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AN ATTEMPT TO ASSESS THE EFFECT OF TUFF DEPOSITION ON A CARBONIFEROUS PEAT- BOG ENVIRONMENT, ON THE BASIS OF MEGASPORES STUDIES OF COAL SEAMS (UPPER SILESIAN COAL BASIN, POLAND)

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ABSTRACT. The aim of this work was to try and assess whether tuff deposition on a Carboniferous peat-bog influenced the character of this type of environment. According to most literature sources, under conditions favourable to coal formation tuffs were converted to tonsteins. Numerous tonstein levels occur in coal seams in the Upper Silesian Coal Basin. The seams investigated in this work were: 209/210 from the Siersza and 301 from the Jan Kanty mine and 816 from the Grodziec region. 23 coal samples were collected from lithologically different coal layers adjacent to tonsteins and were analysed for megaspores. The analysis revealed the presence of 16 species and groups of megaspore species. On the basis of the botanical link between megaspores and the parent plants, the assemblage of Carboniferous vegetation corresponding to each coal sample was determined. The effect of tuff deposition should be reflected by changes in the character of the vegetation associated with coal layers below and above the tonstein level. This is confirmed by quantitative and to a lesser extent qualitative occurrence of megaspore taxones. The character of the vegetation most clearly changed across two tonstein levels, in seam 301 from Jaworzno. The presence of other tonstein levels appeared to find only weak reflection in the occurrence of plant groups.

KEY WORDS: megaspores, tonstein, palaeo peat-bog, Carboniferous, Upper Silesian Coal Basin

CHARACTERISTICS OF THE MATERIAL STUDIED

Coal seams 209/210 and 816 from the Siersza mine and the Grodziec region respectively each contained only one tonstein level, while in seam 301 in the Jan Kanty mine four such levels were present. The situation of the mines in the Upper Silesian Coal Basin is shown in Fig. 1, and the geology of the investigated area on Fig. 2. Stratigraphically, coal seams 209/210 and 301 belong to Łaziska Beds, Westphalian B and seam 816 to Gruszów Beds, lower Namurian A. Tonstein levels present in the seams were from some millimetres to several centimetres thick. Coal samples were collected from lithologically different coal layers several cm thick, adjacent to the tonstein levels, both above them and below. For the single tonstein levels, in coal seams 209/210 at Siersza and 816 at Grodziec, two and four samples respectively came from below the tonstein and four samples from above it, in both cases. In coal seam 301 at Jan Kanty four tonstein levels were present. One coal sample was obtained from above and below each of these levels, with an additional sample from above the uppermost level. Thus, the number of samples examined was 23. They were macerated in the usual way and the megaspores isolated were examined.

Fig. 1. Sketch of the mines. 1 – Grodziec mine, 2 – Jan Kanty mine, 3 – Siersza mine

MEGASPORE STUDY

Analysis revealed the presence of 16 species and groups of megaspore species: *Calamospora* spp., *Crassilagenicula agnina* (Zerndt) S. Dyb.-Jach. *et al, Cystosporites giganteus* (Zerndt) Pot. et Kr., *C. varius*

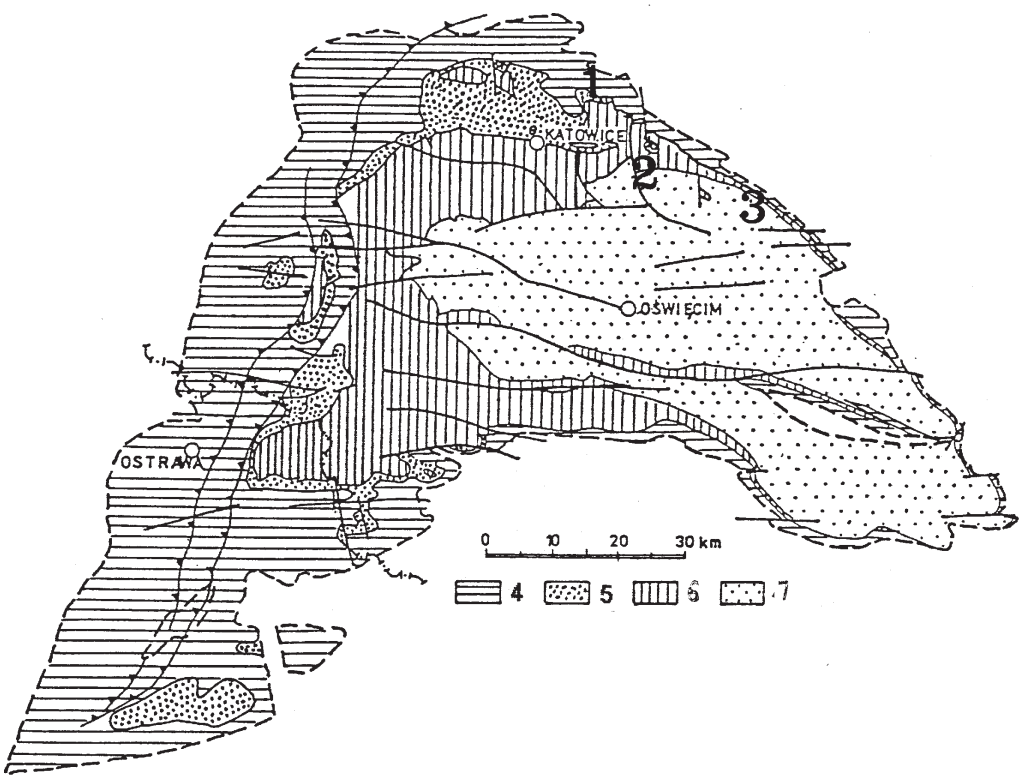

Fig. 2. Sketch of the geological map. 1 – Grodziec mine, 2 – Jan Kanty mine, 3 – Siersza mine, 4 – Paralic Series, 5 – Upper Silesian Sandstone Series, 6 – Siltstone Series, 7 – Cracow Sandstone Series

Table 1. Megaspore species and groups of megaspore species in seam 209/210 in mine Siersza and seam 301 in mine Jan Kanty

	No. sample	Megaspores										
		1	30	48	11	10	14	17	20	24	2	Total
Mine Siersza coal seam 209/210	1				2			2	73			77
	2	6	1		273			49	1259		6	1596
	3	95		2	360			302	2230	8	171	3176
	4	34		2	6			55	9266	39	10	9414
	TONSTEIN											
	5	10			25			6	2627		4	2672
	6	5			178			10	3024		6	3223
Mine Jan Kanty coal seam 301	26/II							1354	1278		321	
	26/I							230	1429		60	413
	TONSTEIN 6											
	25							1546	5071		855	
	11/1	29		7	3	13	56	305				413
	TONSTEIN 3											
	11/2	49	32		254		1117	311		21		1504
	11/3	26			73					312		411
	TONSTEIN 2											
	11/4	57			714		58	7		15		851
	17/II	2			9			5	502			518
	TONSTEIN 1											
	17/I	11			57			7	1716		1	1639

Explanation of the species and group species of the tab. 1–2: 34 – *Crassilagenicula agnina*, 13a – *Setosisporites brevispinosus*, 49 – *Microsporites karczewski*, 32 – *Sporites problematicus*, 27 – *Lagenicula* spp., 21 – *Setosisporites praetextus*, 1 – *Cystosporites giganteus*, 30 – *Cystosporites varius*, 48 – *Cystosporites verrucosus*, 11 – *Valvisisporites auritus*, 10 – *Laevigatisporites glabratus*, 14 – *Tuberculatisporites* spp., 17 – *Triangulatisporites triangulatus*, 20 – *Zonalesporites brasserti*, 24 – *Zonalesporites superbus*, 2 – *Calamospora* spp.

Table 2. Megaspore species and groups of megaspore species in seam 816 in mine Grodziec

No. sample	Megaspores										
	34	13a	49	32	27	21	1	17	20	2	Total
8	81		327		61	144	16		318	152	1099
7	128		59			76	38				301
6	9	2	42			32	77		2	8	172
5	157						113				270
TONSTEIN											
4	133					4	30		2		169
3	117		2			13	8				140
2	4	8	1700			227	10		12	34	1995
1	1	70	2	32	3		8	4	6	2	128

Table 3. Botanical connection between the megaspores and the Carboniferous plants

Megaspores	Plant			Plants groups
Genus	Genus	Order	Class	
Crassilagenicula	*Lepidodendron*	Lepidodendrales	Lycophytina	"tree like"
Lagenicula				
Cystosporites	*Lepidocarpon*			
Laevigatisporites	*Sigillaria*			
Tuberculatisporites				
Setosisporites	*Selaginellites*	Selaginellales		"herbaceous"
Valvisisporites				
Triangulatisporites				
Zonalesporites				
Calamospora		Sphenophyllales Equisetales	Sphenophytina	"herbaceous" and "tree like"
Sporites				
Microsporites	Lycophytina incertae sedis			

(Wicher) Dijkstra, *C. verrucosus* Dijkstra, *Laevigatisporites glabratus* (Zerndt) Pot. et Kr., *Lagenicula* spp., *Microsporites karczewski* (Zerndt) Dijkstra, *Setosisporites brevispinosus* (Zerndt) Brzoz., *S. praetextus* (Zerndt) Pot. et Kr., *Sporites problematicus* Zerndt, *Triangulatisporites triangulatus* (Zerndt) Pot. et Kr., *Tuberculatisporites* spp., *Valvisisporites auritus* (Zerndt) Pot. et Kr., *Zonalesporites brasserti* (Stach et Zerndt) S. Dyb.-Jach. *et al., Z. superbus* (Bartlett) Karcz. Qualitative and quantitative relationships between them are presented in tables 1–2.

The vertical profiles of coal seams consist of coal layers which are different lithologically and petrographically, derived from vegetation with various morphological characteristics. It is possible to define three basic types of plant assemblages, characterized by certain morphological features (Kmiecik & Knafel 1988). These assemblage types are: 1) with a predominance of large tree-like and huge herbaceous plants as well as few small ones; 2) dominated by small plants; and 3) mixed of transitional character.

The megaspores found have been linked to the parent plants with the aid of information presenyed by Bureau (1964, 1967), Potonié & Kremp (1955, 1956), Taylor & Taylor (1995), as well as in several communications on carboniferous plants, table 3. The coal samples examined contained megaspores derived from plant classes Lycophytina and Sphenophytina. The classes Lycophytina and Sphenophytina comprised plants of tree – like habit and small herbaceous plants, belonging to genera of the Lepidodendrales and Equisetales, and small herbaceous plants of the genus *Selaginellites* and some genera of the Sphenophyllales. For all coal samples, the relative frequencies of occurrence of megaspores derived from the three basic groups of plants, are given in tables 4–6, expressed as percentages of the total number of specimens in each sample.

On the basis of a comparison between the megaspores encountered in coal below and above tonstein levels (tables 1 and 2) an attempt was made to assess, whether the deposition of tuff on a Carboniferous peat-bog influenced the assemblage of carboniferous plants that grew before and after the deposition event (tables 4–6). Comparison between the megaspore assemblages present in individual samples indicated that there could have been some quantitative, as well as qualitative changes. Linking this to changes in carboniferous plant assemblages appears to be possible only for tonstein levels 2 and 3 in seam 301 in the Jan Kanty mine (table 5), where above the tonstein level the character of the vegetation ap-

Table 4. Carboniferous plant groups on the basis of the occurrence of megaspores in %, mine Siersza, coal seam 209/210

No. sample	Plants groups			
	Lycophytina		Sphenophytina	
	Lepidodendrales	Selaginellales	Equisetales	Sphenophyllales
	"tree like"	herbaceous	"tree like"and herbaceous	
1	3	97		
2	17	82	+	
3	14	80	5	
4	+	99	+	
TONSTEIN				
5	1	98	+	
6	5	94	+	

Table 5. Carboniferous plant groups on the basis of the occurrence of megaspores in %, mine Jan Kanty, coal seam 301

No. sample	Plants groups		
	Lycophytina		Sphenophytina
	Lepidodendrales	Selaginellales	
	"tree like"	herbaceous	"tree like" and herbaceous
26/II		89	11
26/I		96	4
TONSTEIN 6			
25		89	11
11/1	26	74	1
TONSTEIN 3			
11/2	97	1	
11/3	24	76	
TONSTEIN 2			
11/4	98	3	
17/II	2	98	
TONSTEIN 1			
17/I	4	96	+

Table 6. Carboniferous plant groups on the basis of the occurrence of megaspores in %, mine Grodziec, coal seam 816

No. sample	Plants groups			
	Lycophytina		Sphenophytina	
	Lepidodendrales	Selaginellales	Equisetales	Sphenophyllales
	"tree like"	herbaceous	"tree like"and herbaceous	
8	14	32	14	
7	55	25		
6	50	21	5	
5	100			
TONSTEIN				
4	97	3		
3	90	9		
2	1	12	2	
1	9	62	2	

peared to change towards the domination of herbaceous plants.

The results suggest that in further work on coal seams with tonstein levels the thickness of the tonstein levels, as well as the acidic or basic character of the tuff, should be considered and statistical methods should be employed in analysing the results of megaspore studies.

REFERENCES

BOUREAU E. (ed.) 1964. Traite de Paleobotanique. III – Sphenophyta, Noeggeratiophyta. Ed. Masson & Cie. Paris.

BOUREAU E. (ed.) 1967. Traite de Paleobotanique. II – Bryophyta, Psilophyta, Lycophyta. Ed. Masson & Cie. Paris.

KMIECIK H. & KNAFEL S. 1988. Geneza węgla. In: Karbon Lubelskiego Zagłębia Węglowego. Carboniferous of the Lublin Coal Basin. (summary: Origin of coal). Prace Instytutu Geologicznego, 72: 160–167.

POTONIÉ R. & KREMP G. 1955. Die Sporae dispersae des Ruhrkarbons, ihre Morphographie und Stratigraphie mit ausblicken auf Arten anderer Gebiete und Zeitabschnitte. Palaeontographica, B, 98 (1–3): 1–136.

POTONIÉ R. & KREMP G. 1956. Die Sporae dispersae des Ruhrkarbons, ihre Morphographie und Stratigraphie mit ausblicken auf Arten anderer Gebiete und Zeitabschnitte. Palaeontographica, B, 99(4–6): 85–191.

TAYLOR T.N. & TAYLOR E.L. 1995. The biology and evolution of fossils plants. Prentice Hall, Englewood Clifts, New Jersey.

ŻOŁDANI E. 1993. Badania palinologiczne odmian litologicznych węgla pokładu 301 z KWK Jan Kanty (GZW). (Palinological analysis of lithological variants coal from level 301 the coal mine "Jan Kanty"), Spraw. z Pos. Kom. Nauk. PAN, Oddz. w Krakowie, 47(1): 195–197. (In Polish).

ŻOŁDANI E. 1996. Badania megasporowe pokładów węgla z poziomami tonsztajnu. (summary: Megaspore investigation of coal seams with tonstein horizons (Łaziska beds, Upper Silesian Coal Basin)). In: Lipiarski I. (ed.) Materiały 19 Sympozjum Geologia Formacji Węglonośnych Polski (Proceedings 19 Symposium Geology of coal-bearing strata of Poland): 91–92. (In Polish).