | | △ | | | | | | | | | | | | | | | | | | | | | | | |
| 404/1 | | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | |
| 404/4 | | | | | | | | | | ▲ | | | | | | | | | | | | | | | | | | | | |
| 405 | | | | | | | | | | | | | | ● | | | | | | | | | | | | | | | | |
| 406 | | | | | | | | | | ▲ | | | | | | | | | | | | | | | | | | | | |

Explanations as given in Table 1

## DISCUSSION AND CONCLUSIONS

The comparison of lithostratigraphic character of Upper Siltstone Series and Lublin Beds shows following differences and similarites. They are as follows:

– the same stratigraphical position (Fig. 1);

– very similar lithological character – both series are generally developed in claystone-siltstone facies.

The comparison of microfacies development of coals from Siltstone Series and Lublin Beds shows following general similarites between the latter ones and Orzesze Beds:

– the total lack of vitrite type in all the analysed Lublin coals and strong regression of this type in Orzesze Beds (Tables 1–8);

– the frequency of carbominerite type;

– single occurrences of inertite-durite type.

Following differences should be taken into account:

– vitrite-clarite variety of clarite type is markedly more frequent in Lublin than in Orzesze Beds;

– basic type is more frequent in Orzesze Beds.

Maceral analysis of both Orzesze and Lublin coal seams reveals high average vitrinite content. Content of exinite in Lublin Basin is markedly higher than in coals of Orzesze and than that of inertinite. The appearence of individual macerals shows some differences between coals from Orzesze and Lublin Beds. The latter often consist of "spotty" dark vitrinites and decomposed exinite mass. Syngenetic fine-grained pyrite associated with dark vitrinite and clarite have been also often found. The results presented in this paper allow to draw the following conclusions:

1. The facies conditions during formation of the series have been similar. In both cases we are dealing with predominance of pellitic-aleuritic sediments with thin irregular coal seams, indicating that intensive subsidence has been taking place during their formation.

2. The frequent presence of clarite type in examined coals indicates widespread development of calamitean reeds during their formation.

3. Almost complete absence of inertite-durite type (except for a single sample in Orzesze and two samples in Lublin coals) suggests high groundwater level and conditions unfavourable for peat oxidation.

4. The presence of dark "spotty" vitrites, partially decomposed exinite mass and syngenetic pyrite in Lublin coals suggest that they generally sedimented under more unaerobic conditions than in the case of Upper Silesian coals.

5. The domination of clarite type as well as high vitrinite content in both Orzesze and Lublin coals suggest that they can be considered as good raw material for liquefaction processes. Coals from Lublin Basin with their particularly high exinite-rich clarite content and pyrite assemblages appear most appropriate for liquefaction.

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## REFERENCES

BOJKOWSKI K., DEMBOWSKI Z., JACHOWICZ A., KOTAS A., MALCZYK W., MIGIER T., PORZYCKI J. (1978) – W: Karbon Górnośląskiego Zagłębia Węglowego. Pr. Inst. Geol., 61.

KRUSZEWSKA K., SAPIŃSKA M., MAGNES C. (1977) – Osady karbonu niecki ehwałowickiej w świetle analizy litologicznej oraz badań palinologicznych i petrograficznych węgli. Pr. Nauk. UŚ, nr 164, Geologia, 1, p. 47–86.

KRUSZEWSKA K. (1983) – Microfacies types of coal seams in Upper Silesian Coal Basin. Kwart. Geol., 27, p. 41–58, nr 1.

MUSIAŁ Ł., TABOR M. (1977) – Stratygrafia karbonu LZW na podstawie fauny. W: Stratygrafia węglonośnej formacji karbońskiej w Polsce. 2 Sympozjum, Sosnowiec 4–5 maja 1977, p. 13–17. Wyd. Geol. Warszawa.

PORZYCKI J. (1976) – Budowa geologiczna Centralnego Okręgu Węglowego w Lubelskim Zagłębiu Węglowym. Prz. Geol., 24, p. 385–393, nr 7.

PORZYCKI J. (1977) – Litostratygrafia osadów karbonu LZW. W: Stratygrafia węglonośnej formacji karbońskiej w Polsce. 2 Sympozjum, Sosnowiec 4–5 maja 1977, p. 7–8. Wyd. Geol. Warszawa.

ZDANOWSKI A. (1978) – Karbon produktywny synkliny Stoezek–Dorohucza w LZW. Prz. Geol., 26, p. 523–525, nr 2.

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## PORÓWNANIE CHARAKTERU MIKROFACJALNEGO WĘGLI WESTFALU A I B Z GÓRNOŚLĄSKIEGO I LUBELSKIEGO ZAGŁĘBIA WĘGLOWEGO

Streszczenie

Opisano litostratygrafię serii westfalu A i B w Lubelskim Zagłębiu Węglowym (warstwy lubelskie) oraz Górnośląskim Zagłębiu Węglowym (seria mułowcowa – warstwy załęskie i orzeskie). Scharakteryzowano budowę mikrofacjalną pokładów omawianych warstw w poszczególnych rejonach. Porównanie wykształcenia mikrofacjalnego pokładów w obu zagłębieniach prowadzi do następujących wniosków:

1. Warunki facjalne w czasie tworzenia się omawianych serii pokładów były w obu zagłębiach podobne. Dominacja utworów ilasto-mułowcowych nad piaszczystymi wskazuje na zwiększoną subsydencję.

2. Częstotliwość występowania typu klarytowego wskazuje na znaczny rozwój facji oczeretowej w czasie tworzenia się omawianych pokładów.

3. Prawie zupełny brak mikrofacjalnego typu inertytowo-durytowego w pokładach z obu zagłębi sugeruje wysoki poziom wód gruntowych i niekorzystne warunki dla utleniania torfu.

4. Występowanie „plamistych", ciemnych witrynitów, częściowo rozłożonego egzynitu oraz drobnoziarnistego, syngenetycznego pirytu w węglach lubelskich świadczy, że powstawały one w warunkach bardziej anaerobowych niż węgle górnośląskie.

5. Przewaga typu klarytowego oraz wysoki udział witrynitu w węglach warstw lubelskich i orzeskich pozwala na typowanie ich jako bardzo dobrych surowców do procesów uplynniania. Szczególnie węgle lubelskie bogate w klaryt egzynitowy stowarzyszony z pirytem powinny być brane pod uwagę przy przyszłym upłynnianiu.

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## СРАВИТЕЛЬНАЯ ХАРАКТЕРИСТИКА МИКРОФАЦИАЛЬНОГО СОСТАВА УГЛЕЙ ВЕСТФАЛЯ А И В В ВЕРХНЕСИЛЕЗСКОМ И ЛЮБЛИНСКОМ УГОЛЬНЫХ БАССЕЙНАХ

Резюме

В статье представлена литостратиграфия вестфальских серий А и В в Люблинском угольном бассейне (люблинские слои) и в Верхнесилезском угольном бассейне (алевропитовая серия — заленские и ожеские слои). Охарактеризован микрофациальный состав описываемых слоев по отдельным районам. Сравнение микрофаций пластов в обоих бассейнах позвопяет сделать следующие выводы:

1. Фациальные условия во время образования описываемых серий в обоих бассейнах были одинаковыми. Преобладание глинисто-алевролитовых пород над песчанистыми свидетельствует о усиленном опускании дна бассейна во время осаждения описываемых пород.

2. Частота, с какой встречаются в разрезе породы кларитового типа, свидетельствует о широком развитии очеретовой фации во время образования данных пород.

3. Почти полное отсутствие микрофациального инертитово-дуритового тила в изучаемых пластах обоих бассейнов, предопределяет высокий уровень грунтовых вод и неблагоприятные условия для окисления торфа.

4. Залегание „пятнистых" темных витринитов, частично разложенного экзинита и наличие мелкозернистого, сингенетического пирита в люблинских углях свидетельствует о том, что они образовались в более анаэробных условиях, чем верхнесилезский уголь.

5. Преобладание кларитового типа и высокий уровень витринита в углях люблинских и ожеских слоев позволяет считать их хорошим сырьем для сжижения. Особенно люблинские угли, обогащенные экзинитовым кларитом, солряженным с лиритом, следует принимать во внимание при будущем сжижении.