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FOURTH INTERNATIONAL WORKSHOP ON AGGLUTINATED FORAMINIFERA

EXCURSION GUIDEBOOK

POLISH FLYSCH CARPATHIANS

Edited by: M. ADAM GASIŃSKI & EWA MALATA

Institute of Geological Sciences, Jagiellonian University

IV INTERNATIONAL WORKSHOP ON AGGLUTINATED FORAMINIFERA

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POLISH FLYSCH CARPATHIANS

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Title Cover

Photo depicts a group of geologist during the field excursion to the Carpathians of Galicia, Jaremcze, 4 September 1896: Władysław Szajnocha (seated centre, holding map). Józef Grzybowski (seated right, holding rock) and two unidentified associates. Photo from the collections of the Institute of Geological Sciences, Jagiellonian University.

Back Cover

Copy of the original plate from the Grzybowski's paper 1896.

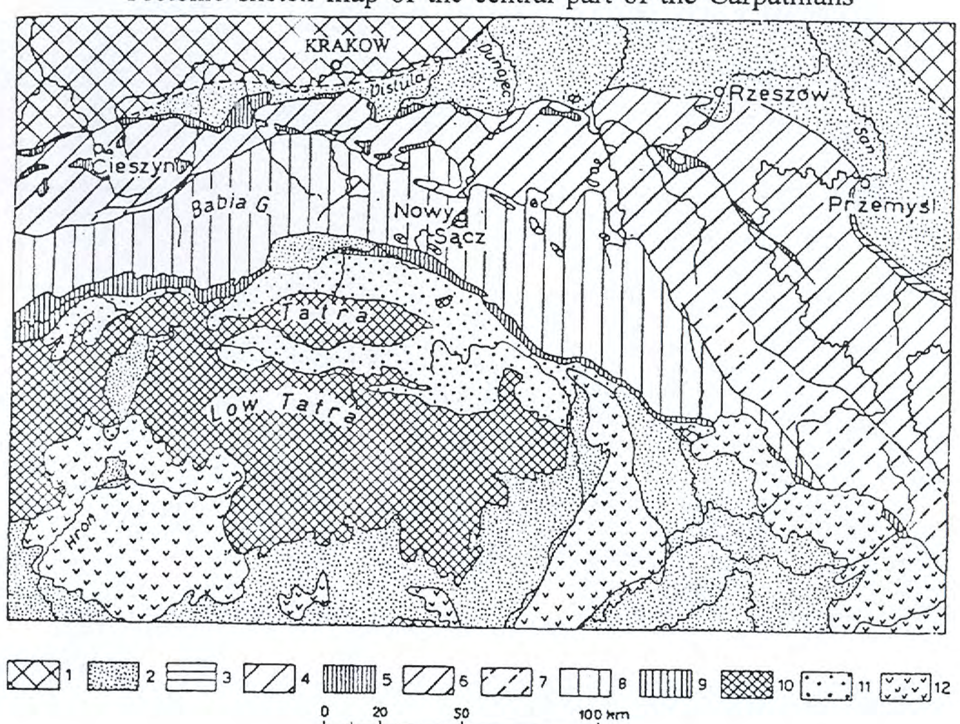
GEOLOGICAL SETTING

The Carpathians form a part of the great arc of mountains stretching from near Vienna in Austria to the Iron Gate of Romania on the Danube. Towards the west the Carpathians are linked with the Alps and to the southeast pass into the Balkan mountain chain.

The Carpathians consist of two main domains: an older one - Inner Carpathians which were affected by Late Cretaceous tectonic phase, and a younger one - Outer Carpathians, which are also known as the Northern or Flysch Carpathians, where main tectonic phase was during Neogene (Książkiewicz, 1977). These two domains are separated by the narrow, tectonicaly complex belt - Pieniny Klippen Belt which was affected by Late Cretaceous and Tertiary tectonic phases.

Figure 1

Tectonic sketch map of the central part of the Carpathians



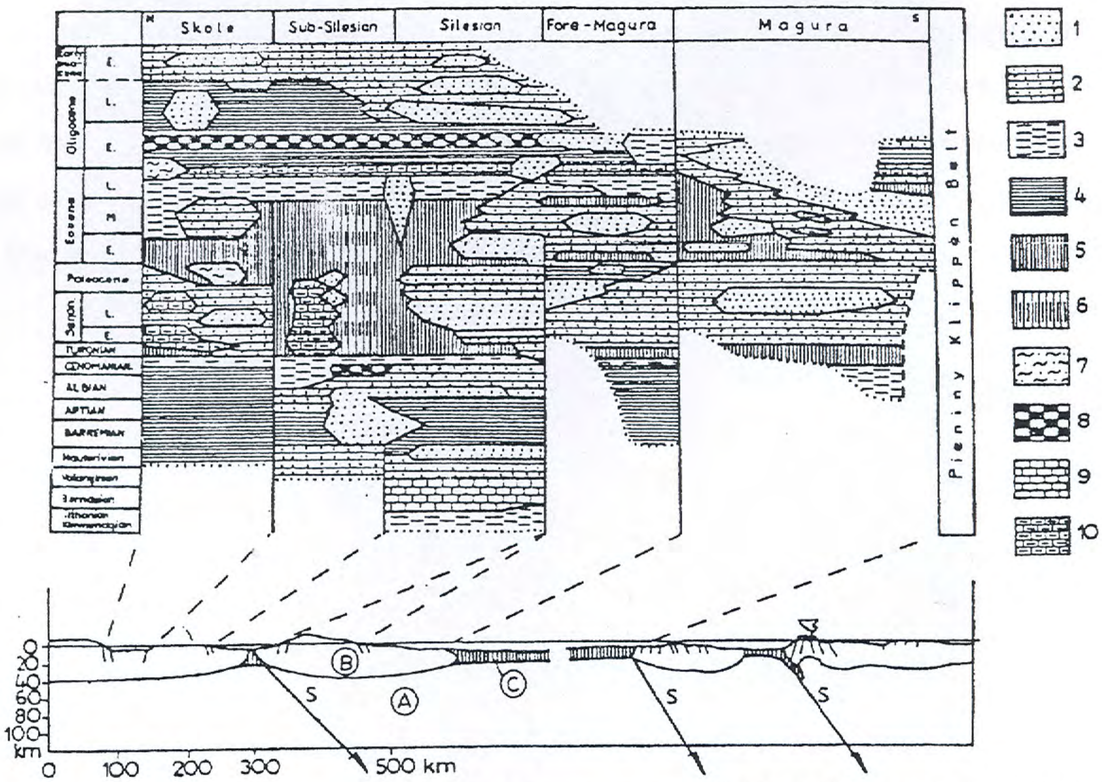
1 Foreland
2 Miocene
3 Marginal nappe of flysch zone
4 Skole Nappe of flysch zone
5 Sub-Silesian Nappe
6 Silesian Nappe
7 Dukla and Fore-Magura Nappe
8 Magura Nappe
9 Pieniny Klippen Belt
10 Pre-Palaeogene
11 Palaeogene
12 Tertiary Volcanics

Outer Carpathians[1]

The sedimentary sequence of the Outer Carpathians began in Kimmeridgian / Tithonian time and lasted till Early Miocene and flysch sedimentation predominated during the whole time.

Figure 2

ORIGIN OF VARIEGATED SHALES FROM FLYSCH



. Scheme of distribution of variegated shales in the Polish Carpathian Flysch (modified after Książkiewicz, in: Bieda et al. 1963, and Koszarski 1985). Palinspastic reconstructions of the Carpathian basins along the Kraków–Zakopane geotraverse (Aptian–Albian stage), based on Birkenmajer (1985) – simplified. A – mantle, B – continental crust, C – oceanic crust, S – subduction zones. 1 – thick-bedded flysch; 2 – thin- and medium-bedded flysch; 3 – shales and shaly flysch; 4 – black shales; 5 – variegated shales; 6 – variegated marls; 7 – chaotic deposits; 8 – siliceous deposits; 9 – turbiditic limestones; 10 – marls.

Leszczyński & Uchman, 1991

During the development of the Outer Carpathian geosyncline, several longitudinal sedimentary basins were created: from the south they were: Magura basin, Fore-Magura-Dukla basins, Silesian basin, Subsilesian basin, Skole basin (Książkiewicz, 1962). Flysch sediments were deposited in the deeper parts of these basins. The depth of the basins was relatively great as it is indicated by complete absence of shallow-water sedimentary structures and the total lack of shallow water fauna in the autochthonous sediments. The depth reached probably its

[1] As the excursion is taking place in the Outer Carpathians, that part of the Carpathians is described only.

Figure 3

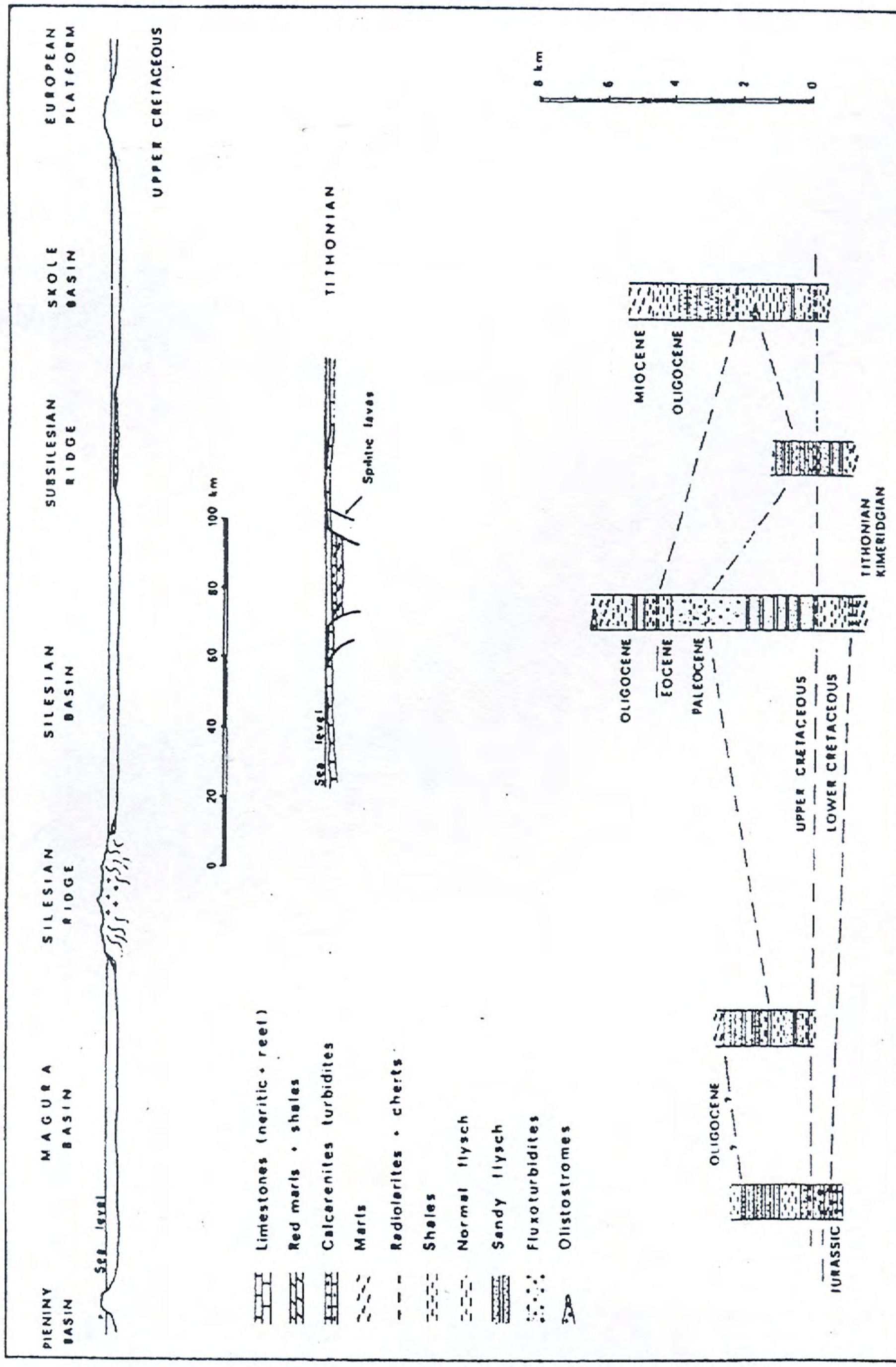


Fig. 3. Northern Carpathians. Paleogeographic domains (basins and ridges) during the Thitonian and the Upper Cretaceous and related stratigraphic columns. The sequences on the ridges are thinner with occasional reef deposits as compared to the sequences in the basins, which are thicker and often terrigenous.

Pescatore & Ślączka, 1984

maximum, about several thousand meters, in the Cenomanian, at the time when radiolarites and radiolaritic shales were deposited (Koszarski & Żytko, 1965). On the basinal slopes and submarine ridges pelitic and marly sediments (red and green marls and shales) prevailed. There was steady and continuous subsidence of the floor of the basins, which permitted the accumulation of flysch sediments of a very great thickness (more than 6000 m in several places). Detrital material which formed a system of deep sea fans was derived both from the margins of the Outer Carpathian geosyncline and from the islands (Cordilleras) which separated individual basins (Książkiewicz, 1965).

Figure 4

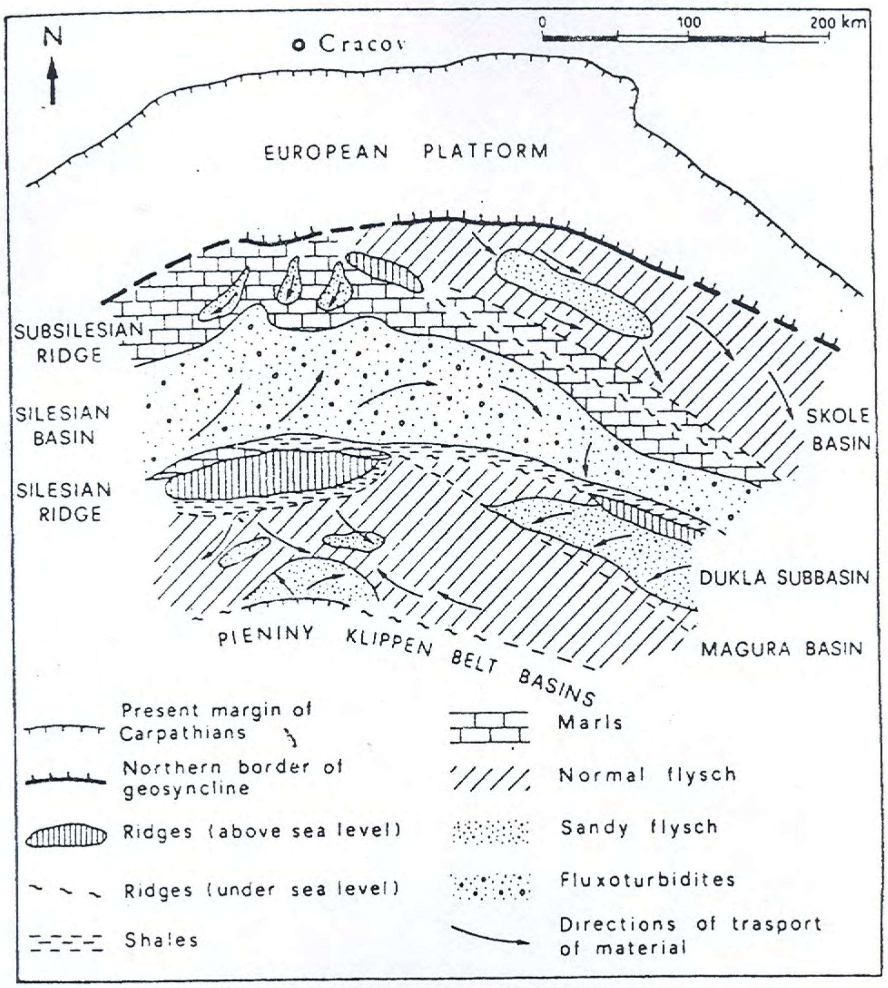
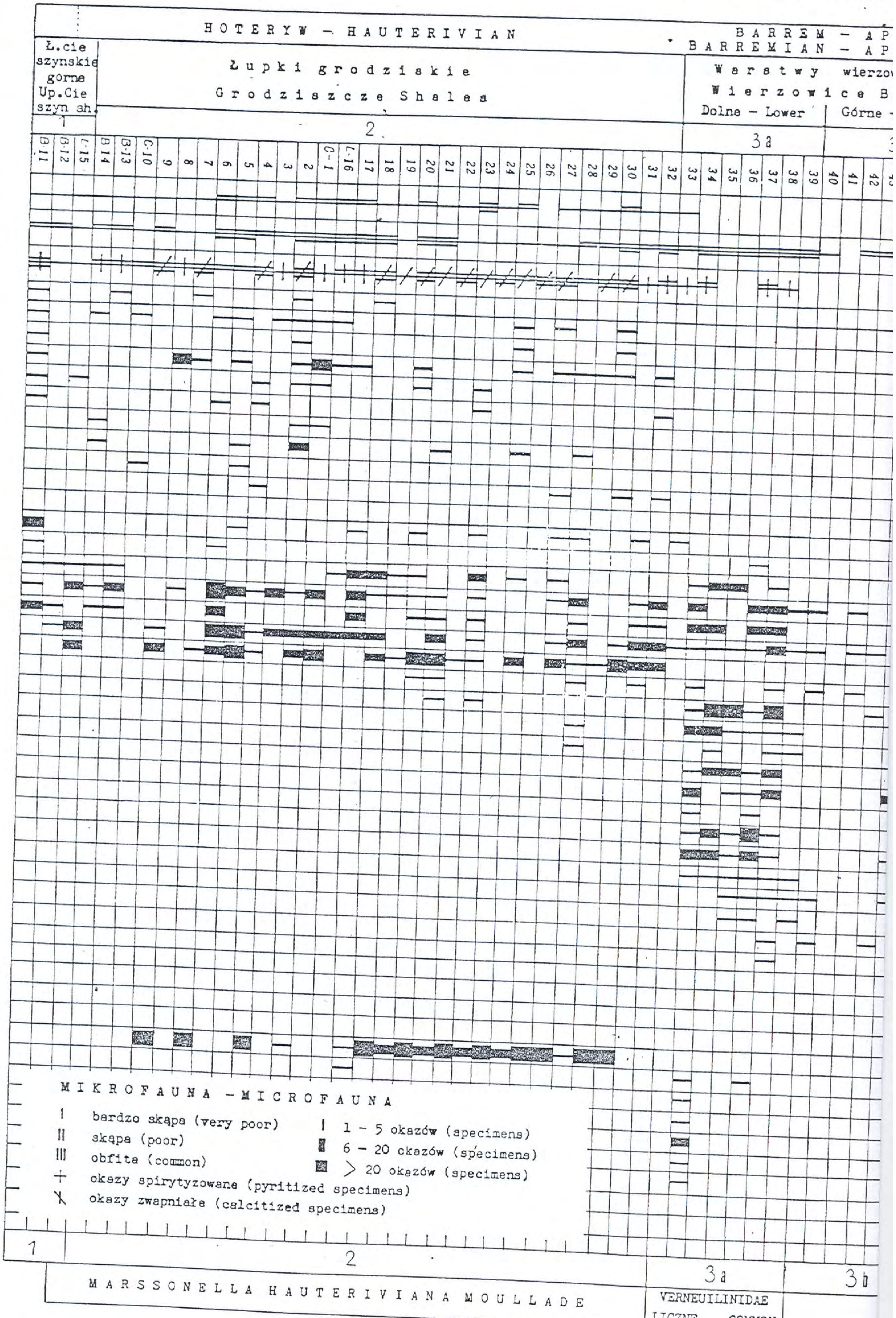


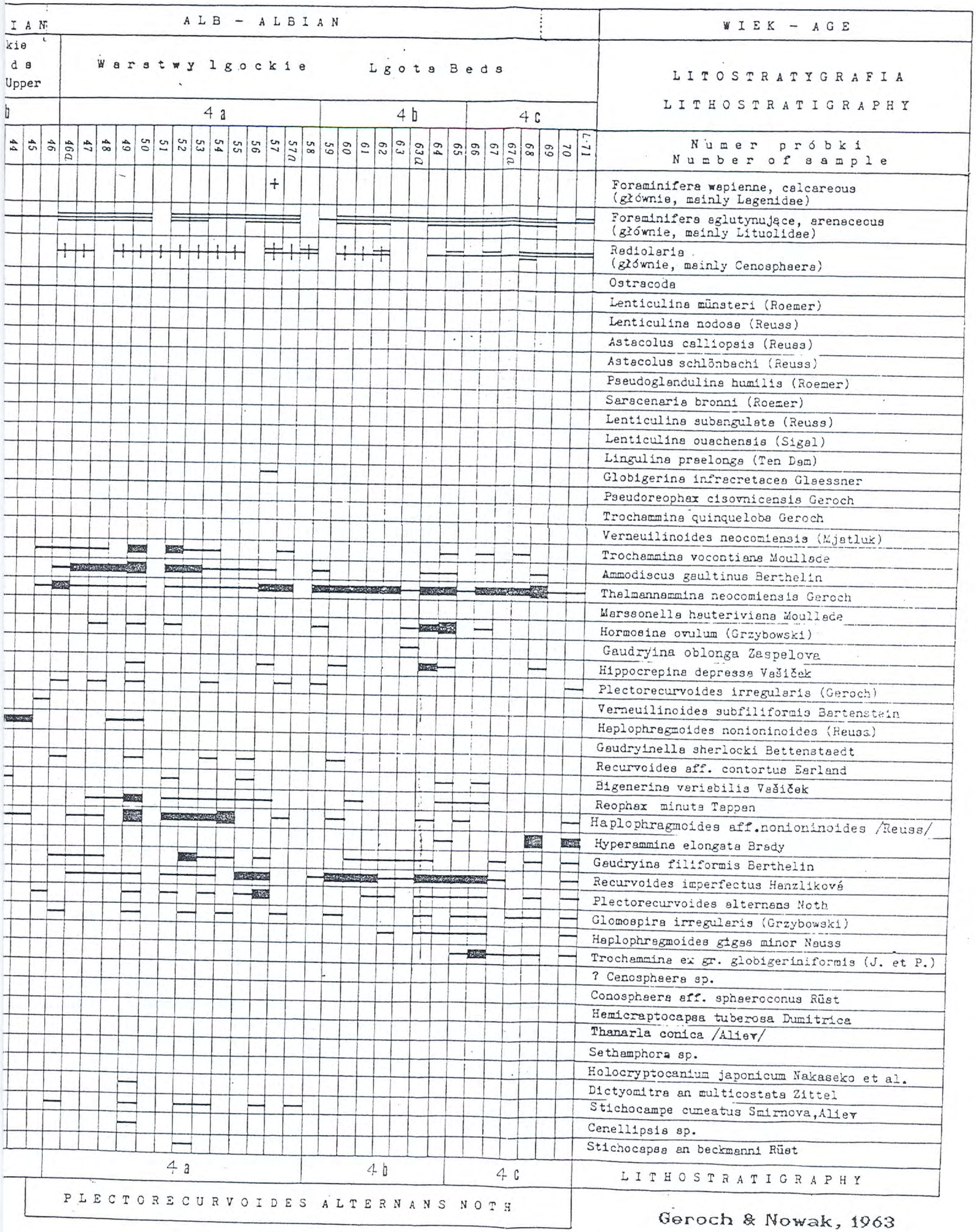
Fig. 4. Northern Carpathians. Source areas and paleocurrent directions in flysch basins.

Pescatore & Ślączka, 1984

Ranges of some



ıicrofossils in the Lower Cretaceous at Lipnik near Bielsko (Western Carpathians)



Geroch & Nowak, 1963
(partly modified)

During the development of the Outer Carpathians three mega-cycles can be distinguished (Koszarski, 1963). The first one (Tithonian - Albian) which started with calcareous turbidities was characterized by presence of the black shales and considerable uniformity of sediments within all basins. During the second cycle (Turonian - Late Eocene) there was characteristic appearance of red shales and differentiation of the sediments in the various basins. This cycle ended at the end of the Late Eocene with sedimentation of Globigerina marls. The third, final cycle (Oligocene - Early Miocene) was distinguished on the basis of the lack of red pelitic sediments and prevailing black and grey shales. During this cycle, once more, sediments in all basins became more uniform and there is very distinct migration of depocenters and tectonic movements across the Outer Carpathians.

During the Neogene (Miocene) orogenic phase the sedimentary basins were fully detached from their basement and transformed into separate nappes with a dominant northern direction of thrusting.

They are from the south:

Magura Nappe (bounded from the south by Pieniny Klippen Belt),

Dukla and Fore-Magura Complex Nappe,

Silesian Nappe,

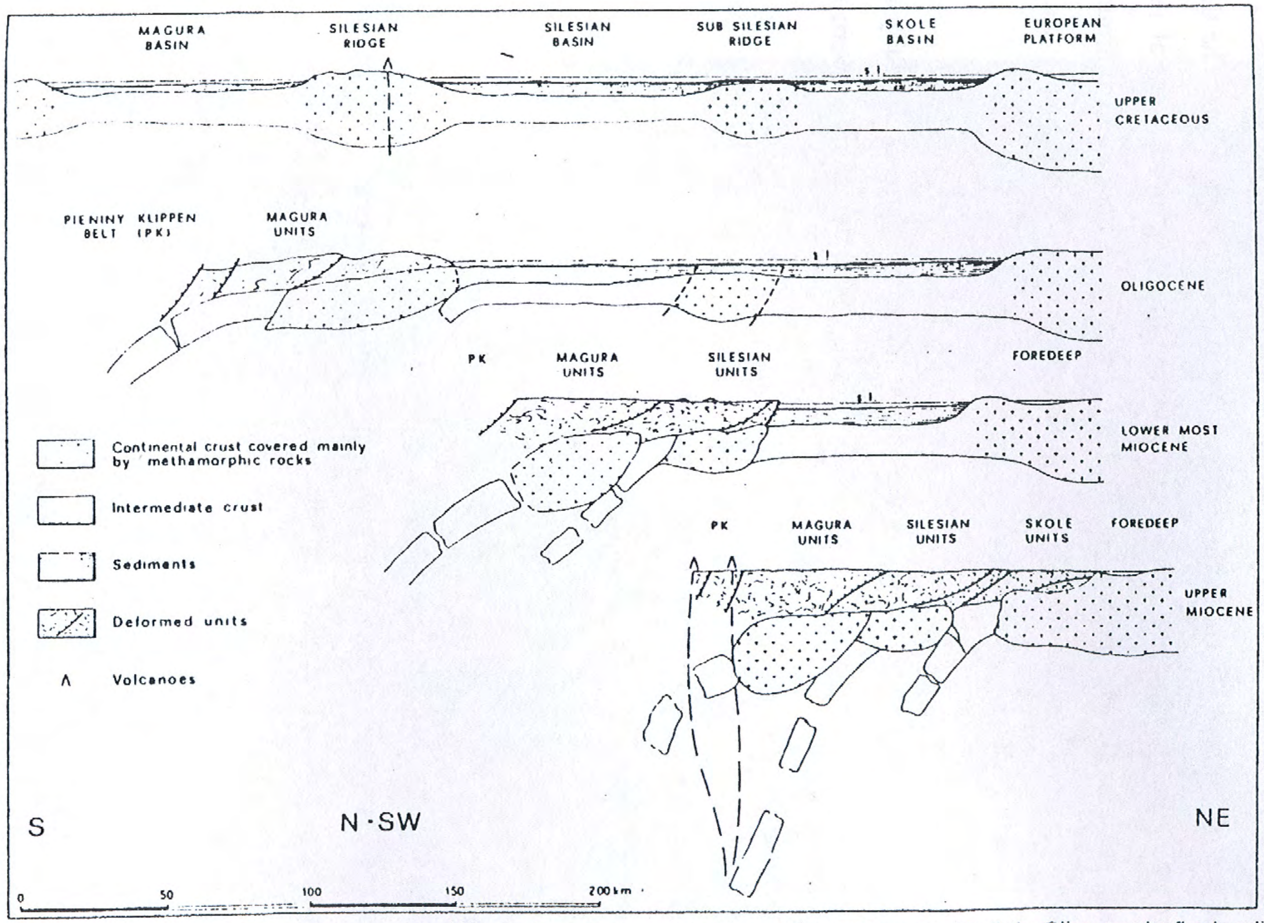
Subsilesian Nappe,

Skole Nappe.

The northward-moving flysch nappes caused a downwarping of the southern margin of the North European Platform, forming a tectonic depression being filled with thick Miocene molasse deposits of the Early and Middle Miocene age.

As the Carpathian orogeny proceeded northward, the depocentre of molasse sedimentation advanced with it (Oszczypko & Ślączka, 1989). During the northward movement of the Carpathian orogeny some of the internal elements of the Miocene molasse were folded and detached in front of the flysch nappes, and along the outer margin of the Carpathians a narrow belt of the folded Miocene deposits occurs. The extent of thrusting of nappes reaches 40 km in the western part of the Carpathians and the whole orogene is thrust over the North European platform for a distance over 60 km.

Figure 6



Northern Carpathians. Palinspastic sections from Upper Cretaceous to Upper Miocene (see text). Until the Oligocene the flysch sedimentation was related to the vertical movements of the ridges (tensile stage), while after the Oligocene the flysch deposition was related to a compressive stage. Diachronism and regressive trends characterize the flysch units during this late stage.

Pescatore & Ślączka, 1984

Łuczkowska & Rolewicz, 1990

No.	PROFILE I PRÓBY / SECTIONS & SAMPLES — TAKSONY OTWORNIC / FORAMINIFER TAXA	poprzecznia Rarańcza									poprz. Kunegunda			pop. Kaniów		poprzecznia Wałczyn									poprz. Kaniów			
		4	5	6	7	8	9	10	11	12	13	14	15	16	17	25	26	27	28	29	30	31	32	33	34	35	36	37
1	Reophax sp.	x																										
2	Alveolophragmium crassum		x		x								x	x								x						
3	Spiroplectammina carinata		x								x	x				x				x		x			x			x
4	— mariae				x		x						x	x		x				x		x	x	x	x	x	x	
5	— serrata				x								x															
6	Karreriella gaudryinoides																											
7	Textularia abbreviata																					x						
8	Listerella communis				x																	x						
9	Pseudotriplasia plana		x	x	x						x	x		x								x					x	
10	Pseudotriplasia minuta		x	x	x						x	x		x								x					x	
11	Quinqueloculina akneriana	x	x		x		x				x	x	x	x	x						x	x	x	x	x	x	x	x
12	— pygmea		x																									
13	— regularis															x					x		x					
14	— suturalis		x								x																	
15	— div sp											x				x										x		
16	Pyrgo amphiconica													x														
17	Pyrgo truncata																						x					
18	Borelis melo														x						x					x		
19	Dentalina elegans																				x					x		
20	Nodosaria longiscala																											
21	Nodosaria div. sp																											
22	Pseudonodosaria aequalis										x	x																
23	Amphimorphina haueriana							x																				
24	Plectofrondicularia adrena																											
25	Dimorphina variabilis																											
26	Lenticulina div. sp.																											
27	Marginulina sp.																											
28	Glandulina learigata																											
29	Haglundina elegans			x	x		x				x					x	x			x	x		x	x				
30	Globigerina apertura	x	x						x	x						x					x							
31	— bulloides	x	x						x	x	x					x					x							
32	— cognata																											
33	— concinna	x	x													x	x		x	x	x	x	x	x				
34	— decoraperta	x	x	x				x	x	x						x	x	x	x	x	x	x	x	x	x			
35	— diplostoma	x	x						x	x						x	x	x	x	x	x	x	x	x	x	x		
36	— praebulloides	x	x																									
37	— subcretacea																											
38	— woodi																											
39	Globigerinoides immaturus							x																				
40	— trilobus	x	x					x	x	x						x				x				x	x	x		
41	Globoquadrina dehiscens							x												x								
42	Candorbulina suturalis							x																				
43	Hastigerina obesa							x																				
44	Hastigerina opinata																											
45	Turborotalia acrostoma							x																				
46	— bykovae							x																				
47	— conica	x						x																				
48	Sphaeroidina bulloides																											

No.	FORAMINIFER TAXA	poprzecznia Eichmüller											podłużnia Tyrol						
		EH 1	EH 2	EH 3	EH 4	EH 5	EH 7	EH 8	EH 9	EH 10	EH 11	EH 12	EH 13	EH 14	EH 15	EH 16	EH 18	EH 20	Tr
1	Reophax sp.																		
2	Alveolophragmium crassum																		
3	Spiroplectammina carinata										x		x	x	x				
4	— mariae												x	x	x				
5	— serrata																		
6	Karreriella gaudryinoides										x								
7	Textularia abbreviata																		
8	Listerella communis																		
9	Pseudotriplasia plana											x							
10	Pseudotriplasia minuta											x							
11	Quinqueloculina akneriana		x	x	x	x							x	x	x		x	x	
12	— pygmea																		
13	— regularis																		
14	— suturalis																		
15	— div sp																		
16	Pyrgo amphiconica												x	x	x				
17	Pyrgo truncata																		
18	Borelis melo																		
19	Dentalina elegans																		
20	Nodosaria longiscala																		
21	Nodosaria div. sp																		
22	Pseudonodosaria aequalis																		
23	Amphimorphina haueriana																		
24	Plectofrondicularia adrena										x								
25	Dimorphina variabilis										x								
26	Lenticulina div. sp.																		
27	Marginulina sp.										x								
28	Glandulina learigata												x	x	x				
29	Haglundina elegans																x		
30	Globigerina apertura		x	x	x	x	x						x	x	x		x	x	x
31	— bulloides		x			x				x			x	x	x				
32	— cognata					x	x	x	x								x		
33	— concinna						x	x	x	x									
34	— decoraperta					x	x	x	x	x								x	x
35	— diplostoma				x	x	x	x	x	x			x	x	x		x	x	x
36	— praebulloides	x			x	x				x			x	x	x		x		
37	— subcretacea				x	x				x									
38	— woodi																		
39	Globigerinoides immaturus																		
40	— trilobus	x																	
41	Globoquadrina dehiscens	x																	
42	Candorbulina suturalis																		
43	Hastigerina obesa						x	x		x									
44	Hastigerina opinata						x	x		x									x
45	Turborotalia acrostoma					x	x	x		x								x	
46	— bykovae					x	x	x										x	
47	— conica																		
48	Sphaeroidina bulloides																		

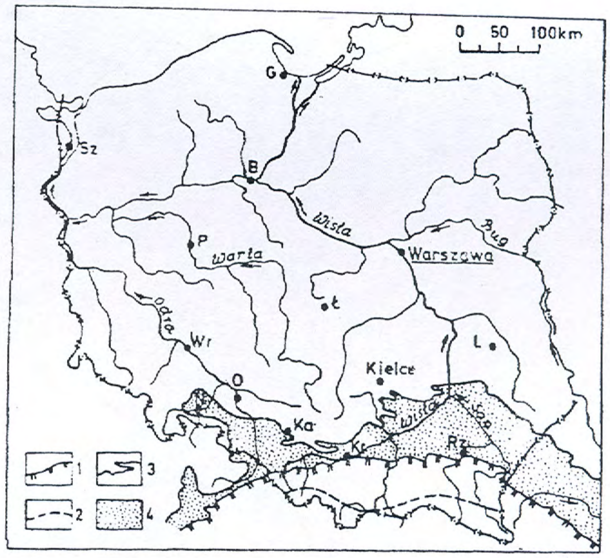
No.	FORAMINIFER TAXA	otwór / borehole H-11 — głęb. w m / depth in m																					
		106.6	107.0	107.5	108.7	109.0	110.0	111.0	112.0	112.5	113.5	116.5	117.5	118.5	120.5	121.5	122.5	123.5	124.5	141.0	149.0	149.5	152.0
1	Reophax sp.																						
2	Alveolophragmium crassum						x																
3	Spiroplectammina carinata	x	x	x															x	x		x	x
4	— mariae								x														
5	— serrata																						
6	Karreriella gaudryinoides		x	x			x		x										x			x	x
7	Textularia abbreviata																						
8	Listerella communis																						
9	Pseudotriplasia plana						x	x	x											x	x	x	
10	Pseudotriplasia minuta						x	x	x											x	x	x	
11	Quinqueloculina akneriana				x	x	x	x	x		x	x	x	x	x	x	x	x		x		x	
12	— pygmea																						
13	— regularis																						
14	— suturalis																						
15	— div sp																						
16	Pyrgo amphiconica																						
17	Pyrgo truncata																						
18	Borelis melo																						
19	Dentalina elegans					x			x														
20	Nodosaria longiscala								x										x				
21	Nodosaria div. sp					x			x										x				
22	Pseudonodosaria aequalis																						
23	Amphimorphina haueriana																		x				
24	Plectofrondicularia adrena																						
25	Dimorphina variabilis																						
26	Lenticulina div. sp.	x	x	x																			
27	Marginulina sp.	x																					
28	Glandulina learigata																						
29	Haglundina elegans					x			x			x	x	x	x	x	x	x			x		
30	Globigerina apertura								x			x	x	x	x	x	x	x		x			
31	— bulloides		x	x		x		x				x	x	x	x	x	x	x		x		x	x
32	— cognata					x														x			
33	— concinna																						
34	— decoraperta		x	x		x		x				x	x	x	x	x	x	x	x	x	x	x	x
35	— diplostoma					x		x				x	x	x	x	x	x	x		x	x	x	x
36	— praebulloides		x	x		x		x															
37	— subcretacea					x																x	x
38	— woodi											x	x	x	x	x	x	x					
39	Globigerinoides immaturus																						
40	— trilobus		x	x		x		x											x				x
41	Globoquadrina dehiscens		x	x		x		x											x				
42	Candorbulina suturalis		x	x		x		x											x				
43	Hastigerina obesa		x	x		x																	
44	Hastigerina opinata																						
45	Turborotalia acrostoma		x	x															x				
46	— bykovae		x	x																			
47	— conica																						
48	Sphaeroidina bulloides																						

TABLE 1

49	Bolivina dilatata															x													x	x	x	x	x	x	x
50	— polonica							x								x													x				x	x	
51	— pseudoplicata																																		
52	— vienensis																																		
53	Stilostomella adolphina			x	x		x		x	x		x				x	x	x		x	x	x	x	x	x		x						x		
54	— elegans			x	x							x																							
55	— neudorphensis																																		
56	Bulimina aculeata	x			x																x								x						
57	— buchiana																																		
58	— echinata			x										x																					x
59	— elongata													x		x	x			x	x	x	x	x				x		x	x	x	x	x	
60	— gibba	x		x	x	x		x	x	x				x		x	x	x	x	x	x	x	x	x	x		x	x		x	x	x	x	x	x
61	— inflata					x				x						x	x	x		x	x	x		x	x		x								x
62	— striata			x	x		x		x	x	x	x				x	x			x	x	x		x	x	x	x								x
63	— subulata																																		
64	Globobulimina ovata																																		
65	— pyrula	x	x														x				x	x	x			x		x						x	
66	Uvigerina aculeata	x					x																						x						
67	acuminata							x																											
68	— asperula											x	x			x	x	x		x	x	x	x	x	x	x	x			x					x
69	— brunnensis												x			x				x	x				x	x	x		x						
70	— costai	x		x						x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		x	x	x	x		
71	— costata							x																											
72	— laviculata																																		
73	— pudica			x	x					x	x		x	x	x	x	x	x		x	x	x	x	x	x		x			x	x	x	x		
74	— urnula	x		x						x	x																								x
75	Fursenkoina schreibersiana		x	x	x		x									x	x	x	x	x	x	x		x	x		x								
76	Cassidulina margareta																																		
77	— punctata			x																									x			x	x		x
78	Globocassidulina subglobosa							x																											
79	Caucasina gutsulica	x					x		x	x	x		x	x		x				x		x						x							
80	Valvulineria complanata	x	x		x		x	x	x	x	x			x		x	x	x	x	x	x	x	x	x	x		x	x	x	x	x	x	x	x	
81	Eponides repandus										x	x		x																					
82	Heterolepa dutemplei													x		x		x			x		x	x	x	x									
83	— haidingeri							x																											
84	Glabratella platyomphala																		x							x									
85	Cibicides aknerianus										x																								
86	— lobatulus						x							x		x					x									x	x	x	x		x
87	Cibicidoides conspiciendus														x																				
88	— pseudoungerianus																																		
89	ungerianus		x		x		x				x	x				x		x		x	x			x	x		x		x		x	x	x		x
90	Hanzawaia boueana											x						x														x			
91	Asterigerina minula			x																															
92	— planorbis																									x			x						
93	Florilus boueanus																																		
94	Nonion depressulum																									x									
95	Pullenia miocenica			x			x		x	x		x	x	x		x	x	x	x	x	x	x	x	x	x		x								x
96	— quinqueloba							x																											
97	— subcarinata																		x																
98	Astrononion perfossum																		x																
99	Melonis formosus	x					x				x																								
100	— soldanii			x			x				x	x				x	x	x		x	x		x	x	x	x	x	x							
101	Allomorphina trigona																																		
102	Ammonia beccarii																	x								x									
103	Elphidium advenum																																		
104	— crispum														x											x									
105	— fichtelianum	x					x																			x									
106	— flexuosum																									x									
107	— macellum														x				x	x						x			x						

49	Bolivina dilatata	x		x					x				x					x	x														x	x
50	— polonica												x	x	x																			
51	— pseudoplicata																																x	x
52	— vienensis												x	x	x																			
53	Stilostomella adolphina					x	x	x				x		x	x	x		x	x	x	x	x											x	
54	— elegans			x									x	x	x				x	x	x									x	x			
55	— neudorphensis			x																														
56	Bulimina aculeata									x			x		x		x	x	x	x	x											x		
57	— buchiana																	x																
58	— echinata				x													x		x	x										x	x		
59	— elongata			x	x				x	x								x					x	x	x	x	x	x	x		x			
60	— gibba	x	x	x	x				x	x	x												x	x	x	x	x	x	x	x	x	x		
61	— inflata				x					x	x		x					x		x	x	x	x	x	x	x	x	x	x	x			x	x
62	— striata									x			x	x	x			x	x	x	x			x	x	x	x	x	x		x	x	x	x
63	— subulata												x	x	x			x							x	x	x	x	x					
64	Globobulimina ovata				x					x			x	x	x	x																		
65	— pyrula	x	x																															
66	Uvigerina aculeata																																	
67	acuminata			x																														
68	— asperula			x						x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
69	— brunnensis									x				x	x		x	x					x			x	x				x		x
70	— costai	x	x		x	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
71	— costata			x																														
72	— laviculata			x																														
73	— pudica				x	x	x				x	x		x	x	x		x	x	x	x		x	x	x	x	x	x	x		x	x	x	x
74	— urnula																		x			x									x	x	x	
75	Fursenkoina schreibersiana					x	x	x					x					x					x	x	x	x	x	x	x				x	
76	Cassidulina margareta																	x													x			
77	— punctata									x	x	x						x	x				x	x	x	x	x	x	x		x			
78	Globocassidulina subglobosa			x																														
79	Caucasina gutsulica									x							x			x	x	x	x	x	x	x	x	x	x	x	x	x	x	x
80	Valvulineria complanata	x	x		x	x	x	x	x	x		x				x	x	x	x													x		
81	Eponides repandus																																	
82	Heterolepa dutemplei	x											x										x	x	x	x	x	x	x					
83	— haidingeri																																	
84	Glabratella platyomphala																																	
85	Cibicides aknerianus																																	
86	— lobatulus				x	x	x	x		x		x	x				x	x	x				x	x	x	x	x	x	x			x		
87	Cibicidoides conspiciendus			x																														
88	— pseudoungerianus			x						x			x	x	x																	x		
89	ungerianus			x						x	x			x	x	x		x													x			
90	Hanzawaia boueana															x																		
91	Asterigerina minula																	x																
92	— planorbis																	x																
93	Florilus boueanus												x	x	x	x																		
94	Nonion depressulum																x																	
95	Pullenia miocenica				x	x	x					x		x	x	x	x	x		x	x	x	x	x	x	x	x	x	x	x	x	x		
96	— quinqueloba																																	
97	— subcarinata																																	
98	Astrononion perfossum																																	
99	Melonis formosus																																	
100	— soldanii				x	x	x		x				x				x	x		x	x		x	x	x	x	x	x	x				x	x
101	Allomorphina trigona			x																														
102	Ammonia beccarii																																	
103	Elphidium advenum																x																	
104	— crispum																																	
105	— fichtelianum																																	
106	— flexuosum																																	
107	— macellum																	x		x	x		x	x	x	x	x	x	x					

Figure 8

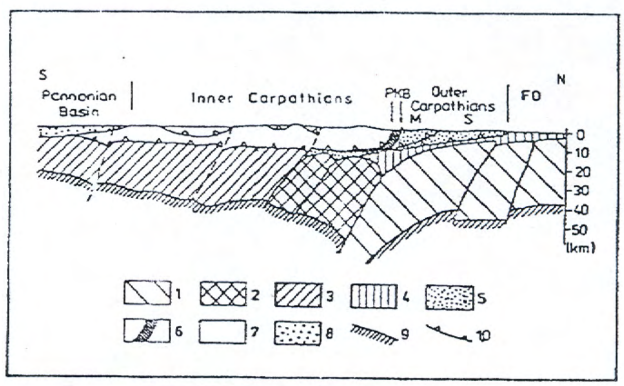


Miocene Basin: 1 - actual edge of the Carpathians, 2 - presumably extension of the Miocene below the Carpathians, 3 - northern edge of the Miocene Basin, 4 - Carpathian Foredeep; B - Bydgoszcz, G - Gdańsk, Ka - Katowice, Kr - Kraków, L - Lublin, Ł - Łódz, N - Nysa, O - Opole, P - Poznań, Rz - Rzeszów, Wr - Wrocław, Sz - Szczecin

(after Łuczkowska)

Figure 9

Hypothetical deep cross section through Carpathians along meridian of Kraków



1- North European Platform
2- Outer Carpathians basement
3- Inner Carpathians basement
4- Neogene in Carpathian foredeep (molasse)
5- Outer Carpathian flysch
6- Pieniny Klippen Belt
7- Inner Carpathians
8- Neogene of intermontaine basins
9- Moho
10- Overthrusts

M - Magura Nappe
S - Silesian Nappe
FD - Carpathian Foredeep

Oszczypko & Ślączka, 1986

EXCURSIONS

EXCURSION TO THE WIELICZKA SALT MINE

12 September, 1993

Itinerary: Kraków - Wieliczka - Kraków

The Wieliczka halit deposit is a part of a vast area of evaporites connected with the Carpathian Foreland, and belongs to its inner, strongly folded part. The evaporites formed during the salinity crisis which affected the Carpathian Foredeep basin at the beginning of the Serravalian (Middle Miocene, ±15 My). The halite deposits consist of two members: lower - Stratified and upper - Breccia Member. Stratified Member displays sedimenetary structures which show that the bulk of the halite layers represent sediments produced by redeposition by gravity mass movements. The Breccia Member represents olistostromes deposited by the submarine debris flow.

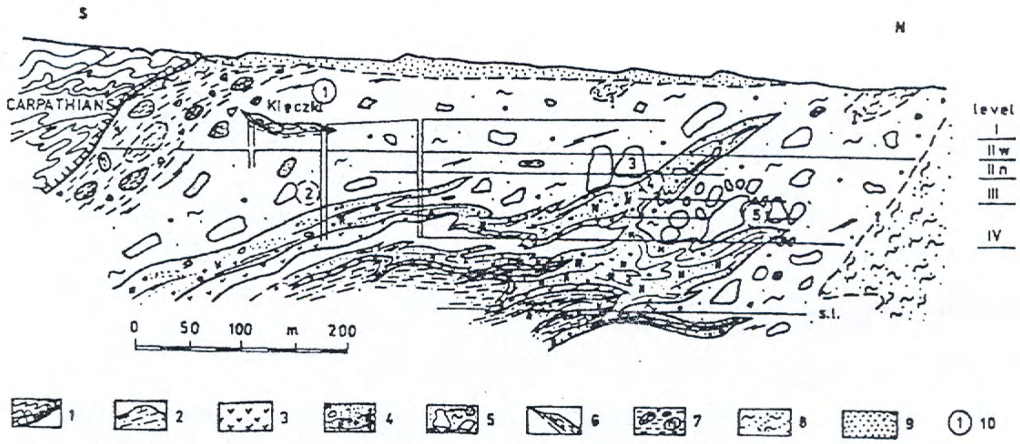
Figure 10

Fig.10. Map showing position of salt bearing deposits in Wieliczka-Bochnia region. 1 — salt deposits in overthrust unit; 2 — northern margin of the Carpathians; 3 — boreholes (after Garlicki, 1975)

It appears that the rocks of the Stratified Member are practically devoid of autochtonous microfauna. In the Breccia Member, rich and well preserved microfauna occurs in redeposited marly claystones. This microfauna represents various environments. The composition of the assemblage is shown in Table 1.

The itinerary of the excursion will cover the galleries and chambers excavated in XVII - XIX c. of the tourist route and the museum. They are situated in the central and western parts of the salt deposits. The galleries usually cross the Stratified Member and chambers which are

Figure 11

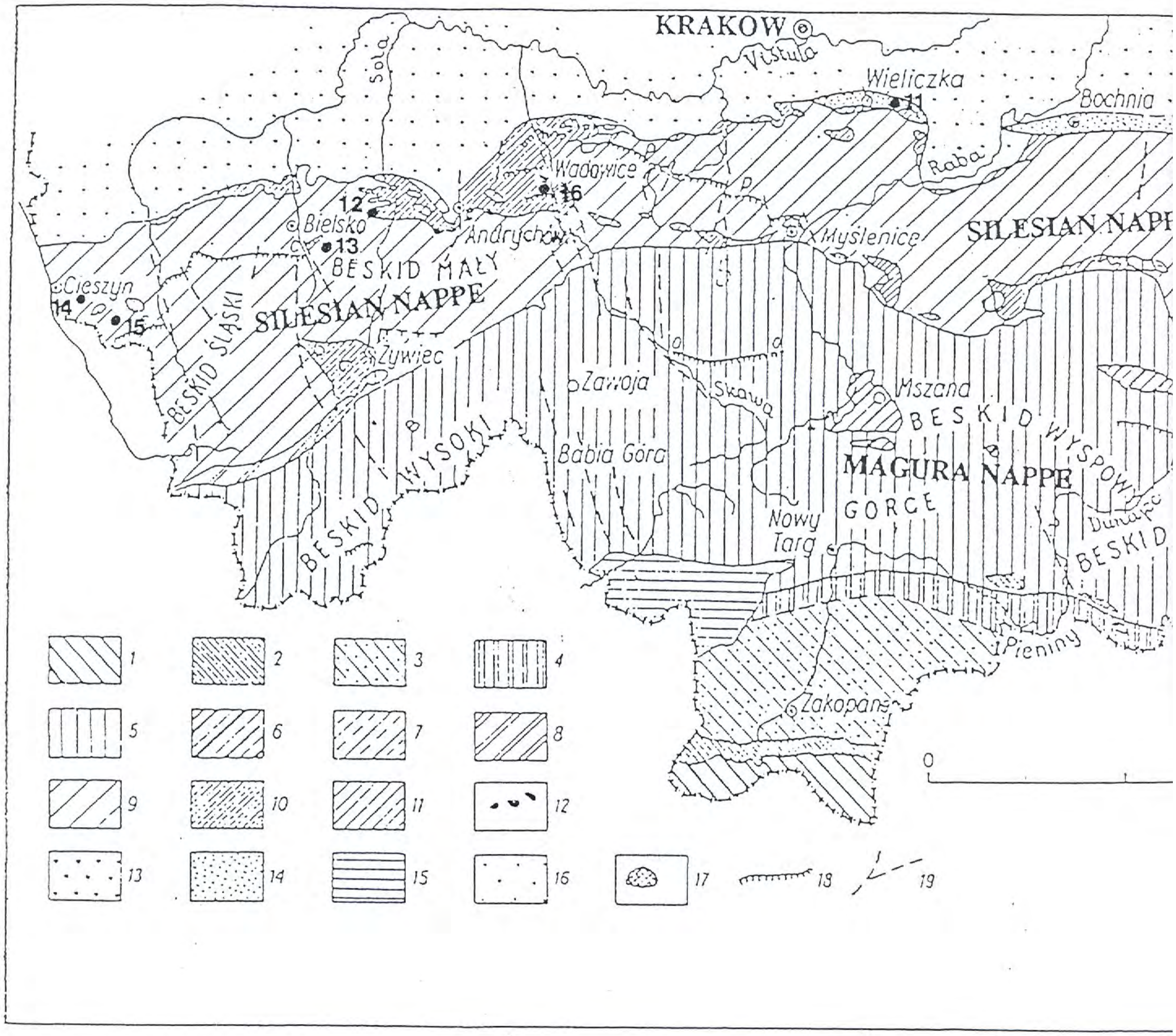


Transversal cross-section of the Wieliczka Salt Mine. *1* – Carpathians; *2* – marly claystones, Skawina Beds; *3* – lower part of the Stratified Member: green and shaft salt with anhydrites and mudstones; *4* – upper part of the Stratified Member: spiza salt (submarine fan deposit); *5* – Chaotic Member: Zuber (olisthostromes with rock salt blocks); *6* – Chaotic Member: lens of salt conglomerate and sandstone; *7* – Chaotic Member: olisthostromes with Carpathians and Miocene blocks, without salt blocks; *8* – Chodenice Beds; *9* – Quaternary; *10* – stops

(Kolasa & Ślączka, 1985)

excavated in huge salt blocks within the Breccia Member. In a few places a contact between the two members is visible.

TECTONIC SKETCH MAP C

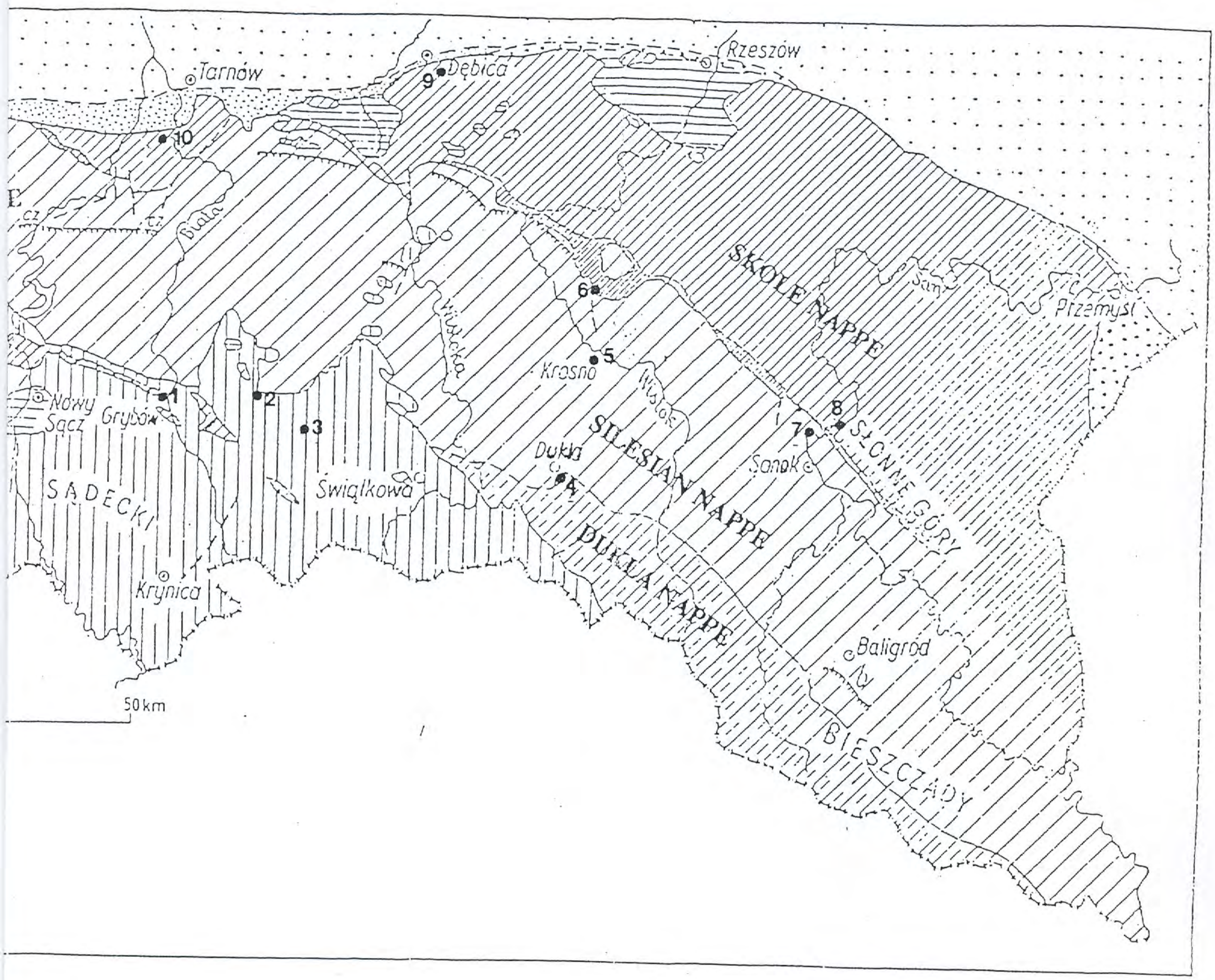


1- Inner Pre-Palaeogene Tatra Unit
2- Inner Pre-Palaeogene Sub-Tatra Nappes
3- Inner units post-orogenic cover
4- Pieniny Klippen Belt
5- Magura Nappe
6- Tectonic Windows of Magura Nappe
7- Dukla Nappe
8- Fore-Magura Nappe
9- Silesian Nappe
10- Sub-Silesian Nappe
11- Skole Nappe
12- Andrychow Klippe
13- Stebnik Unit
14- Wieliczka and Bochnia Folds
15- Neogene
16- Autochthoı
17- Andesites :
18- Overthrust

•1 — •16 -

F THE POLISH CARPATHIANS

Figure 7



Książkiewicz, 1977

ous Miocene

d other magmatic rocks

Exposures described in Guidebook

EXCURSION A

16 - 18 September, 1993

First Day

Itinerary: Kraków - Nowy Sącz - Szymbark - Siary - Gorlice - Iwonicz Zdrój

Leaving Kraków, the itinerary of the excursion will bring us along the Carpathian Foredeep. The higher hills towards the south mark the northern border of the Carpathians. The part of the Carpathians situated southeast from Kraków is made up of five, well defined nappes all thrust upon each other. From south to north, these are:

The Magura Nappe,
The Dukla-Fore Magura Nappe,
The Silesian Nappe,
The Sub-Silesian Nappe,
The Skole Nappe.

During this day the excursion will visit the exposures within the Magura Nappe.

At the town of Brzesko the route will enter the Carpathians and cross several flat folds of the Silesian Nappe. The bank of the artificial lake supplies several outcrops of the Late Cretaceous thick-bedded sandstones (Lower Istebna Beds). South from Jakubowice the excursion party will pass the northern margin of the Magura Nappe.

The northern part of the Magura Nappe either rests on different units belonging to the Dukla-Fore-Magura Nappe or directly on the Silesian Nappe. It consists of several disharmonic folds. The exposed part of the Magura sequence begins with sediments from the Mid-Cretaceous to the Oligocene. On the basis of lithologic criteria, four facies zones can be distinguished from south to north: the Krynica Subunit which corresponds to the Kochanovice Unit in Slovakia, the Sącz subunit corresponding to the Bystrica Unit, the Gorlice Subunit corresponding to the Raca Subunit and the Siary Subunit.

The excursion will visit mainly the Siary Subunit. It consists of the following beds:

the Inoceramian Beds: Late Senonian - Palaeocene, the Swiątkowa Beds: Palaeocene (uppermost part of Inoceramian Beds), the Variegated Shales with intercalations of thick-bedded, glauconitic sandstones: Palaeocene - Late Eocene, the Magura, glauconitic sandstones: Late Eocene - Oligocene.

After crossing the Dunajec river, a quarry in the Oligocene sandstones is seen towards the north. These sandstones belong to the Fore-Magura Nappe system, exposed in the tectonic window. Near the town of Nowy Sącz the route will cross the Miocene piggy-back basin laying on the Magura Nappe. After passing Nowy Sącz the route will run until Grybów along the marginal part of the Magura Nappe. In this part several fragments of the lower tectonic units are tectonically incorporated into the Magura Nappe creating the so called tectonic windows.

Exposure 1. Grybów

In Grybów along Biała river it is possible to observe an exposure of the Late Cretaceous Inoceramian Beds represented by thick- and medium-bedded, laminated sandstones intercalated by grey and green shales and marls. Agglutinated foraminifers from the Inoceramian Beds are: *Rhabdammina cylindrica* Glaessner, *Rh. robusta* (Grzybowski), *Nothia excelsa* (Grzybowski), *N. latissima* (Grzybowski), *Rhizammina indivisa* Brady, "*Bathysiphon*" sp., *Saccammina placenta* (Grzybowski), *S. scabrosa* Mjatliuk, *S. grzybowskii* (Schubert), *Ammodiscus cretaceus* (Reuss), *A. tenuissimus* Grzybowski, *Glomospira charoides* (J. et P.), *G. gordialis* (J.et P.), *G. serpens* (Grzybowski), *G. irregularis* (Grzybowski), *G. grzybowskii* Jurkiewicz, *Reophax* cf. *pilulifer* Brady, *R. splendida* Grzybowski, *Kalamopsis grzybowskii* (Dylążanka), *Hormosina excelsa* (Dylążanka) *H. ovulum* (Grzybowski), *H. velascoensis* (Cushman), *H. gigantea* Geroch, *Aschemocella* div.sp., *Recurvoides* div. sp., *Cystaminella* div.sp., *Karrerulina* div.sp., *Rzehakina epigona* (Rzehak), *Rz. inclusa* (Grzybowski).

Microfaunal analysis has displayed distinct vertical differentiation in foraminiferal assemblages in individual shally banks (Table 2).

From Grybów up to Szymbark, the excursion will follow the marginal part of the Magura Nappe.

Exposure 2. Szymbark

At Szymbark in the stream-bed of the Ropa river, near the small creek of Bielanka, the Inoceramian Beds are exposed.

Figure 12

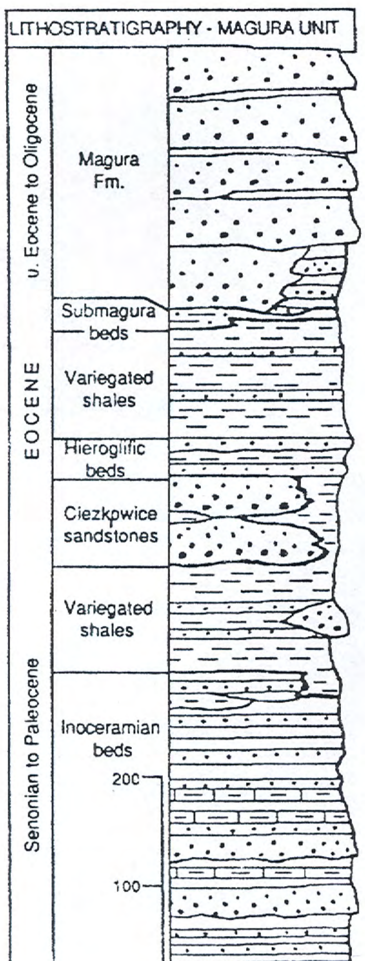


Figure 12. Composite stratigraphic column of the Magura Unit in the Siary-Szymbark area.

These are dark-grey and greenish shaly silts and argillaceous shales, alternated with thin- and medium-bedded, fine and medium grained, calcareous laminated, micaceous sandstones. Locally thick-bedded, medium and coarse grained sandstones are developed. This part of the Inoceramian Beds belongs to the Late Senonian and corresponds to the Inoceramian Beds described by Dylążanka in the Szymbark Quarry (Dylążanka, 1923). In the shales, the following species have been found (Table 3).

TYPES OF INTERTURBIDITIC SHALES AND THEIR MICROFOSSILS

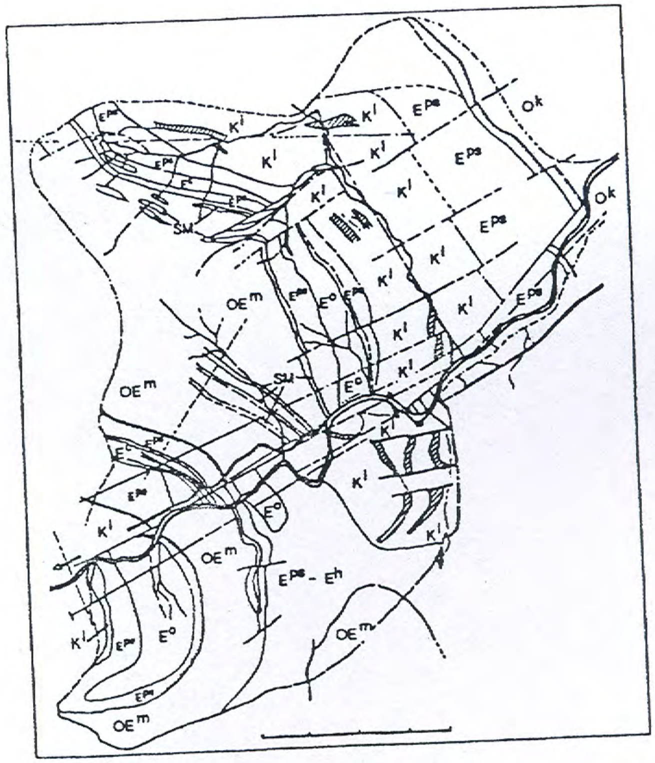
Outcrop of Inoceramian beds /late Senonian/, Magura nappe, in the Biała Dunajcowa river at Grybów, Outer Carpathians

Planktonic forams /very rare/			x										
Calcareous benthic forams /v.r./			x		x			x					
"Cenosphaera" lenticularis				x				x	x				
Rzehakina inclusa, Rz.epigona		x	x	x						x	x		
Hormosina excelsa		x	x	x	x	x			x	x	x		
Hormosina ovulum		x					x						
Trochamminoides, Recurvoides		x	x	x	x	x	x	x	x	x	x		
Reophax		x	x	x	x	x	x			x	x		
Ammodiscus, Glomospira		x	x	x	x	x	x			x	x		
Saccammina placenta, Psammosphaera		x	x	x	x	x	x	x		x	x		
Rhabdammina, Nothia Rhizammina, Hyperammina		x	x	x	x	x	x	x	x	x	x		
Big "Bathysiphon" Aschemocella		x		x		x				x			
Percent of fragments of tubular forams		40	45	45	70	60	80	60	70	80	80		
Amount of specimens of forams pro 100 g of rock		900	90	700	550	600	100	35	45	1000	300		
Lithology	sandstone	dark shale	beige-grey sh.	dark-grey shale	beige sh.	grey sh.	greenish sh.	grey sh.	beige sh.	grey sh.	greenish-grey sh.	"laminated" sandstone	convoluted sandstone
Number of layer	13	12	11	10	9	8	7	6	5	4	3	2	1
Thickness of layer /cm/	19	1	2	10	2	2	3	4	3	2	5	14	
	turbidite	pelagic autochthonous (—) or partly resedimented by slow bottom currents										turbidite	

Planktic foraminifers in layer 11: Globotruncana cf.arca, G.cf.stuarti, Rugoglobigerina sp.

after Geroch

Figure 13



Geological map of the Szymbark area, after Sznicer (1991).
E^c - Ciężkowice sandstones, E^{ps} - Variegated shales, E^h - Hieroglyphic beds, K^i - Inoceramian beds with lenses of red shales, K^{is} - thick-bedded sandstones of the Inoceramian beds, OE^m - Magura Formation, SM - Sub-Magura shales.

Exposure 3. Ropica

At Ropica, along the stream-bed of the Sękówka river, near the road bridge, a cross-section made up of the Inoceramian Beds, Swiątkowa Beds, Variegated Shales, Sub-Magura Beds and Magura Sandstones will be visited.

The Inoceramian Beds consist of alternating medium-and thin-bedded, laminated calcareous sandstones and grey-green shales. The upper surfaces of the sandstones are covered with numerous organic traces. The abundant microfauna contains the Late Cretaceous assemblages (Table 4).

The Inoceramian Beds are overlain by the Swiątkowa Beds, a complex consisting mainly of dark grey and black shales with subordinate intercalations of thin-bedded, laminated sandstones. The foraminiferal assemblages are shown in Table 4.

SZYMBARK section shale-samples	5.7.91-2 light green	" -3 grey	" -4 green-grey	12.8.91-2a "	" -2b grey	" -2c green-grey	" -2d light green	" -2e green-grey
Frequency of fossils in washed residue	R-F	R-F	R-F	F-C	C	C	R	F
Rhabdammina cylindrica	x				x			
Rh.robusta					x		x	x
Nothia excelsa	x	x	x	x	x!	x	x	x
N.latissima			x		x			
Rhizammina indivisa			x	x	x	x		x
Saccammina placenta	x			x	x	x!		x
S.scabrosa				x	x			
Ammodiscus cretaceus	x	x	x	x	x	x		x
A.tenuissimus				x	x	x		x
Glomospira gordialis	x	x				x	x	
G.charoides								x
G.grzybowskii	x							x
G.irregularis						x		
Reophax cf.pilulifer					x	x		
R.duplex			x	x	x	x		x
R.scalaria + R.splendida					x	x		x
Kalamopsis grzybowskii					x			
Hormosina excelsa	x	x		x	x	x		x
H.ovulum		x						
Trochamminoides div.sp.	x	x	x	x	x	x	x	x
Recurvoides div.sp.	x	x	x	x	x	x	x	x
Cystamminella div.sp.	x			x	x	x		
Karrerulina tenuis							x	x
Rzehakina sp.				x	x	x		
Rz.epigona	x	x	x	x	x	x		x
Remesella varians	x	x	x	x	x	x		x
benthic calc.forams	x				x	x		
"Cenosphaera" lenticularis								x
radiolarians indet.	x					x		

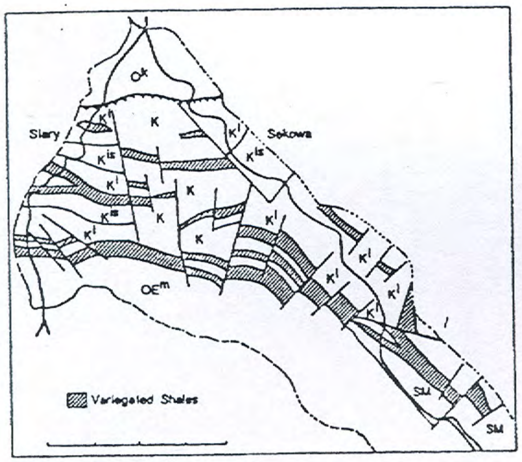
Inoceramian beds
Remesella varians zone
Maastrichtian

Explanation of symbols: C - common, F - frequent, R - rare,
x- occurs in microfossil assemblage, x! - characteristic or dominant forms

Occurrence of calcareous forams: sample 5.7.91-2: ?Osangularia sp., sample 12.8.91-2b: Nodosaria sp., sample 12.8.91-2c: Nodosaria sp., Gyroidinoides sp., Nuttallides truempyi, and calcareous nannofossils - Cribrosphaerella? daniae, Micula murus, indicating CC 25-26 zones /pers.inf.J.Ślęzak/

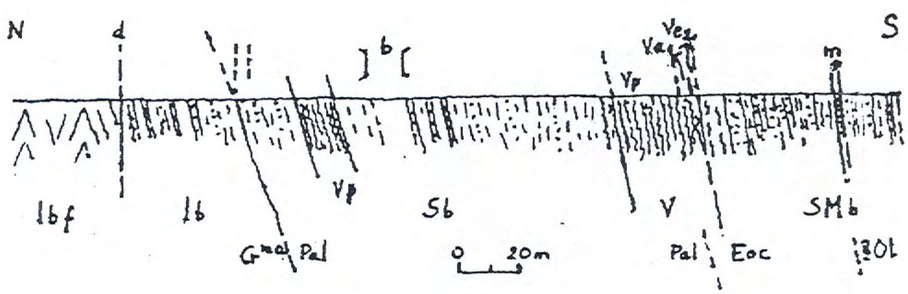
after Geroch

Figure 14



Geological map of the Siary - Sękowa area, after Widz (1985). E^c - Ciezkowice sandstones, K^i - Inoceramian beds with lenses of red shales, K^{is} - thick-bedded sandstones of the Inoceramian beds, K - Inoceramian beds (undifferentiated), O^k - Krosno beds, OE^m - Magura Formation, SM - Sub-Magura shales.

Figure 15



Section at ROPICA GORNA

Ibf - Inoceramian beds, strongly folded, Ib - Inoceramian beds, Sb - Swiątkowa beds, V - Variegated, mainly red shales: Vp - Paleocene, Ve_1 - early Eocene, Ve_2 - middle Eocene, SMb - Submagura beds, m - earliest intercalation of Menilite-type shales, d - fault, b - bridge

after Koszarski

The Swiątkowa Beds pass gradually into Variegated, red and green Shales. They contain intercalations of thin-bedded glauconitic sandstones. The red shales have yielded the foraminiferal assemblages of the Palaeocene, Early Eocene and Middle Eocene age (Table 3). The variegated shales are covered by a complex of medium- and thick-bedded, coarse grained,

TABLE 4

ROPICA section shale-samples	Frequency of fossil in washed residue	Rzehakina epigona	Hormosina excelsa	H.velascoensis	H.ovulum	Aschemocella div.sp.	Remesella varians	"Cenosphaera"lenticularis	Rzehakina fissistomata	Glomospira grzybowskii	Ammolagena clavata	Haplophragmoides walteri	Karrerulina coniformis	Reticulophr. amplectens	Reophax elongatus	Rhabdammina cylindrica	Nothia excelsa	Saccammina placenta	Glomospira charoides	Kalamopsis grzybowskii	Karrerulina div.sp.	Trochamminoides div.sp.	Recurvoides div.sp.	Cystamminella div.sp.	calcar. foraminifers	radiolarians	diatoms
Sub-Magura beds late Eocene	O-R											x				x	x	x	x			x	x	x	x	x	x
Variegated beds: middle Eocene	F-C										x	x	x	x	x	x	x	x	x	x	x	x	x	x	x		
Variegated beds: early Eocene	C-A					x					x	x	x			x	x	x	x	x	x	x	x	x		x	
Variegated beds: Paleocene	C-A				x	x			x	x	x					x	x	x	x	x	x	x	x	x			
Swiątkowa beds Paleocene	F-A	x	x	x	x	x	x	x	x	x	x					x	x	x	x	x	x	x	x	x	x		
Inoceramian beds late Senonian	C-A	x	x	x	x	x										x	x	x	x	x	x	x	x	x	x		

Explanation of symbols: A - abundant, C - common, F - frequent, R - rare, O - not found, x- occur in microfossil assemblage.

Occurrence of calcareous foraminifers: Inoceramian beds - very rare Globotruncana sp. G.cf.arca, ?Osangularia sp., Bolivina sp.; Swiątkowa beds - very rare Globigerina cf.triloculinoides, Dentalina sp.,?Gyroidinoides sp.; Sub-Magura beds- rare Chilostomella sp., ?Gyroidinoides sp.

Occurrence of calcareous nannofossils: Sub-Magura beds - /acc.to J.Ślęzak/ rich assemblage Chiasmolithus modestus, Ch.oamaruensis, Coccolithus pelagicus, Corannulus germanicus, Cyclicargolithus floridanus, Dictyococcites bisectus, Discoaster lodoensis, Ericsonia formosa, Istmolithus recurvus, Pemma papillatum, Reticulofenestra umbilica, R.reticulata, Sphenolithus spiniger, Zygrhablithus bijugatus,indicating NP 19 zone.

after Geroch

glauconitic sandstones of the Late Eocene. They are overlain by a thin layer of dark brown shales. The latter show strong similarity to the Menilitic Shales of the Silesian Unit.

The brown shales are covered by thick complex of the Magura Formation. It consists of thick- to medium-bedded, coarse grained, conglomeratic, glauconitic sandstones with subordinate shales. In this part of the section it is possible to observe various sedimentary structures connected with synsedimentary erosion, load proceses and slumps.

From Siary, the excursion party, near the wooden church from the XVI century, will cross the contact of the Magura Nappe and the Silesian Nappe and after passing the town of Gorlice will follow the Gorlice fold. One of the oldest oil fields in the Carpathians is connected with this fold. The production started in the middle part of the XIX century. Farther east the itinerary will cross a tectonic peninsula (the Harklowa peninsula) of the Magura Nappe. East of the village of Folusz the excursion party will again enter the Silesian Nappe. On the right side, the forested range representing the marginal part of the Magura Nappe will be visible. The hills in front are constituted of the southern part of the Silesian Nappe. On passing towards the town of Dukla the excursion will travel along the depressions made up of the Krosno Beds belonging to the Silesian Nappe. In the vicinity of the town of Dukla, towards the south, a steep hill is visible. It marks the northern margin of the Dukla Nappe and is constituted of the Oligocene Cergowa Sandstones.

From Dukla to Iwonicz, the route will run along the southern part of the Central Carpathian Synclinorium made up mainly of the Oligocene Krosno Beds forming several, narrow thrust folds. Small oil fields are connected with these folds and Grzybowski conducted foraminiferal researches of material from bore-holes of some of these fields. In one of them (the Bóbrka-Rogi anticline) the first oil well in Poland was sunk in the year 1853. Mineral waters are connected with the oil fields. Iwonicz is one of the health resorts that have been using these mineral waters since the XVI century.

Second Day

Itinerary: Iwonicz - Dukla - Bl. John Hermitage - Bóbrka - Krosno - Węglówka.

The area that will be visited consits of three tectonic - sedimentary units: The Dukla, Silesian and Subsilesian Nappes.

The Dukla Nappe

The Dukla Nappe is constituted of several imbricated folds which show their maximum elevation in the eastern part and gradually plunge towards the northwest. Towards the west the Dukla Nappe is burried under the Magura Nappe and it or its equivalents are visible in several tectonic windows within the Magura Nappe. Near the town of Dukla, the Dukla Nappe lays flatly on the Silesian Nappe.

The full succession of the Dukla Nappe in the frontal segment (which is the part that will be visited) is as follows:

the Inoceramian Beds, Senonian - Palaeocene.
the Hieroglyphic Beds with Variegated Shales, Middle - Early Eocene
the Green Shales, Late Eocene
the Globigerina Marls, Late Eocene
the Mszanka Sandstones
the Jawornik Marls
the Cergowa Sandstones
the Menilite Shales with the Skalnik Limestone horizon
] Menilite Beds, Oligocene
the Krosno Beds, Oligocene

The Silesian Nappe

The segment of the Silesian Nappe which will be visited is represented by a vast synclinorium - the Central Carpathian Synclinorium. It plunges towards the southeast where is composed mainly of the Krosno Beds (Oligocene - Early Miocene). The Central Carpathian Synclinorium is made up of several, long, narrow, imbricated folds which display axial culminations where strata, older than Oligocene are visible on the surface. The older strata also outcrop along the northern, marginal segment and along the southern uplifted segment (the Fore-Dukla Zone) of the Silesian Nappe.

The sequence of the segment of the Silesian Nappe which will be visited is as follows:
the Upper Cieszyn Shales, Valanginian - Hauterivian.
the Verovice Shales, Barremian - Aptian
the Lgota Beds, Albian
the Green Shales with radiolarites, Cenomanian
the Red Shales, Turonian - Early Senonian
the Istebna Beds, Late Senonian - Paleocene
the Ciężkowice Sandstones, Paleocene - Early Eocene
the Variegated Shales and Hieroglyphic Beds, Early - Late Eocene
the Globigerina Marls, Late Eocene
the Menilite Beds, Oligocene
the Krosno Beds, Oligocene - Early Miocene.

The Subsilesian Nappe

This nappe appears from below the Silesian Unit in a tectonic semiwindow, north of the town of Krosno, and it is represented by imbricated folds (the Węglówka folds). The Subsilesian Nappe is thrust onto the Krosno Beds of the Skole Nappe.

The succession of beds in the Węglówka zone is as follows:
the Verovice Shales with lenses of Grodziszcze Sandstone, approx. 220 m, Barremian- Aptian.
the Lgota Beds, lower part, 180 m, Albian
the Lgota Gaize Beds, 100 m, Albian - Cenomanian
the Variegated Shales, 120 m, Cenomanian - Turonian
the Red and variegated Węglówka Marls, up to 300 m, Senonian - Middle Eocene.

Between Iwonicz and Dukla the route will run along the same road as on the previous day. From the town of Dukla the excursion party will go to the south, crossing the northern margin of the Dukla nappe which is thrust at a low angle onto the Silesian Nappe. In the old quarry the Oligocene Cergowa Sandstones and, farther on, the dark brown Menilite Shales containing intercalations of organodetritic conglomerates lately named Metressa layer, are visible.

Figure 16

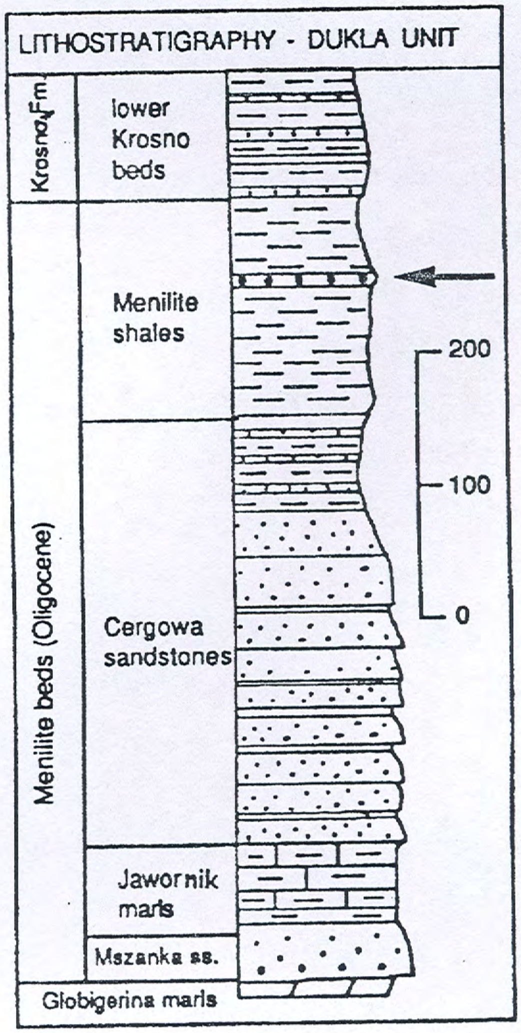


Figure 16. Composite stratigraphic section of the upper Eocene to Oligocene deposits of the Dukla Unit in the vicinity of Dukla. Arrow indicates the position of the Skalnik limestone, sampled by Grzybowski (1894).

Exposure 4. Trzciana near Dukla

In the village of Trzciana, on the summit of the hill situated on the west side of the road there are old quarries of organodetritic conglomerate. The quarries are grown over and scarcely visible. The most visible one is situated north from the hermitage of Blessed John of Dukla. The conglomerate comprises fragments of Lithothamnia and Bryozoa and Foraminifera described by Grzybowski (1894). The bed displays gradation and lamination and contains very large carbonate clasts. A thickness of 180 cm is visible. This bed represents a seismoturbidite deposited by a SE-flowing turbidity current from the Silesian Cordillera where shallow-water sediments had been developed. As a result of this redeposition, material containing fauna mainly of the Late Eocene were laid down within the Oligocene sediments (Table 5).

Figure 17

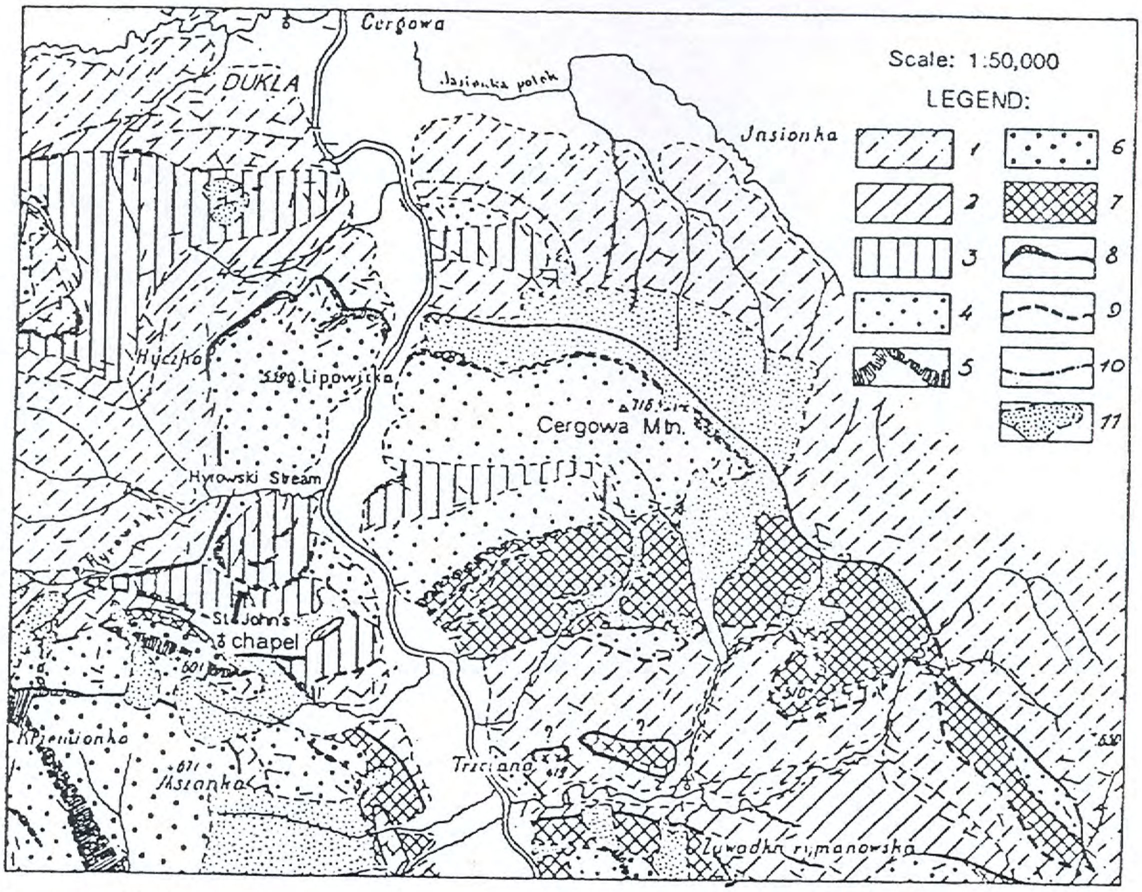


Figure 17. Geological sketch map of the area south of Dukla, from Teisseyre (1930). Map symbols are as follows: 1. Krosno Formation, 2. Transitional beds between the Krosno Fm. and the Menilite beds, 3-6. Menilite beds (3. Menilite shales, 4. Cergowa sandstones, 5. cherts and Jawornik marls, 6. Mszana sandstones), 7. variegated shales, 8. line of main overthrust, 9. line of secondary overthrust, 10. tectonic contact, 11. landslips.

After visiting the quarry, the excursion party will go to the Bóbrka Oil Museum crossing the southern segment of the Central Carpathian Synclinorium constituted mainly of the Oligocene

DUKLA. Type locality of Grzybowski's paper /1894/

Sandy limestone layer /Skalnik limestone/

Foraminifers acc. to T.Smigielska /1961/		Equivalent in the paper by J.Grzybowski /1894/
Spiroplectammina sp.	F	Textularia conica d'Orb.
Vulvulina haeringensis /Gümbel/	VR	Schizophora haeringensis Gümbel
Karreriella subglabra /Gümbel/	VR	Tritaxia an tricarinata Reuss
Keramosphaera sp.	R	
Nodosaria longisulcata Grzyb.	VR	Nodosaria longisulcata Grzyb.
Robulus alato-limbatus /Gümbel/	R	
R.arcuato-striatus /Hantken/	F	Robulina arcuato-striata Hantken
Dentalina sp.	VR	
Globulina gibba d'Orb.	R	
G.deflexa /Grzyb./	R	Polymorphina deflexa Grzyb.
G.inflata Reuss	R	Globulina inflata Reuss
Guttulina communis /d'Orb./	R	
G.humboldti /Bornemann/	R	Polymorphina humboldti Bornemann
Discorbis sp.	VR	
Baggina sp.	VR	Bulimina contraria Reuss
Eponides pusillus /Uhlig/	C	Discorbina pusilla Uhlig
Parella pteromphalia /Gümbel/	VR	
Schlosserina asterites /Gümbel/	C	Pulvinulina concentrica Parker
Ceratobulimina sp.	VR	
Asterigerina bimammata /Gümbel/	C	Pulvinulina bimammata Gümbel
A.rotula /Kaufmann/	F	Pulvinulina rotula Kaufmann
Amphistegina sp.	VR	
Pseudovalvulineria sp.	VR	
Cibicides aff.grimsdalei Nuttal	VR	
C.lividus /Grzyb./	VR	Truncatulina livida Grzyb.
C.rzehaki /Grzyb./	F	Truncatulina rzehaki Grzyb.
C.sublobatulus /Gümbel/	R	
C.tenellus /Reuss/	VR	Truncatulina tenella Reuss
Gypsina globulus Reuss	F	Gypsina globulus Reuss
Cribrogloborotalia sp.	VR	Sphaeroidina austriaca d'Orb.
Rotalia lithothamnica Uhlig	C	Rotalia lithothamnica Uhlig
Gyroidina sp.	VR	Valvatina umbilicata Bornemann
Rotorbinella uhligi /Grzyb./	F	Discorbina uhligi Grzyb.
R.fungiformis /Subbotina/	VR	
Rotorbinella sp.	C	
Baculogypsinoides tetraedra/Gümb./	VR	
Nummulites sp.	R	
Grzybowskia multifida Bieda	VR	Heterostegina n.sp.ind.
Discocyclina sp.	R	
Asterocyclina sp.	R	
Elphidium sp.	VR	

Explanation of symbols indicating foraminifers frequency:
VR - very rare, R - rare, F - frequent. C - common.

after Geroch

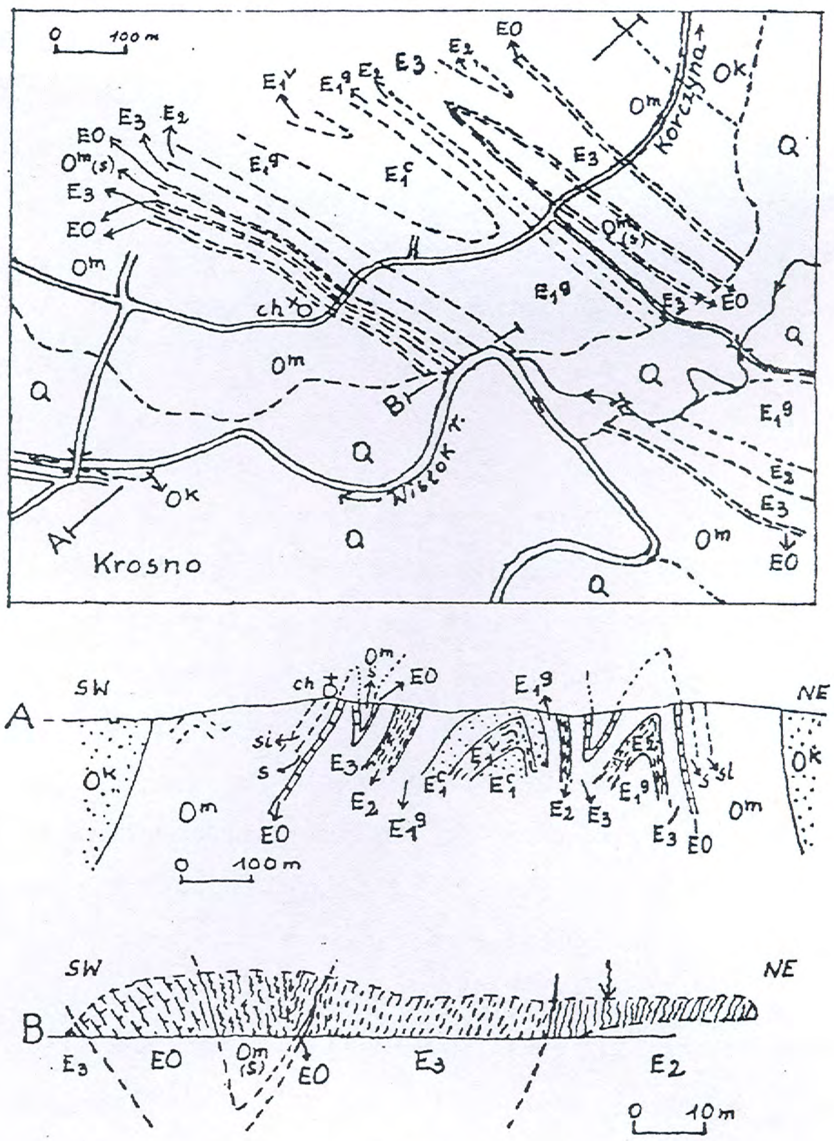
Krosno Beds. At Bóbrka the party will cross the southern limb of the Bóbrka anticline where, in its core, the Ciężkowice Sandstones of the Early Eocene age are visible. One of the oldest oil mines was situated along that fold. After visiting the Bóbrka Museum, the excursion party will cross the morphological depression made up mainly of the Oligocene Krosno Beds and will reach the medieval town of Krosno. On its northern outskirts, in the Ślączka district, the party will reach the core of the Potok-anticline containing Menilite Beds and Eocene strata. Oil has been produced from this anticline for more than one hundred years.

Exposure 5. Krosno

Below the church of St. Adalbertus, a cross section along Wisłok river exposing a southern limb of the anticline will be visited. This is the exposure described by Grzybowski in 1898. The oldest sediments exposed here are represented by red and sporadic green and brown clayey shales (Middle Eocene). They contain abundant manganiferous carbonate micronodules (rhodochrosite up to 96%; pers. com. T. Wieser). These beds pass into green shales (Middle and Late Eocene). Farther down the river the distorted core of a small syncline consisting of the lowermost part of the dark brown Menilite Beds (Subsilex menilite shales and marls) is visible. The southern limb of this syncline is made up of the yellowish-green marls representing the horizon of the Globigerina Marls.

Both red shales complex and green shales complex contain assemblages of agglutinated foraminifers. These faunas display a numerical dominance of tubular agglutinated, lituolids and ammodiscids, but not of high diversity (ca. 35 species). Characteristic are: *Rhabdammina cylindrica* Glaessner, *Ammodiscus latus* Grzyb., *Glomospira charoides* (J. et P.), *G. serpens* (Grzyb.), *Reophax elongatus* Grzyb., *Eratidus* sp. and *Reticulophragmium amplectens* (Grzyb.), which disappears in the upper part of the green shales complex and *Cyclammina rotundidorsata* (Hantken), which appears in the uppermost part of the green shales. In this part of the section occur rare calcareous foraminifers, which are abundant in the horizon of the Globigerina Marls (see: J. Grzybowski, 1898, 1969; Jurkiewicz, 1967).

Figure 18



(after Koszarski)

Potok fold at KROSNO.

A - general cross-section, B - Grzybowski´s outcrop.

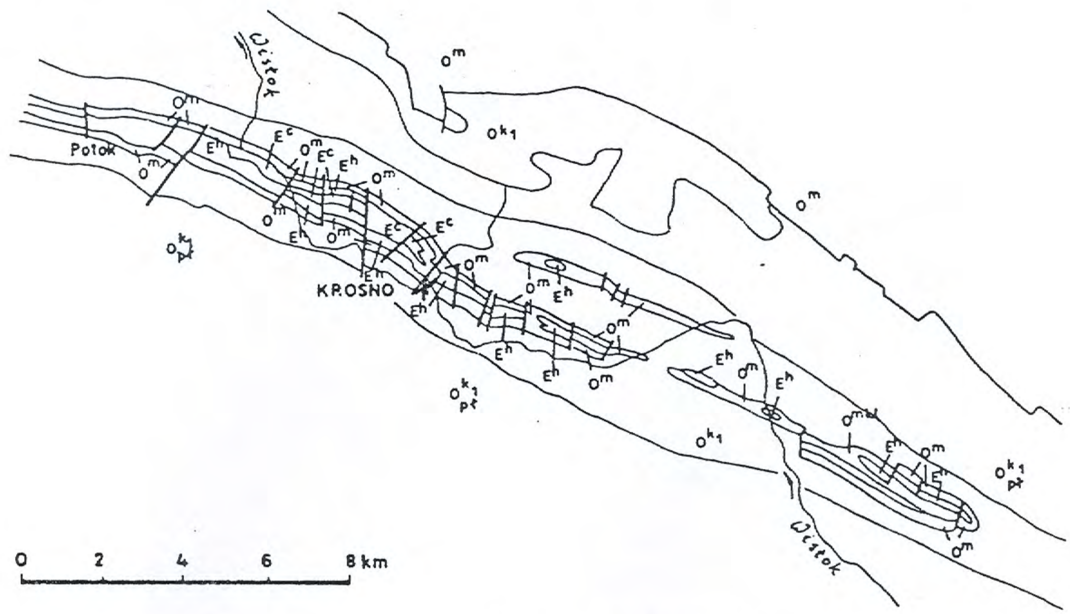
Eocene: E_1^v - variegated shales, mainly red, E_1^c - Ciez-kowice sandstones, E_1^g - grey-greenish shales with thin turbidites, E_2 - red shales, E_3 - green shales, EO - Globigerina marls.

Oligocene: O^m - Menilite bituminous shales (s- subsilex shales, si- silex), O^k - lower Krosno sandstones.

Q - Quaternary fluvial deposits, ch - old St.Adalbertus church.

Figure 19

Andrzej Ślączka



Geological map of the Krosno Area. O^k- Krosno beds; O^m- Menilite beds (sandstones); E^h- Hieroglyphic Beds; E^c- Ciężkowice Sandstones; O^{mkl}- Menilite beds - Kliwa Sandstones.

Examples of assemblages in Globigerina Marls (after B. Olszewska):

1 - The main components of the assemblage are: *Catapsydrax scandretti* (Blow et Banner), *C. perus* (Todd), *Tenuitella liverovskae* (Bykova), *Globigerina officinalis* Subbotina, *Chiloguembelina gracillima* (Andreae). As single specimens occur: *Turborotalia cerroazulensis* (Cole), *T. pomeroli* (Toumarkine et Bolli), *Globigerina ampliapertura* Bolli, *Subbotina brevis* (Jenkins), *S. transdanubica* (Samuel). The above mentioned forms suggest for the assemblage the latest Eocene age and correlation with the P 17 zones of Toumarkine & Luterbacher (1985) and Berggren & Miller (1988).

2 - A poorly diversified assemblage is composed predominantly of *Catapsydrax perus* (Todd), with lesser amount of *C. scandretti* (Blow et Banner), *C. unicavus* (Bolli et al.). The occurrence of *Globoquadrina tapuriensis* (Blow et Banner), *Globigerina ampliapertura* Bolli, *Tenuitella liverovskae* (Bykova) and *Subbotina droogeri* (Mjatliuk) suggests the latest Eocene-earliest Oligocene age for the assemblage. It corresponds to the combined P 18-19 zones of Bolli & Saunders (1985) or to the lower part of the P 18 zone of Berggren & Miller (1988).

3 - The assemblage is typical for the uppermost part of the Sub-Menilite Globigerina Marls or the lowest part of the Menilite Shales (Olszewska, 1983). It is composed of single specimens of so called " large globigerinas " (tropical) and of moderate amounts of minute planktonic and benthic forms. Important for age designation are: *Globoquadrina selli* Borsetti, *G. tapuriensis* (Blow et Banner), *Subbotina vialovi* (Mjatliuk). These species suggest the early Oligocene age for the assemblage, permitting for its correlation with upper part of the combined P 18-19 zones of Bolli & Saunders and the P-18 zone of Berggren & Miller. The benthic assemblage is typical for earliest Oligocene of the Polish Carpathians. It contains such, rather shallow-water species as: *Svratkina perlata* (Andreae), *Brizalina subtillissima* (Mjatliuk), *Globocassidulina globosa* (Hantken), *Anomalinoides affinis* (Hantken), *Eponides binominatus* Subbotina, *Escornebovina leganyi* (Kenavy et Nyiro), *Rosalina* div. sp., *Asterigerina* sp. Compare also Van Couvering et al. 1981.

North from Krosno the party will traverse the northern part of the Central Carpathian Synclinorium which is bordered at the north by an elevated, frontal segment of the Silesian Nappe. On the tops of the hills picturesque rocky formation are visible. They are made up of Paleocene - Early Eocene Ciężkowice Sandstones. In the upper part, directly below the big tors, they are underlain by Early Eocene red shales (corresponding to the sediments mentioned by Grzybowski, 1897, 1898 in bore-holes from Potok-Krosno anticline). These shales contain characteristic assemblage of agglutinated foraminifers rich in *Glomospira* In the lower part the Ciężkowice Sandstones are intercalated by variegated shales, which contain Palaeocene assemblages of agglutinated foraminifers.

Going down from the hills, the route passes the older strata of the Silesian Nappe: the Istebna Beds (thick-bedded sandstones and black and grey shales of the Late Senonian - Palaeocene age), the red shales (Turonian - Campanian) containing agglutinated foraminifers of *Hormosina gigantea* and *Uvigerinammina jankoi* zones, the Upper Lgota Beds (Late Albian - Cenomanian) and the Upper Cieszyn Beds (Valanginian - Hauterivian). Between red shales and Lgota Beds a thin complex (up to 10 m) of greenish and black shales with thin calcareous turbidites is visible. Some of the shaly layers contain radiolarians and scarce agglutinated foraminifers (tubular and ammodiscids). These sediments correspond to the Cenomanian - Turonian boundary and are developed as radiolarian shales or radiolarites (described by Sujkowski,

1932) in all the nappes of the External Carpathians and also in all the successions of the Pieniny Klippen Belt.

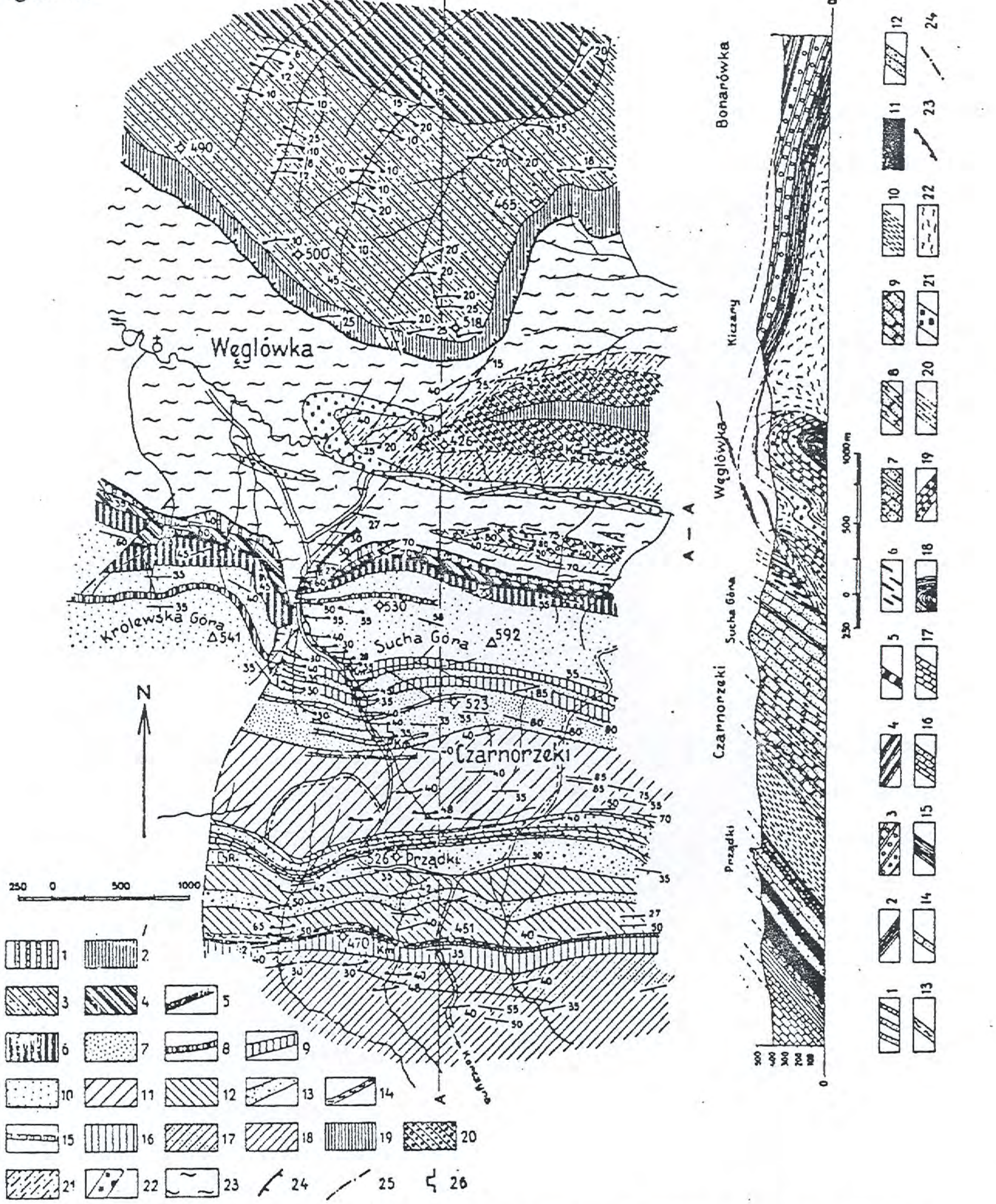
In the marginal zone of the Silesian Nappe, east of Węglówka region, all the Late Cretaceous - Eocene turbiditic formations are wedging out and are replaced gradually by red shales of the same age. Close to the village of Węglówka the excursion will pass the thrust surface of the Silesian Nappe and enter the Subsilesian Nappe.

Exposure 6. Węglówka

At Węglówka, along the stream, a sequence of the Senonian Węglówka Marls may be examined. These are green and pink-red marls with weak fissility. Sporadic burrows are visible. Well exposed Campanian marls contain rich, mainly calcareous microfauna. Red and greenish marls contain well preserved and diverse fauna of planktonic as well as agglutinated and calcareous benthic foraminifers. This fauna displays a high overall diversity and a numerical dominance of planktonic genera such as: *Hedbergella*, *Heterohelix*, *Globigerinelloides* and *Globotruncana* s.l.. Agglutinated forms and calcareous benthic species constitute less than 10% of the assemblages. Green and reddish marls comprise different assemblages ; planktonic foraminifers are very rare, diversity is still quite high, but agglutinated species constitude about 50% of the assemblages. The following agglutinated forms are characteristic: *Hormosina ovulum* (Grzybowski), *H. velascoensis* (Cushman), *Kalamopsis grzybowskii* (Dylążanka), *Spiroplectammina* aff. *dentata* (Alth), *S. costata* Huss, *S. lanceolata* Huss, *Dorothia crassa* (Marsson), *Tritaxia subparisiensis* (Grzyb.). Charateristic benthic calcareous *Reussella szajnochae* (Grzyb.) always occurs. (See: Liszkowa, 1954; Huss, 1957, 1966; Kaminski, 1981).

From Węglówka the excursion party will return to Iwonicz.

Figure 20



Geological map and cross-section of the Czarnorzeki — Węglówka area (after S. Jucha, F. Mitura, H. Świdziński)

Map. Silesian unit: 1 — Upper Cieszyn Shales (Valanginian-Hauterivian), 2 — Verovice Shales (Barremian — Aptian), 3 — Lower Lgota Beds (Albian), 4 — Upper Lgota Beds (Albian), 5 — Siliceous Marls (Cenomanian), 6 — Variegated Shales (Cenomanian-Turonian), 7 — Lower Istebna Beds (Senonian), 8 — interbed of grey shales in the Istebna Sandstone, 9 — Fucoidal marls (Upper Senonian), 10 — Upper Istebna Sandstone (Paleocene), 11 — Upper Istebna Shales (Paleocene), 12 — Variegated Shales (Paleocene — Eocene), 13 — Ciężkowice Sandstone (Paleocene — Eocene), 14—15—16 — Menilitic Beds: white marls, Kliwa Sandstone, Menilitic Shales (Eo-Oligocene), 17 — Passage Beds (Oligocene), 18 — Krosno Beds

Sub-Silesian unit: 19 — Verovice Shales and Grodziszcze Sandstone (Barremian), 20—21 — Lgota Beds with gaizes (Albian), 22 — Variegated Shales (Cenomanian — Turonian), 23 — Węglówka Marls (Senonian), 24 — thrust-line of the Silesian nappe, 25 — lines of tectonic discontinuity, 26 — quarries

Cross-section. Silesian unit: 1 — Upper Cieszyn Shales, 2 — Verovice Shales, 3 — Lower Lgota Beds, 4 — Upper Lgota Beds, 5 — Siliceous Marls, 6 — Variegated Shales, 7 — Lower Istebna Sandstone, 8 — Fucoidal marls, 9 — Upper Istebna Sandstone, 10 — Upper Istebna Shales, 11 — Variegated Shales, 12 — Ciężkowice Sandstone, 13—14—15 — Menilitic Beds: white marls, Kliwa Sandstone, Menilitic Shales, 16 — Passage Beds, 17 — Krosno Beds

Sub-Silesian unit: 18 — Verovice Shales, 19—20 — Lgota Beds with gaizes, 21 — Variegated Shales, 22 — Węglówka Marls, 23 — thrust-line of the Silesian nappe, 24 — lines of tectonic discontinuity

Third Day

Itinerary: Iwonicz - Ropczyce - Zawada - Wieliczka - Kraków

On the road from Iwonicz to Zawada the excursion will cross, once more, the marginal part of the Silesian Nappe and will traverse the strongly folded Late Cretaceous, Palaeogene and Early Miocene rocks of the Skole Nappe.

Exposure 7. Międzybrodzie

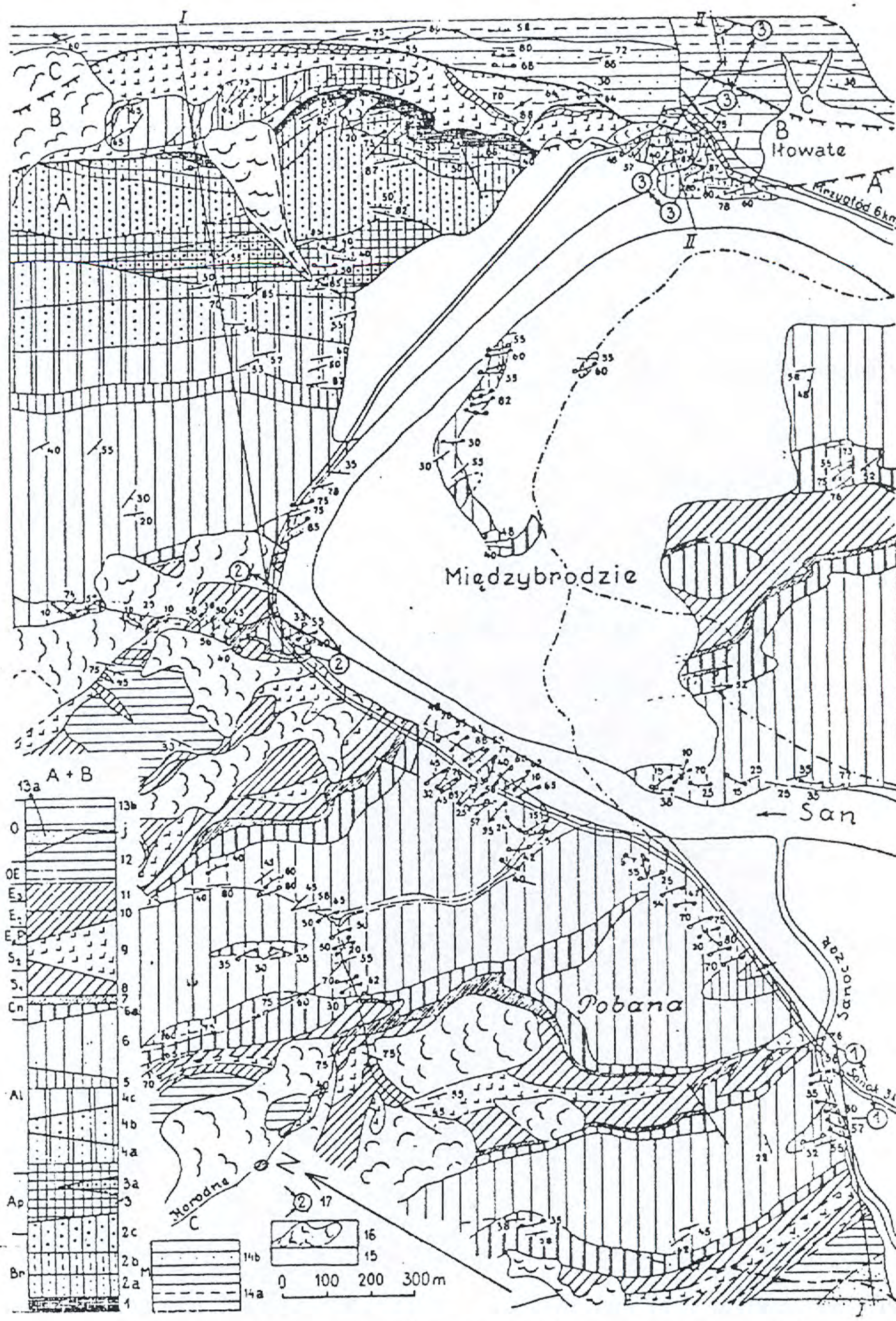
The outcrop is in the most external zone of the Silesian Nappe, in the valley of the San river, north of Sanok (transition zone to the Subsilesian Nappe). The frontal part of the nappe (named here Grabownica-Załuż Fold) is build of a few anticlines made up by Early Cretaceous flysch deposits. In these synclines the Turonian-Eocene pelagic variegated (mainly red) shales occur (without turbidites) with an intercalated thin complex of the Late Senonian variegated marls.

In the exposure, at the top of the Gaize Beds (Late Albian-Cenomanian sandstones and dark shales rich in sponge spicules) a thin complex, up to 10 m, of the Cenomanian-Turonian Radiolarian green shales (compare exposure at Węglówka) with black bituminous shales in the lower part, and a few layers of bentonized tuffs (91.4 ±4.7 Ma- see: Van Couvering et al. 1981) can be observed. The shales are rich in montmorillonite and contain barite and celestobarite crystals (see: Wieser, 1982).

The microfauna consits of radiolarians e.g: *Praeconocaryomma lipmanae* Pessagno, *Gongylothorax siphonofer* Dumitrica, *Orbiculiforma* sp., *Protostichocapsa stocki* (Campbell et Clark), *Cryptamphorella* sp., *Stichomitra communis* Squinabol (personal inf. M. Bąk). Radiolarians are common in some layers, but foraminifers are very rare e.g: *Rhizammina*, *Ammodiscus*, *Glomospira*, *Recurvoides*. In some regions the microfauna of this key horizon (corresponding to CTBE) is more diversified (see: Geroch et al. 1985, Gzik & Koszarski, 1990) and nearly everywhere the presence of ammodiscids is characteristic.

The next member, Red Shales are exposed here in their lower part only (Turonian - Coniacian). These red shales with thin intercalations of the green ones contain rich fauna of small,

Figure 21



Geological map of the frontal part of the Silesian unit and the Sub--Silesian unit in the San Valley

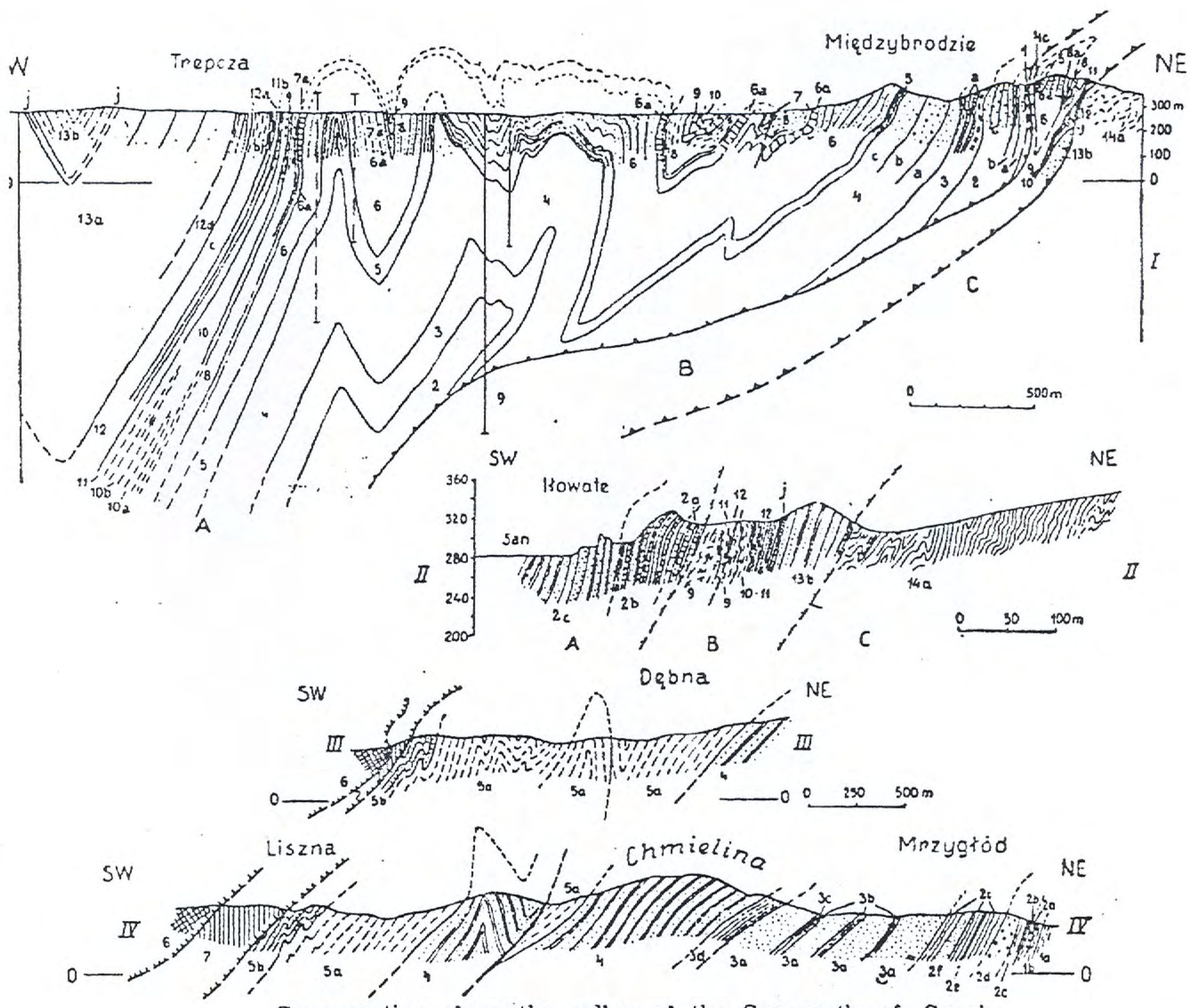
A — Silesian unit; *B* — Sub-Silesian unit; *C* — Skole unit. *Br* — Barremian, *Ap* — Aptian, *Al* — Albian, *Cn* — Cenomanian, S_1 — Lower Senonian, S_2 — Upper Senonian, E_1P — Paleocene — Lower Eocene, E_2 — Middle Eocene, E_3 — Upper Eocene, *OE* — Eo-Oligocene, *O* — Oligocene, *M* — Lower Miocene, *Q* — Quaternary

1 — Lower Verovice Shales, *2* — Grodziszcze Sandstone, *2a* — platy sandstones, *2b* — convoluted sandstones and shales, *2c* — thick-bedded sandstones, *3* — Upper Verovice Shales, *3a* — interbeds of thick-bedded sandstones, *4* — Lower Lgota Sandstone, *4a* — lower glauconitic sandstones, *4b* — blocky sandstones, *4c* — upper glauconitic sandstones, *5* — Middle Lgota Beds, shales, *6* — Gaize Beds, *6a* — dark shales and gaizes with siliceous marls nad spongiolites. *7* — green radiolarian shales, *8* — red shales (in Upper Cretaceous), *9* — Węglówka Marls, *10* — red shales (in Paleogene), *11* — Green Shales, *12* — Menilitic Shales, *13* — Lower Krosno Beds, *13a* — Sub-Jaslo Krosno Beds, *13b* — Supra-Jasło Krosno Beds, *j* — horizon of Jaslo Shales, *14* — Upper Krosno Beds, *14a* — shales, *14b* — convoluted sandstones, *15* — river terraces (undivided), *16* — slumps, *17* — visited autcrops

I—I, *II—II*, lines of cross-sections in Fig. 20

after L. Koszarski

Figure 22

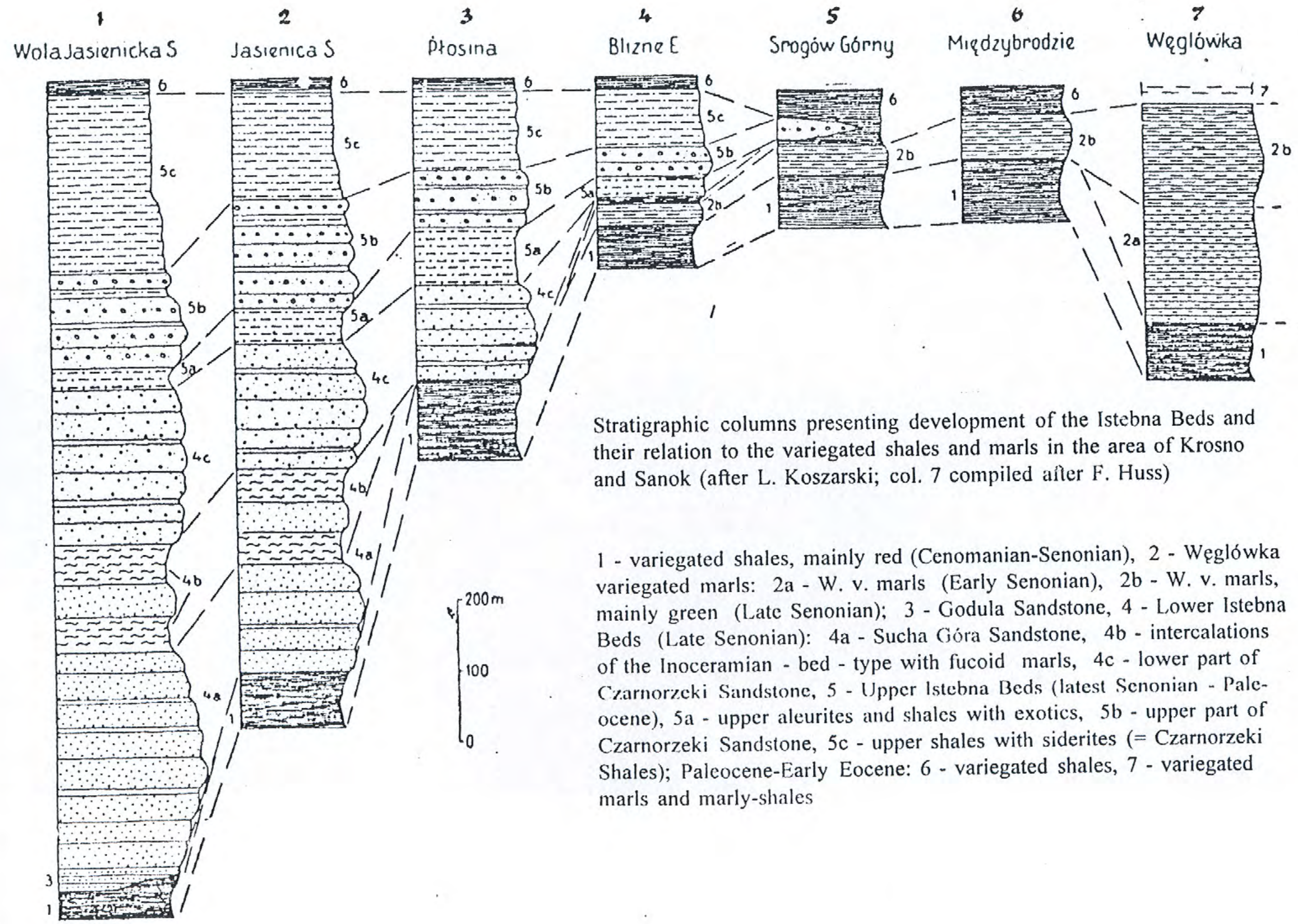


Cross-section along the valley of the San north of Sanok.
I-I, II-II — cross-sections of the frontal part of the Silesian unit and of the Sub-Silesian unit

Explanation, see Fig.21. In addition: 10a - Upper Istebna Sandstones (Paleocene), 10b - Hieroglyphic Beds (Middle Eocene), 11a - Globigerina Marls (Late Eocene), 12a - Sub-silex Menilite Shales, 12b - Menilite Silex, 12c - Menilite Shales, 12d - Passage Beds (between Menilite Shales and Krosno Beds)
III-III, IV-IV - Cross-sections of the inner part of the Skole unit (after L. Koszarski and F. Szymakowska). Explanation, see Fig. 24.

after Książkiewicz, 1968

Figure 23



Stratigraphic columns presenting development of the Istebna Beds and their relation to the variegated shales and marls in the area of Krosno and Sanok (after L. Koszarski; col. 7 compiled after F. Huss)

1 - variegated shales, mainly red (Cenomanian-Senonian), 2 - Węglówka variegated marls: 2a - W. v. marls (Early Senonian), 2b - W. v. marls, mainly green (Late Senonian); 3 - Godula Sandstone, 4 - Lower Istebna Beds (Late Senonian): 4a - Sucha Góra Sandstone, 4b - intercalations of the Inoceramian - bed - type with fucoid marls, 4c - lower part of Czarnorzeki Sandstone, 5 - Upper Istebna Beds (latest Senonian - Paleocene), 5a - upper aleurites and shales with exotics, 5b - upper part of Czarnorzeki Sandstone, 5c - upper shales with siderites (= Czarnorzeki Shales); Paleocene-Early Eocene: 6 - variegated shales, 7 - variegated marls and marly-shales

predominantly finely agglutinated specimens belonging to *Rhizammina*, *Glomospira*, *Ammodiscus*, *Recurvoides*, *Gaudryina*, *Kalamopsis grzybowskii* (Dylążanka), *Hormosina ovulum* (Grzyb.), *Uvigerinammina jankoi* Majzon, *Ammobaculites problematicus* Neagu, *Trochammina* cf. *gyroidinaeformis* Krasheninnikov and others.

Higher up, in the small creek, Late Senonian greenish, rose and red soft marls contain (after Liszkowa In: Koszarski, 1963) rich microfauna, consisting predominantly of agglutinated forms with an admixture of calcareous benthics up to 15%. Characteristic forms are as follows: *H. ovulum* (Grzyb.), *Spiroplectammina dentata* (Alth), *Goesella rugosa* (Hanzlikova), *Dorothia crassa* (Marsson), *Reussella szajnochae* (Grzyb.), *Stensioeina beccariformis* (White), *Nuttallinella florealis* (White). Planktonic forms are absent or very rare and poorly preserved.

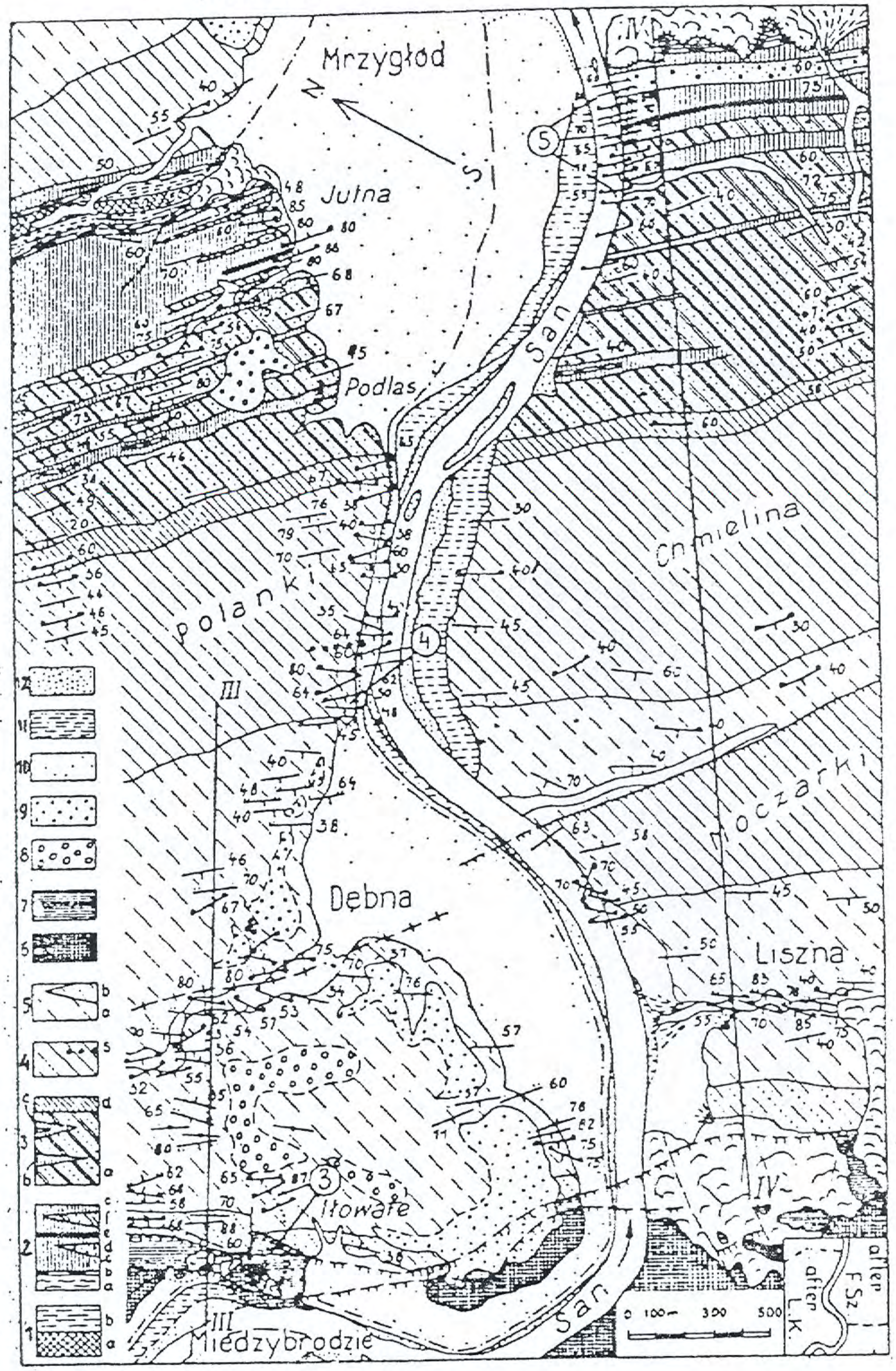
Westwards, near the zone of lateral transition from Variegated Marls to Red Shales (in the same Grabownica Fold), the admixture of calcareous benthics progressively disappears. This transition zone was interpreted as an ancient CCD. In the visited section this occurrence of the Variegated Marls above the Red Shales may be considered as the result of lowering of the CCD close to the Campanian / Maastrichtian boundary.

The Skole Nappe

The Skole Nappe occupies a large area in the eastern part of the Outer Carpathians. It appears near Brzesko, from beneath the Silesian and Subsilesian nappes. To the east, between Tarnów and Pilzno, the Skole Nappe locally disappears beneath the two higher nappes, but farther to the east it becomes broader and along the eastern Polish border it is ca. 40 km wide. The sequence of the Skole Nappe which will be visited is as follows:
the Spas Shales, Barremian - Albian
the Radiolarian Shales (Dołhe shales), Cenomanian
the Red Shales, Cenomanian - Turonian
the Siliceous (Hołownia) Marls, Turonian - Coniacian
the Inoceramian (Ropianka) Beds, Coniacian - Paleocene
the Variegated Shales, Paleocene, Early and Middle Eocene
the Green Shales, Middle and Late Eocene

Figure 24

Geological map of the inner part of the Skole unit in the San valley
(after L. Koszarski and F. Szymakowska)



1 - Eocene, 1a - black shales, 1b - green shales, 2 - Menilite Beds (Eo-Oligocene and Oligocene), 2a - Sub-silex Shales, 2b - Silex, 2c - Menilite Shales, 2d - Kliwa Sandstone, 2e - Jasło Shales, 2f - interbed of sandstones and shales of Krosno type alternating with Menilite Shales, 3 - Lower Krosno Beds (above the Jasło Shales), 3a - thick-bedded sandstones, 3b - interbeds of Menilite Shales, 3c - interbeds of silex, 3d - horizon of grey shales with tuffs, 4 - Middle Krosno Beds (Early Miocene?), 4a - submarine mudflow with blocks and pebbles of flysch rocks, 5 - Upper Krosno Beds (Early Miocene), 5a - shales, 5b - interbed of convoluted sandstones, 6 - Silesian unit (Cretaceous undivided), 7 -Sub-Silesian unit (Upper Cretaceous, Paleogene undivided); 8-12 - Quaternary: 8 - upper terrace 45-60 m., 9 - middle terrace 30-35 m., 10 - lower terrace 5-6 m., 11 - lower terrace 1-3 m., 12 - gravels in the stream-bed of San; III-III, IV-IV - cross-sections.

after Książkiewicz, 1968

Figure 25

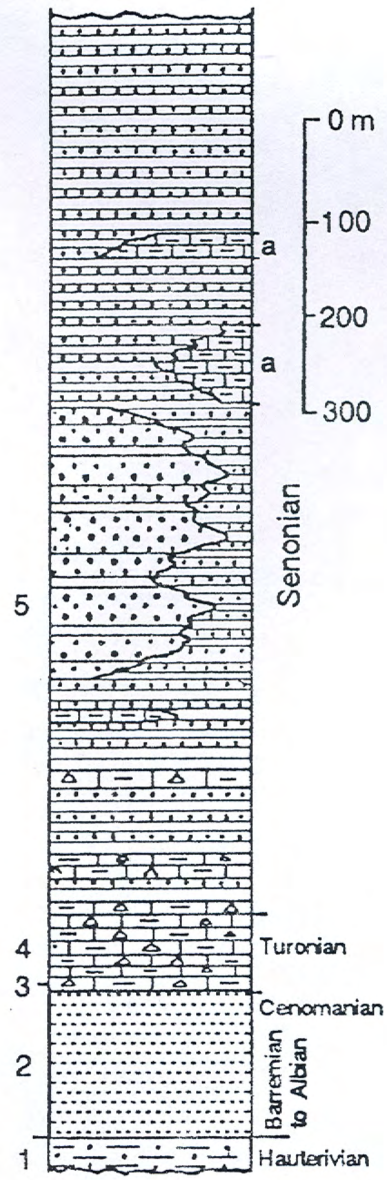


Fig. 25. Composite lithostratigraphic succession of the Skole Unit in the Rzeszow - Debice area. 1- Belwin Siltstones, 2 - Spas Shales, 3 - Variegated Shales, 4 - siliceous marls, 5 - Inoceramian beds, a - Baculites marls.

the Globigerina Marls, Late Eocene
the Menilite Beds, Oligocene
the Krosno Beds, Oligocene - Early Miocene.

Exposure 8. Dębna

Near the village of Dębna, on the western side of the San valley, the Krosno Beds of the internal zone of the Skole Nappe are exposed. The whole section, above Eocene red, green shales and Globigerina Marls comprises black bituminous Menilite Shales (Oligocene) and very thick turbidite sequence (ca. 2500 m) of the Early Miocene Krosno Beds, composed of grey sandstones and shales. The lower Krosno Beds are composed mainly of thick-bedded sandstones with shaly, key complex (Niebylec Shales; see: Nowak et al., 1985, Koszarski et al., 1985) in their top; the middle Krosno Beds are represented mainly by medium-bedded sandstones with shaly intercalations and the upper Krosno Beds are shaly with subordinate thin-bedded sandstones.

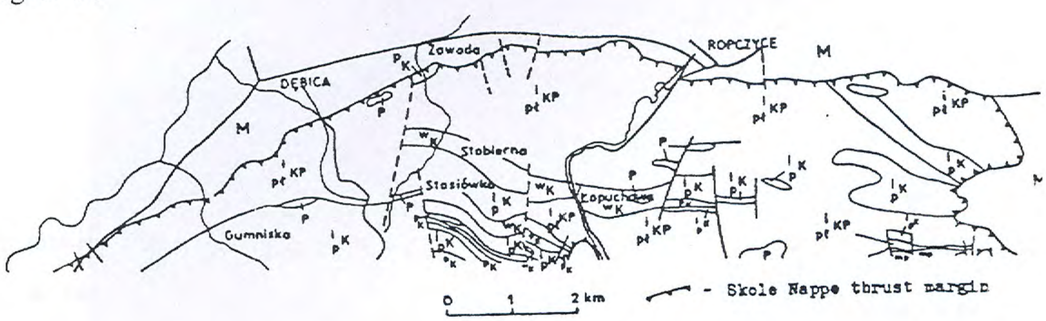
In the visited exposure the transition between middle and upper Krosno Beds is visible, which corresponds to NN 3 nannozone (*Helicosphaera ampliaperta* Bramlette et Wilcoxon, *H. carteri* (Wallich) emend. Kamptner, *H. walbersdorfensis* Mueller, *Sphenolithus belemnos* Bramlette et Wilcoxon: according to J. Ślęzak). Shaly intercalations at the top of some turbiditic rhytms contain foraminifers representing the youngest, very poor agglutinated assemblages known from the Carpathian flysch. This fauna displays extremely low diversity, mostly Haplophragmoides sp.

Exposure 9. Zawada

Between the villages of Zawada and Stasiówka small exposures of the middle part (Campanian - Early Maastrichtian) of the Inoceramian Beds are visible. Foraminifera from the shally intercalations were studied by Friedberg (1901). In the village of Zawada marly part of the Inoceramian Beds with a few intercalations of thin-bedded sandstones is exposed.

Between the villages of Zawada and Stobierna the exposure of the green-grey marly and clayey shales with marly and sandy turbidites is visible. In the southern part of the exposure a submarine slump deposit is exposed. It is made up of the light grey marls containing planktonic foraminifers and fragments of the black marly shales of the Early Cretaceous age. In the village of Stasiówka the marly shales intercalated with thin-bedded sandstones are visible. In all the outcrops, visited near Dębica, in the turbiditic marly intercalations calcareous foraminifers (planktonic and benthic) are prevailing eg.: *Hedbergella, Globigerinelloides, Globotruncana* s.l., *Heterohelix, Nodosariidae, Pleurostomella, Osangularia, Reussella szajnochae* (Grzybowski), debris of echinoderms and molluscs and ostracods; with accompanying *Dorothia, Arenobulimina, Ataxophragmium, Spiroplectammina* and others.

Figure 26

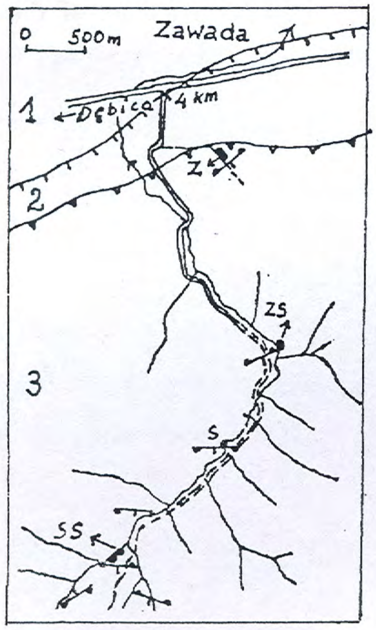


Geological map of the Skole Nappe in the Dębica region. M - Miocene; P - Eocene variegated shales, KP - Upper Cretaceous - Paleocene Inoceramian beds; W_k - Upper Senonian Wegierka (Baculites) Marls; K - Upper Cretaceous Inoceramian sandstones; P_k - Turonian Pisarzowice beds.

Jurkiewicz & Woiński, 1986

Shally autochthonous layers in the outcrops at Zawada-Stobierna and Stasiówka contain nearly exclusively agglutinated foraminifers eg.: *Rhabdammina cylindrica* Glaessner, *Nothia excelsa* (Grzybowski), *Saccammina placenta* Grzybowski, *Ammodiscus cretaceous* Reuss, *Glomospira charoides* (J et P), *G.gordialis* (J et P), *Hormosina ovulum* (Grzybowski), *H. velascoensis* (Cushman), *Kalamopsis grzybowskii* (Dylążanka), *Trochamminoides, Recurvoides, Cystaminella, Rzehakina epigona* (Rzehak), *Rz. inclusa* (Grzybowski), *Dorothia crassa* (Marsson) and "*Cenosphaera*" *lenticularis* Grzybowski. The Inoceramian Beds of the Skole Unit in contrast to the equivalent strata of the Magura Unit contain much more calcareous foraminifers. This may be explained by more shallow-water environment and proximity of shelf and slope.

Figure 27



FRIEDBERG's investigations area near DĘBICA.
Middle Miocene: 1 - autochthonous Badenian, 2 - folded and thrusted Badenian.
Late Cretaceous - early Paleocene: 3 - Skole nappe - folded Inoceramian beds.
Outcrops: Z - ZAWADA, ZS - ZAWADA-STOBIERNA, S - STOBIERNA, SS - STASIÓWKA. after Koszarski

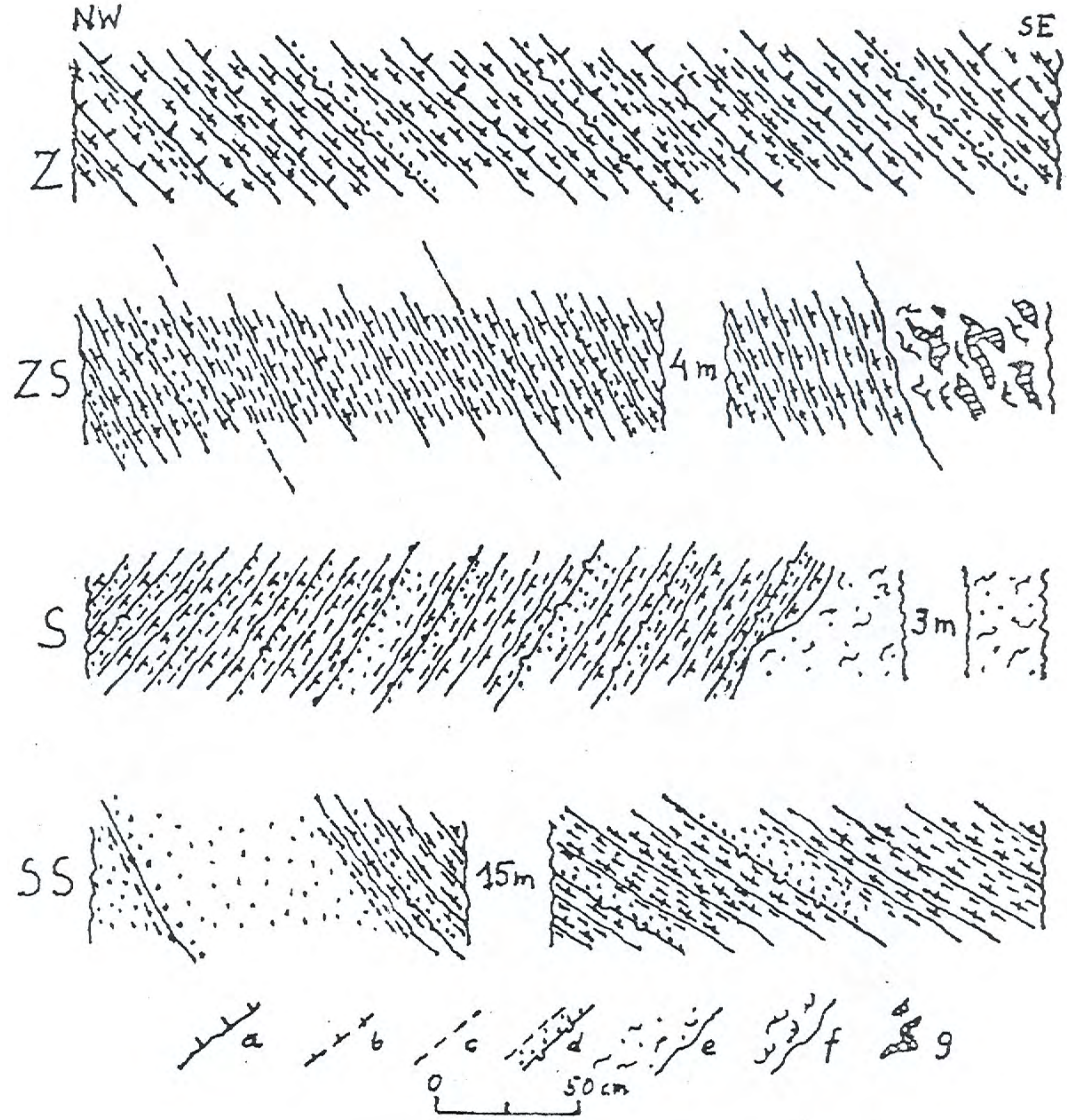
From Zawada after crossing the frontal part of the Skole Nappe, the route will run towards the west along the Carpathian Foredeep filled up by the Middle Miocene molasse deposits.

Exposure 10. Szczepanowice

West of Tarnów the excursion will go to the south to the village of Szczepanowice, where the lower part of the Skole Nappe sequence is visible. It is composed of the Spas Black Shales (Early Cretaceous), thin horizon of greenish and red shales (Late Cenomanian - Early Turonian) and a series of calcareous thin-bedded flysch (so called "siliceous and fucoid marls" of Turonian - Senonian) passing into shaly-sandstone flysch of the higher part (Late Senonian - Palaeocene) of the Inocermanian Beds.

Well exposed calcareous turbidites (fine calcarenites-calcilutites) are composed of limestone and quartz grains, sponge spicules, calcareous (mainly planktonic) foraminifers, radiolarians etc. Shaly layers contain both calcareous and agglutinated foraminifers. The Inoceramian Beds sequence corresponds to *Uvigerinammina jankoi* and *Hormosina gigantea* zones.
From Szczepanowice section we will return to the Carpathian margin.

Figure 28

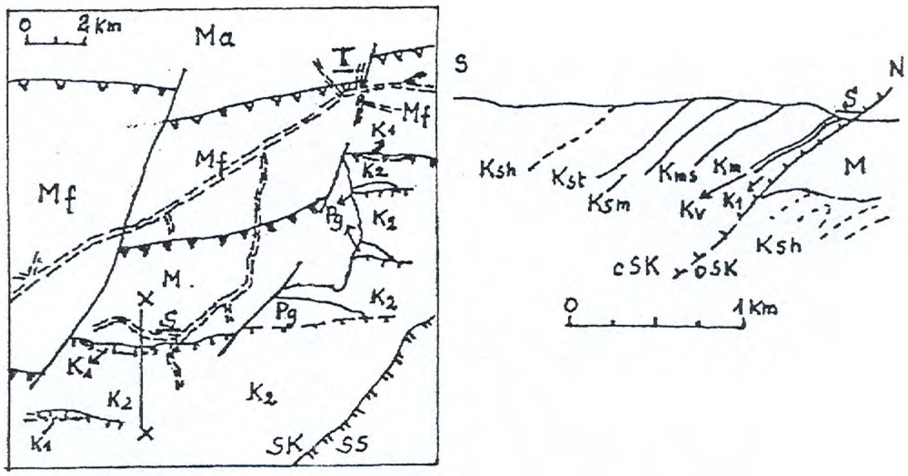


Sequences in outcrops of the Inoceramian Beds near Dębica

a - hard marl, b - soft marl, c - shale, d - sandstone - shale sequence
e - mudflow, f - slump of marls, g - fragments of early Cretaceous black shales in slump

after L. Koszarski

Figure 29



Skole Nappe near Szczepanowice (after L. Koszarski)

Map. Middle Miocene (Badenian): Ma - autochtonous, Mf - folded and thrusted, M - Badenian cover on the Skole Nappe; SL - Skole Nappe: K_1 - Early Cretaceous, K_2 - Late Cretaceous-Early Paleocene, Pg - Late Paleocene-Oligocene; SS - Silesian and Subsilesian Nappes; x-x line of section

Section. Skole Nappe: oSK - outer zone, cSK - central zone, K_1 - Early Cretaceous Spas black Shales, Inoceramian beds (Turonian-Early Paleocene): Km - siliceous marls, Kms - hard marls with shales, Ksm - fukoid marls and shales, Kst - sandstones and shales, Ksh - shales and sandstones; M - Badenian cover

T - Tarnów, S - Szczepanowice

Exposure 11. Sułków

At the village of Sułków, near the town of Wieliczka, the Middle Miocene (Badenian) deposits will be visited. The agglutinated foraminifers according to E. Łuczkowska are connected with detrital facies of the sea, at the northern and southern borders of the foredeep. They are represented by index species *Cylindroclavulina rudis* (Costa) and *Textulariella lithothamnica* Łuczkowska. In the foredeep, the assemblages of agglutinated foraminifers are comprised of numerous *Cyclammina, Haplophragmoides, Protobotellina, Hyperammina, Rhabdammina.* They are developed in the sandy and mudy facies of the central part of the foredeep, while the marly and clayey facies are poor of agglutinated foraminifers (see: Łuczkowska, 1990). The distribution of selected foraminiferal species in the Badenian of the Carpathian Foredeep is presented in Fig. 30.

Figure 30

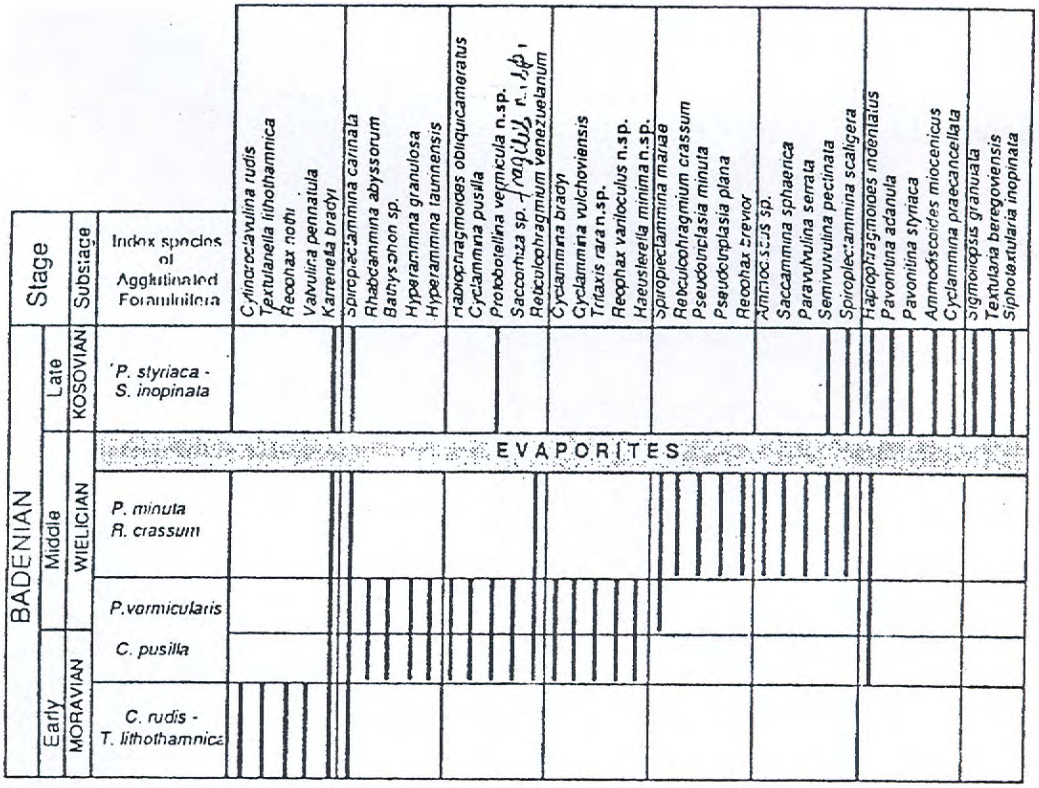


Figure 30. Stratigraphic ranges of selected agglutinated foraminiferal species in the Badenian of the Carpathian Foredeep in Poland.

Łuczkowska, 1990

In the small exposure, marls and calcareous mudstones of the Chodenice beds (the Late Badenian) are exposed. They overlain the Wieliczka salt deposits. In the area of Wieliczka only the Late Badenian (Kosovian) sediments are exposed (eg. in Sułków), while westward from Wieliczka the Late Badenian sands, so called "Bogucice Sands" are distributed. In the area of Cracow the Early and Middle Badenian claystones are developed. They represent the deeper facies of the foredeep and contain abundant planktonic foraminifera, but agglutinated forms do not occur in this area.

EXCURSION B

19 September, 1993

Itinerary: Kraków - Wadowice - Bielsko Biała - Gumna (near Cieszyn) - Goleszów

The itinerary of the excursion will run along the margin of the Northern Carpathians. This part of the Carpathians is made up of the Silesian Nappe thrust onto Late Cretaceous and Palaeogene beds, forming the Subsilesian Nappe. This latter nappe appears on the surface in the narrow belt along the Silesian Nappe and in small tectonic windows. Near Wadowice a more external nappe (the External Flysch) is visible. It is made up of the Cretaceous and Palaeogene rocks. According to some theories this represents the western prolongation of the Skole Nappe from the Eastern Carpathians. The frontal part of the Silesian Nappe and the Subsilesian Nappe in the area visited are strongly folded.

In the area of Wadowice the succession of the Subsilesian unit is as follows:
the Red Shales, Turonian.
the Red Shales and Marly Shales, Coniacian - Santonian
the Red and Variegated Marls, Campanian
the Green Marls, Maastrichtian
the Greenish Marls, Variegated Marls and Shales, Paleocene
the Red Marls, Variegated and Green Marly Shales, Early Eocene
the Green Marls, Variegated Marly Shales, Middle Eocene
the Green Marls, Upper Eocene
the Menilite Shales, Oligocene.

The composition of the Silesian Unit in the area which will be visited, between Bielsko and Cieszyn, is as follows:
the Lower Cieszyn Shales, ? Kimmeridgian - Tithonian.
the Cieszyn Limestones, Late Tithonian - Berriasian
the Upper Cieszyn Shales, Valanginian - Hauterivian
the Grodziszcze (Hradiste) Shales, Hauterivian

the Verovice Shales, Barremian - Aptian

the Lgota Beds, Albian

the Mikuszowice Cherts, Albian - Cenomanian

the Lower Godula Sandstones, Turonian - Early Senonian

Exposure 12. Bujaków

Hantkenina marls (after Gasiński, M. A. 1978).

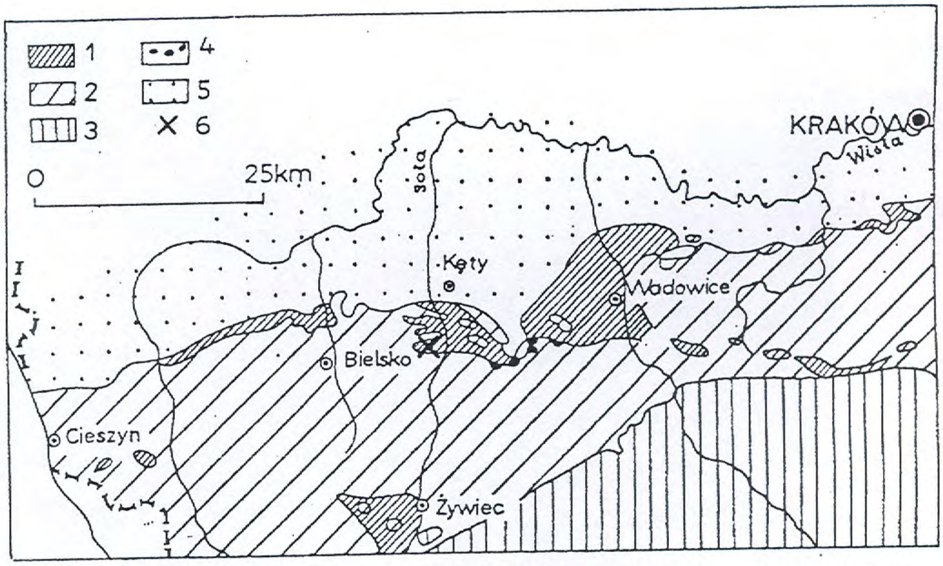
Middle Eocene, Hantkenina, variegated, mainly green marls occur at the village of Bujaków, situated between Bielsko and Kęty (Fig. 31). These sediments belong to the sequence of the Subsilesian Unit. The assemblage of microfossils consists of planktonic foraminifers, ca. 95%, mostly *Globigerina, Globorotalia* s.l., *Globigerapsis, Hastigerina* and of benthic ones ca. 5%, mostly calcareous forms. *Hantkenina* comprises ca. 1% of the total assemblage (Fig. 32). This is the farthest to the north situated outcrop of the Hantkenina marls in the Carpathians.

Exposure 13. Lipnik

At Lipnik, east from the town of Bielsko-Biała, along the small creek the following members of the Silesian Nappe are cropped out: the upper part of the Upper Cieszyn Shales (Valanginian - Hauterivian), the Grodziszcze Shales (Hauterivian - Early Barremian), the Verovice Shales (Barremian - Aptian - Early Albian), the Lgota Beds (Albian - Cenomanian) and the Godula Sandstones (Turonian) (Figs. 33, 34, 35).

Between these members there are transitions with the exception of the boundary between the Lgota and Godula Beds, where there is probably a hiatus caused by intraformational erosion. The Upper Cieszyn and Grodziszcze Shales are characterized by the presence of calcium carbonate. In the younger members (Verovice Shales and Lgota Beds) the pelitic sediments are devoided of calcium carbonate. This bears upon the distribution of microfauna (Table 6).

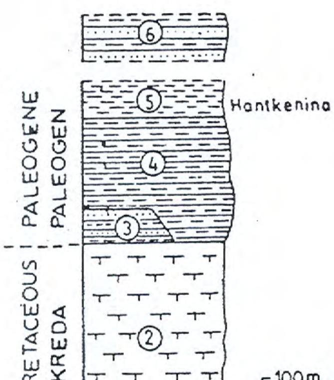
Figure 31



A fragment of the tectonic map of Western Polish Carpathians (Budowa Geologiczna Polski, IV, Tektonika cz. 3, fig. 40, 1972). 1 — Sub-Silesian nappe; 2 — Silesian nappe; 3 — Magura nappe; 4 — Andrychów klippen; 5 — Miocene; 6 — Bujaków village

Fragment mapy tektonicznej Polskich Karpat Zachodnich (Budowa Geologiczna Polski IV, Tektonika cz. 3, fig. 40, 1972). 1 — płaszczowina podśląska; 2 — płaszczowina śląska; 3 — płaszczowina magurska; 4 — skałki andrychowskie; 5 — miocen; 6 — Bujaków

Gasiński, 1978

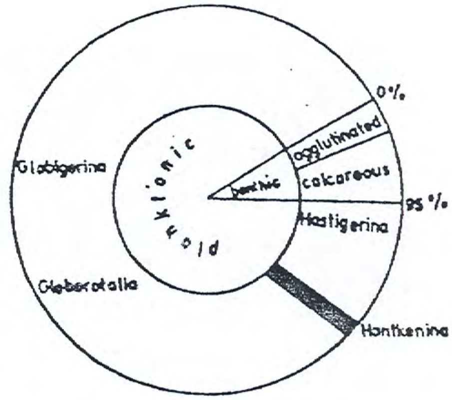


Position of marls with *Hantkenina* in the sequence of beds in the Sub-Silesian series (after W. A. Nowak, in S. Geroch, 1967, fig. 67). 1 — variegated shales (Turonian-Lower Senonian); 2 — variegated marls (Upper Senonian), 3 — dark shales, sandstones and conglomerates of Istebna Beds (Paleocene); 4 — green-brown shales, marls, glauconitic sandstones, variegated marls (Paleocene-Eocene); 5 — variegated marls, partly marls with *Hantkenina* (Middle and Upper Eocene); 6 — micaceous sandstones and marly shales of Krosno Beds (Oligocene)

Pozycja margli z *Hantkenina* w profilu jednostki podśląskiej (wg W. A. Nowak, 1958, S. Geroch, 1967, fig. 67). 1 — pstre łupki (turon-senon dolny); 2 — pstre margle (senon górny); 3 — ciemne łupki, piaskowce i zlepieńce — warstwy istebniańskie (paleocen); 4 — zielonobrunatne łupki, margle, piaskowce glaukonitowe, pstre margle (paleocen-eocen); 5 — pstre margle, częściowo margle z *Hantkenina* (eocen środkowy i górny); 6 — piaskowce mikowe i margliste łupki — warstwy krośnieńskie (oligocen)

Figure 32

Gasiński, 1978



Foraminiferal assemblage from *Hantkenina* marls at Bujaków (diagram)

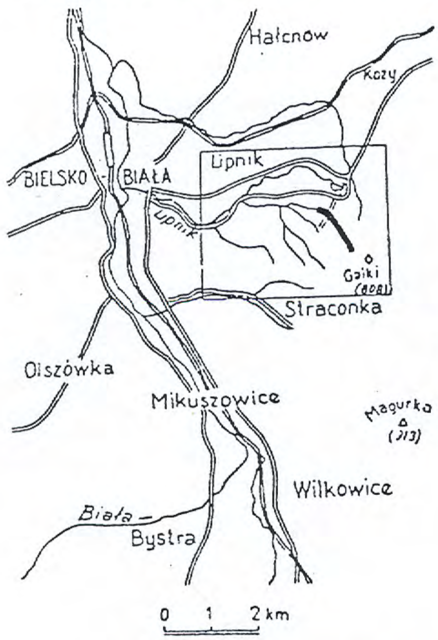
Diagram ilustrujący skład ilościowy otwornic w próbce margla z Bujakowa

INCOMPLETE LIST OF SPECIES:

Rhabdammina sp.	R[2]
Hyperammina sp.	F
Ammodiscus siliceus (Terquem)	F
Glomospira charoides (Parker et Jones)	R
Reophax pilulifer Brady	R
Cribrostomoides subglobosus Sars	F
Haplophragmoides walteri (Grzybowski)	F
Recurvoides sp.	R
Trochamminoides coronatus Brady	R
Ammobaculites agglutinans (d'Orbigny)	R
Vulvulina eocaena Montagne	R
Textularia agglutinans d'Orbigny	F
Clavulinoides cf. *midwayensis* Cushman	R
Dorothia sp.	R
Nodosaria annulifera Cushman et Bermudez	R
Nodosaria cf. *hochstetteri* Schwager	R
Chrysalogonium tenuicostatum Cushman et Bermudez	F
Lagena crebra Matthes	R
Nuttallides trümpyi (Nuttall)	C
Hastigerina micra Cole	C
Globorotalia broedermanni Cushman et Bermudez	F
Globorotalia densa (Cushman)	A
Globigerina boweri Bolli	A
Globigerina eocaena Gümbel	A
Globigerina yeguaensis Weinzierl et Applin	A
Subbotina linaperta (Finlay)	A
Truncorotaloides topilensis Cushman	F
Globigerapsis kugleri Bolli, Loeblich et Tappan	F
Globigerapsis mexicana (Cushman)	R
Globigerapsis rubriformis (Subbotina)	R
Globigerinita corpulenta (Todd)	F
Hantkenina mexicana Cushman	F
Hantkenina liebusi Shokhina	C
Hantkenina dumblei Weinzierl et Applin	F
Eponides umbonatus Reuss	C
Cibicides cushmani Nuttall	C
Pleurostomella sp.	R
Aragonia sp.	R

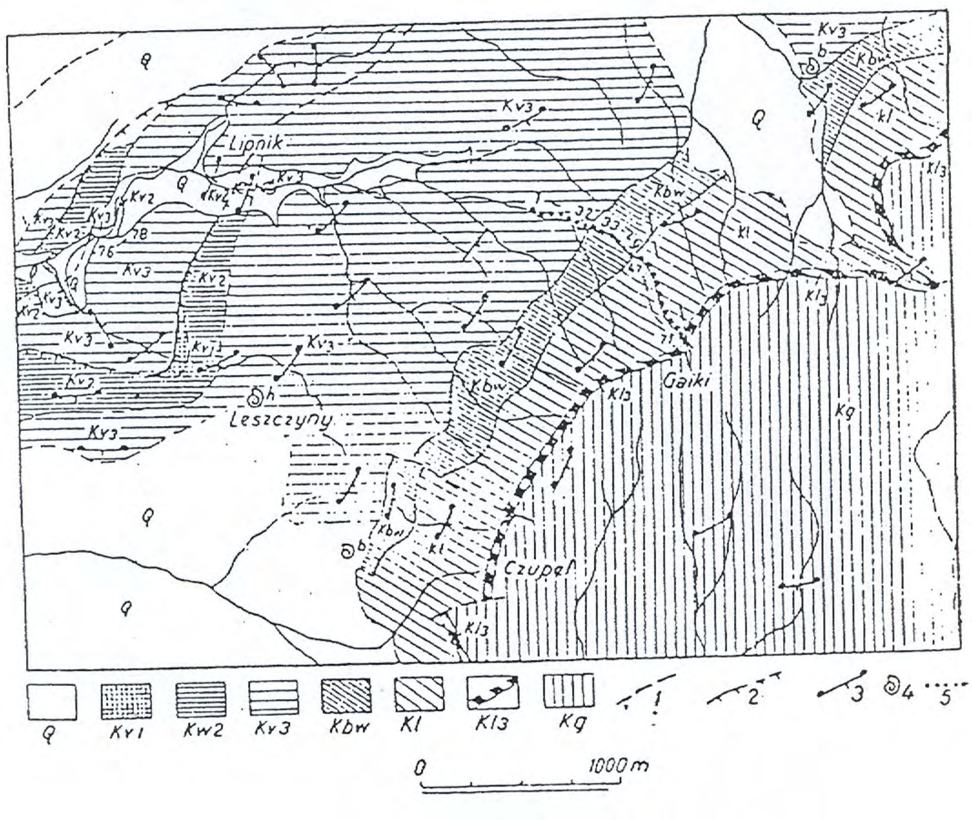
Figure 33

LIPNIK SECTION (near Bielsko-Biała) after Geroch & Nowak, 1963



Mapka okolicy Bielska-Białej. W prostokącie teren objęty mapą geologiczną fig. 2; linie grube oznaczają odsłonięcia dolnej kredy badane mikropaleontologicznie

Map of the vicinity of Bielsko-Biała. The rectangle—area included in the geological map fig. 2; the heavy line denotes outcrops of the Lower Cretaceous investigated micropaleontologically



Geological map of the vicinity of Lipnik. Q - Quaternary; Kg - Lower Godula Beds (Cenomanian-Turonian); Kl_3 Upper Lgota Beds (Mikuszowice silex); Kl - Middle and Lower Lgota Beds; ($Kl+Kl_3$ Albian-Cenomanian?); Kbw-Wierzowice Beds (Barremian-Aptian-Early Albian?); Kv_3 - Grodziszcze Shales and Upper Cieszyn Shales (Valanginian-Hauterivian); Kv_2 - Cieszyn Limestones; Kv_1 - Lower Cieszyn Shales (Kv_2+Kv_1 Titonian-Beriasian); 1 - faults; 2 - overthrusts; 3 - strike and dip, position of hieroglyphs; 4 - old outcrops and presumable position with macrofauna described by V. Uhlig (1883, 1901); from Fallaux's and L. Hohenegger's collections (b - Barremian fauna, h - Hauterivian fauna); 5 -outcrops of the Lower Cretaceous investigated micropaleontologicaly

Figure 34

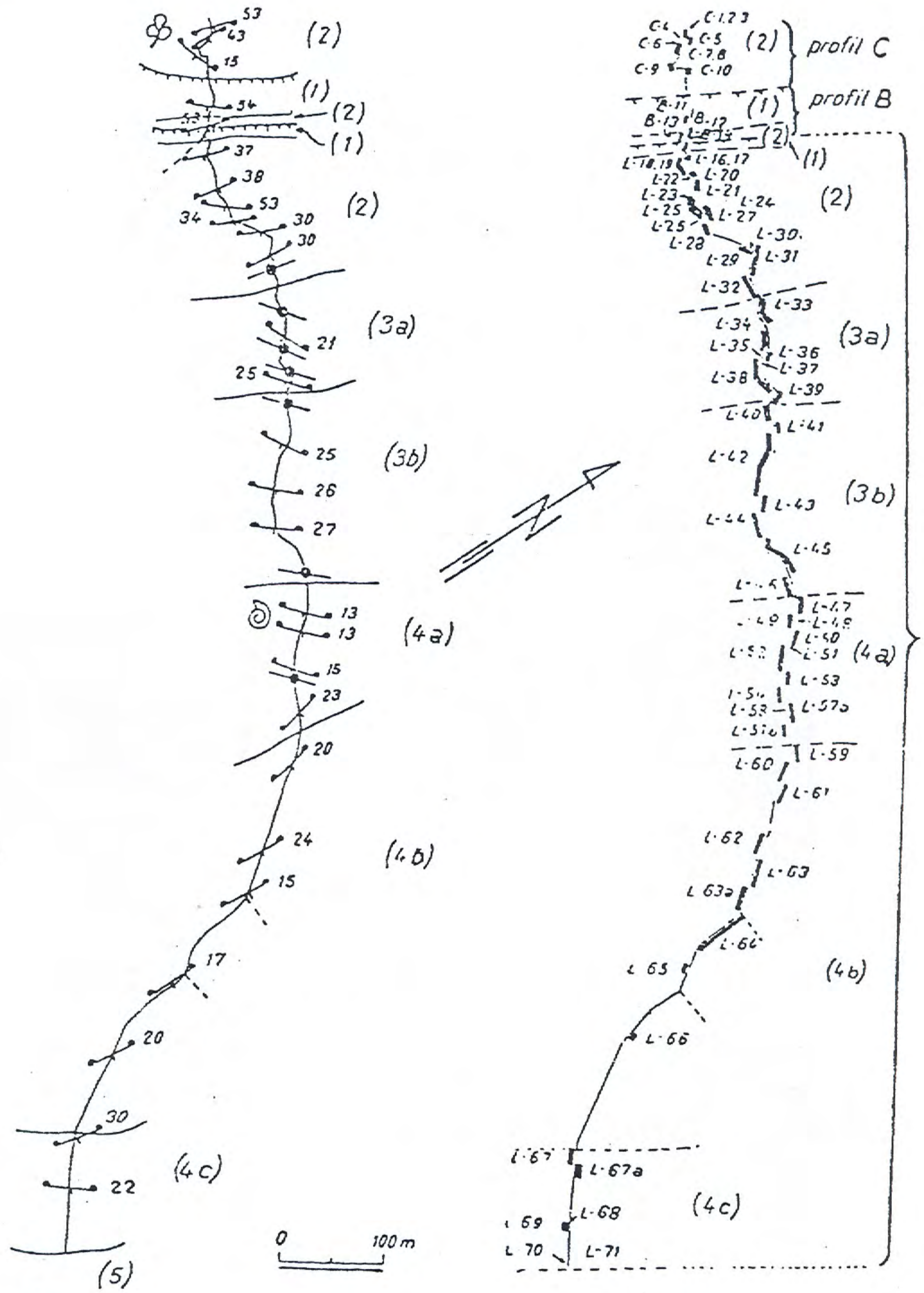
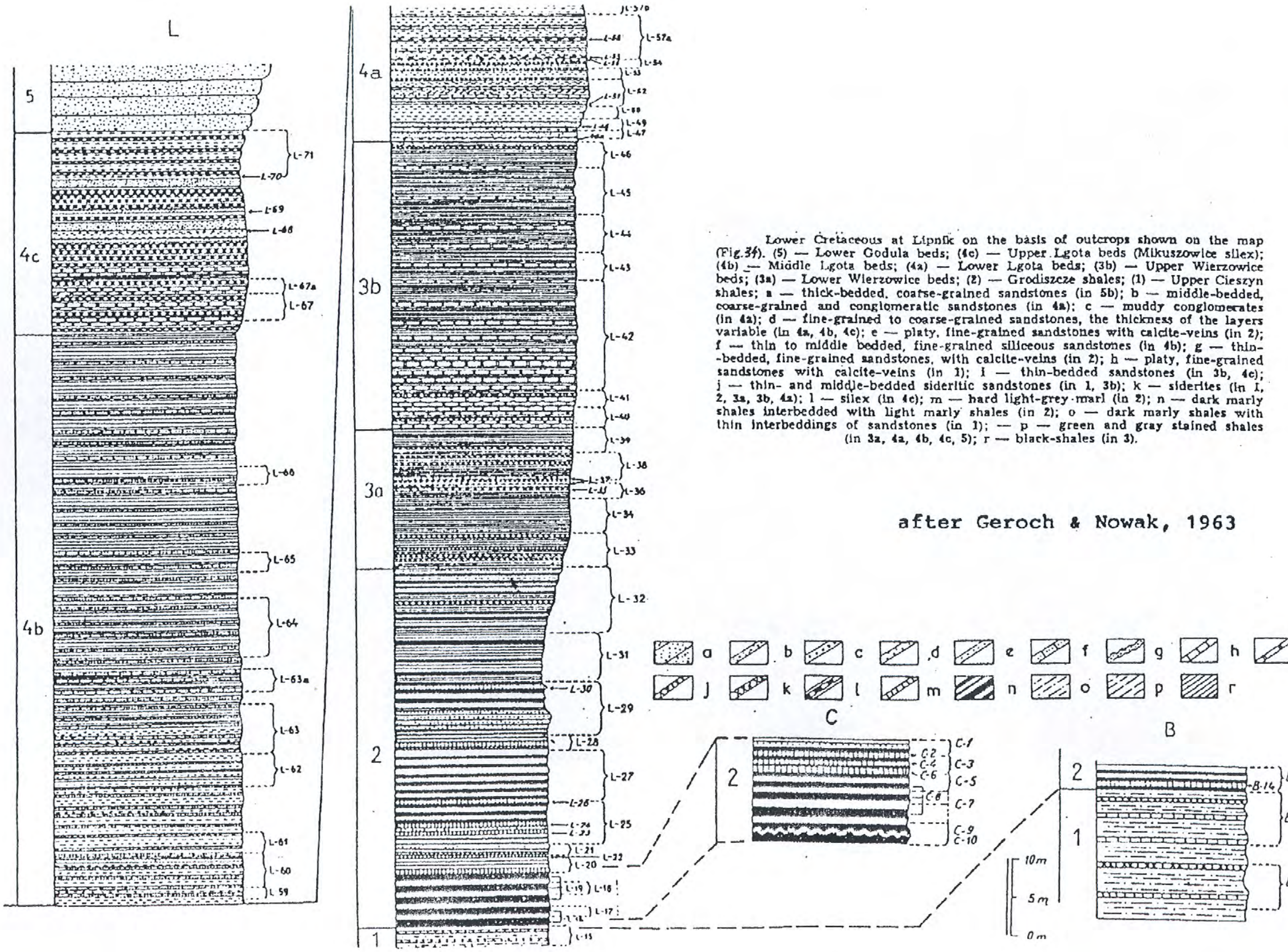


Fig. 3a *Fig. 3b*

Geological map showing a section of the stream with outcrops of the Lower Cretaceous (fig. 3a) and the localization of samples [C. 1—10, B. 11—14, L. 15—71] taken for microfauna investigations (fig. 3b); (5) — Lower Godula beds; (4c) — Upper Lgota beds (Mikuszowice silex); (4b) — Middle Lgota beds; (4a) — Lower Lgota beds; (3b) — Upper Wierzowice beds; (3a) — Lower Wierzowice beds; (2) — Grodziszcze shales with marked new position of fossil flora (*Weichselia lumbricata* S t o c k e s et W e b b. and *Frenelopsis hoheneggeri* S c h e n c k determined by dr J. R e j m a n); (1) — Upper Cieszyn shales

after Geroch & Nowak, 1963

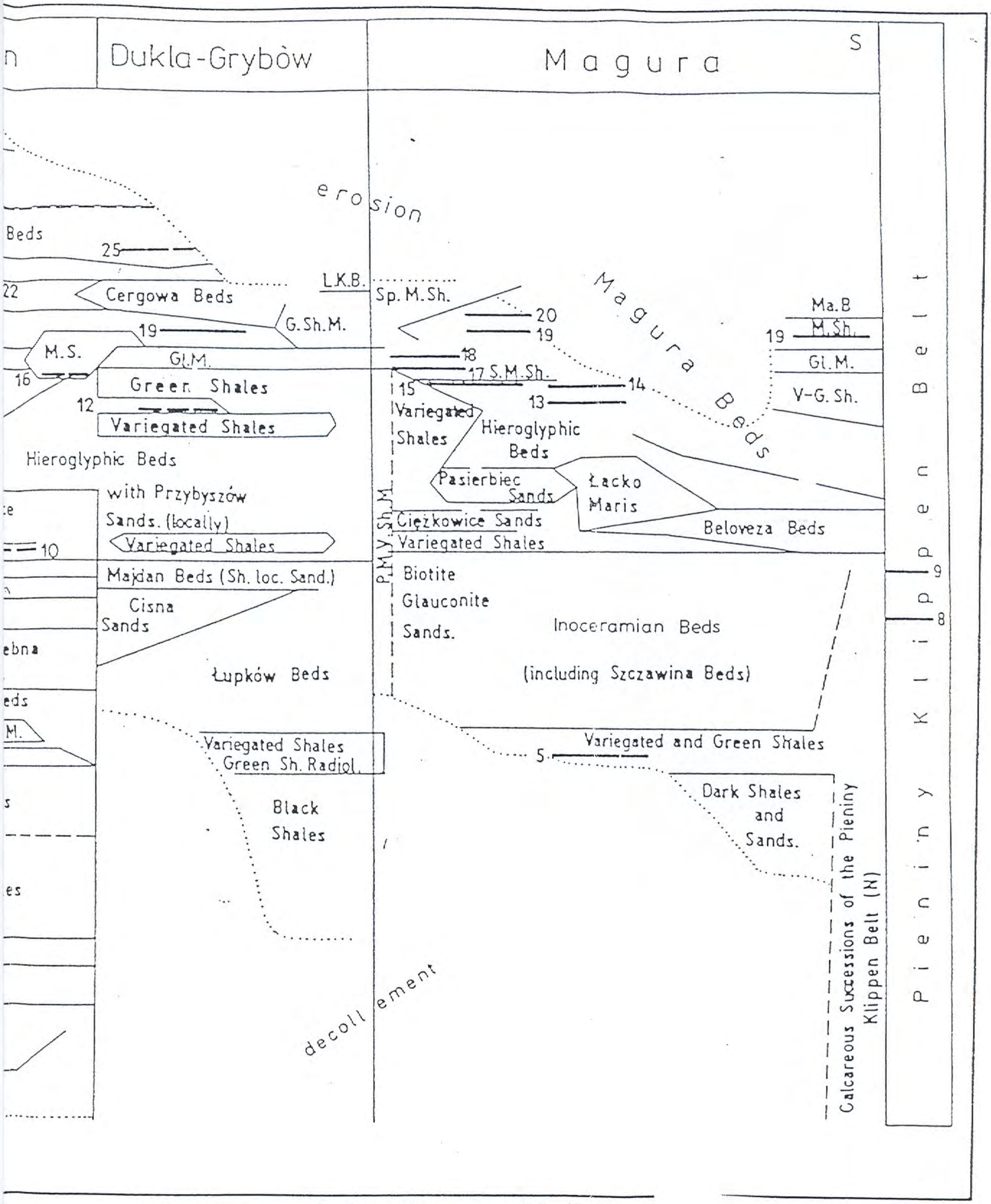
Figure 35



Lower Cretaceous at Lipnik on the basis of outcrops shown on the map (Fig. 34). (5) — Lower Godula beds; (4c) — Upper Lgota beds (Mikuszowice silex); (4b) — Middle Lgota beds; (4a) — Lower Lgota beds; (3b) — Upper Wierzowice beds; (3a) — Lower Wierzowice beds; (2) — Grodiszcze shales; (1) — Upper Cieszyn shales; a — thick-bedded, coarse-grained sandstones (in 5b); b — middle-bedded, coarse-grained and conglomeratic sandstones (in 4a); c — muddy conglomerates (in 4a); d — fine-grained to coarse-grained sandstones, the thickness of the layers variable (in 4a, 4b, 4c); e — platy, fine-grained sandstones with calcite-veins (in 2); f — thin to middle bedded, fine-grained siliceous sandstones (in 4b); g — thin-bedded, fine-grained sandstones, with calcite-veins (in 2); h — platy, fine-grained sandstones with calcite-veins (in 1); i — thin-bedded sandstones (in 3b, 4c); j — thin- and middle-bedded sideritic sandstones (in 1, 3b); k — siderites (in 1, 2, 3a, 3b, 4a); l — silex (in 4c); m — hard light-grey marl (in 2); n — dark marly shales interbedded with light marly shales (in 2); o — dark marly shales with thin interbeddings of sandstones (in 1); — p — green and gray stained shales (in 3a, 4a, 4b, 4c, 5); r — black-shales (in 3).

after Geroch & Nowak, 1963

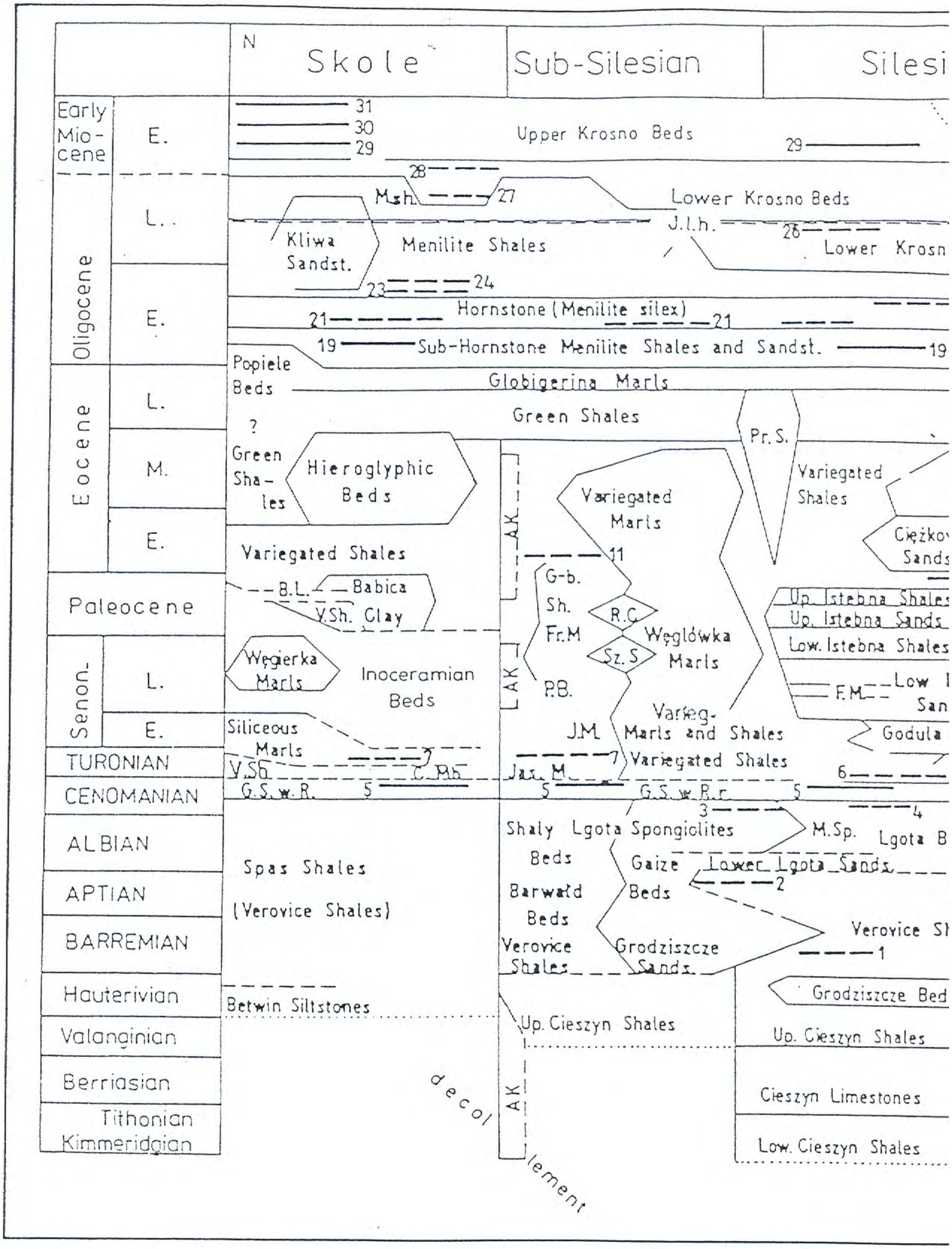
FLYSCH CARPATHIANS IN POLAND



(after Koszarski, L.)

= Cisowa Member; F.M. = "Fucoides" Marls; Fr.M. = Grey Frydek Marls; ıd Sub-Grybów Marls; G.S.w.R. = Green Shales with Radiolarians; one horizon; J.M. = Jastrzebia Marls (with gaizes); Jas.M. = Jasienica nka Sandstones; M.Sp. = Mikuszowice Spongiolites; P.B. = Pisarzowice R.C. = Rybie Conglomerates and Sandstones; S.C.M. = Sub-Cergowa s; Sz.S. = Szydlowiec Sandstones; V-G.Sh. = Variegated and/or Green

SIMPLIFIED STRATIGRAPHY OF TH



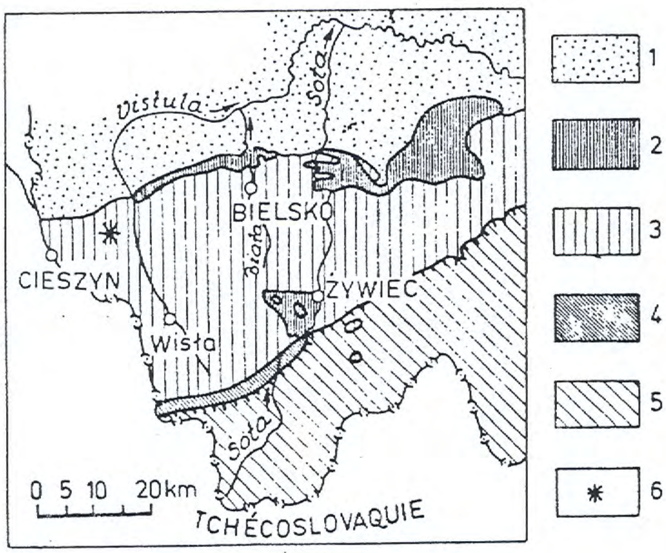
numbers 1-31 inclusive
indicate tuff horizons

A.K. = Calcareous successions of External Andrychów Klippen; B.L. = Bircza Limestones; C.M
Gl.M. = Globigerina Marls; G-B.Sh. = Green-Brown Shales; G.Sh.M. = Grybów Shales
G.S.W.R.r. = Green Shales with Radiolarians and Radiolarites; J.l.h. = Jaslo coccolithic Lim
Marls; L.K.B. = Lower Krosno Beds; Ma.B. = Malcov Beds; M.Sh. = Menilite Shales; M.S. = Ma
Beds; Pm.V.Sh.M. = Pre-Magura Variegated Marls and Shales; Pr.S. = Przysietnica Sanstone
Marls; S.M. = Siliceous Marls; S.M.Sh. = Sub-Magura Shales; Sp.M.Sh. = Supra-Magura-Sha
Shales; V.Sh. = Variegated Shales.

Exposure 14. Gumna

At Gumna, in a road-cutting the Lower Cieszyn Shales (? Kimmeridgian-Tithonian) are exposed. These are dark-grey marly shales with a few intercalations of detrital limestones. Noteworthy is the presence of slump structures which suggest that the observed deposits represent a part of the submarine slump. Microfauna in the marls consists mainly of small *Trocholina, Nodosariidae,* radiolarians ? and ostracods. Agglutinated specimens are rare e.g. *Ammodiscus, Glomospira, Paleogaudryina* ?. Detrital limestones contain fragments of macrofauna e.g. echinoderms and molluscs. Selected microfossils are indicated in Table 7.

Figure 36

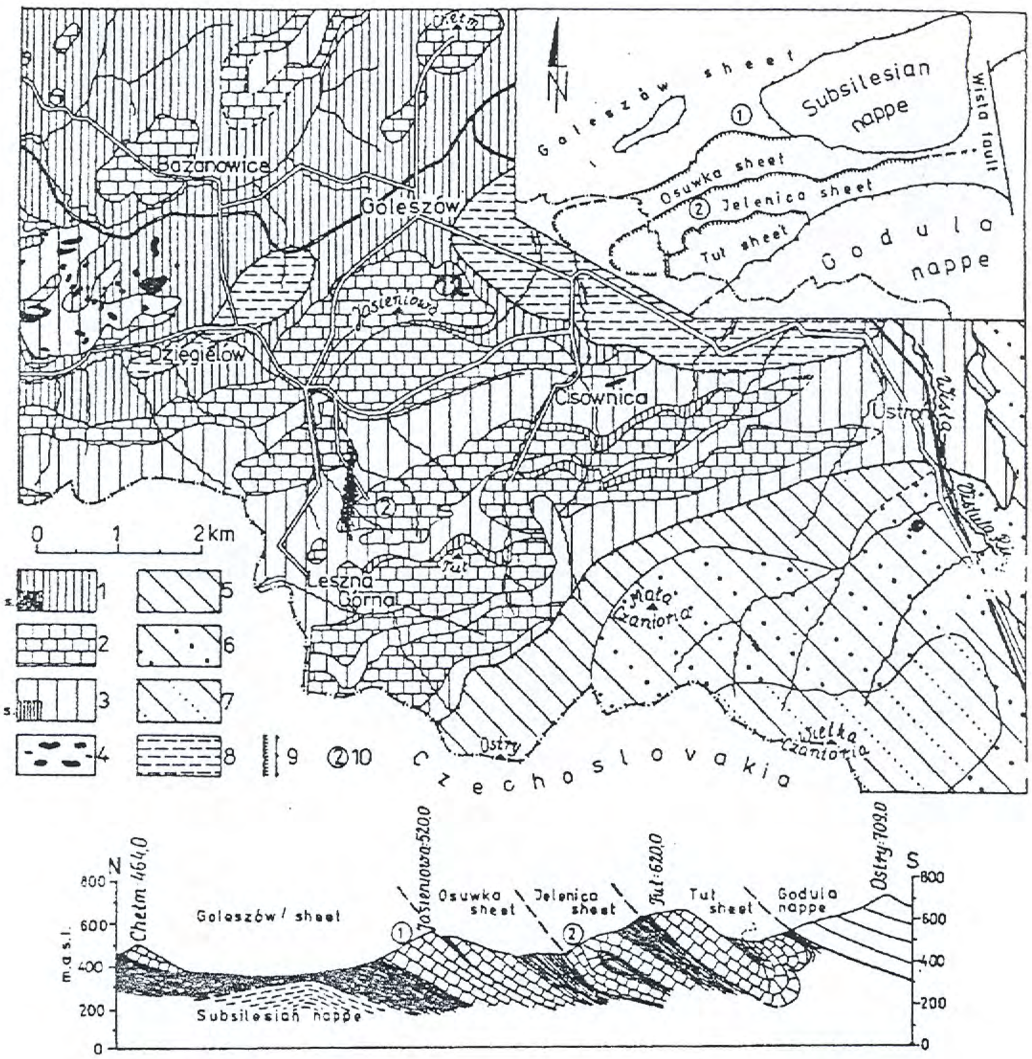


Location of Gumna exposure (after Geroch et.al., 1967)
1 - Miocene of the Carpathian Foredeep
2 - Sub-Silesian Unit
3 - Silesian Nappe
4 - Fore-Magura Unit
5 - Magura Unit
6 - Gumna

Exposure 15. Goleszów

At Goleszów, a large quarry in Cieszyn Limestone (Late Beriassian) will be visited. In the traverse cutting leading to the main quarry the lower part of the limestones is exposed. The section begins with grey-white, thin-bedded limestones alternating with marly shales. Some of the layers contain tintinnids, mainly *Calpionella alpina* Lorenz. Higher up, the limestone layers become darker in colour. They alternate with grey shales. Graded bedding is discernable in several layers, which are thin - and medium-bedded and often composed of graded and pelitic parts. Different microfaunal associations are connected with different lithology.

Figure 37

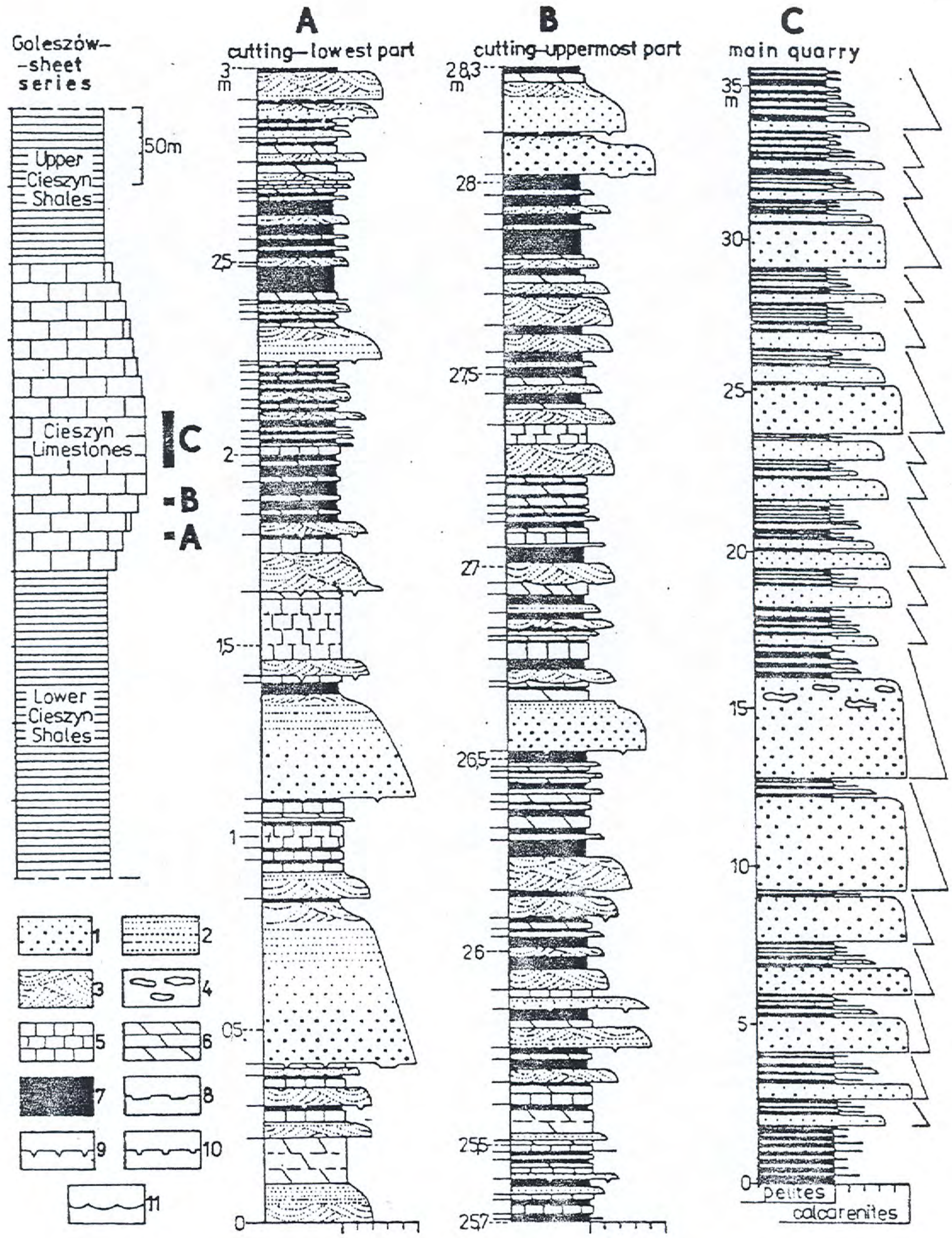


Geology of the visited area with locality of stops. Cieszyn subnappe: *1* – Lower Cieszyn Shales (Upper Kimmeridgian–Middle Tithonian); *2* – Cieszyn Limestones (Upper Tithonian–Berriasian); *3* – Upper Cieszyn Shales (Valanginian–Hauterivian); *4* – intrusions of teschenite. Godula subnappe: *5* – Wierzowice Shales, Grodzisko Shales and Lgota Beds (Hauterivian–Lower Cenomanian); *6* – Lower Godula Beds (Upper Cenomanian–Turonian); *7* – Middle Godula Beds (Turonian). Subsilesian nappe: *8* – undivided sediments (Upper Cretaceous–Palaeogene). *9* – overthrust fronts; *10* – stops

Malik, 1986 (after Książkiewicz)

According to Bieda et al. (1963), Geroch et al. (1967), Geroch & Olszewska (1990) the detrital, turbiditic limestone layers contain calcareous agglutinated and calcareous secreted foraminifers (*Textulariidae, Lituolidae, Ataxophragmiidae, Nodosariidae, Involutinidae*), ostracods, sponge spicules and fragments of echinoderms, molluscs and bryozoans. Pelitic limestone layers are characterized by radiolarians, calpionellids, stomiosphaerids, Nannoconus and Globochaete.

Figure 38



Representative detailed logs of the Cieszyn Limestones from Goleszów, Jasieniowa quarry

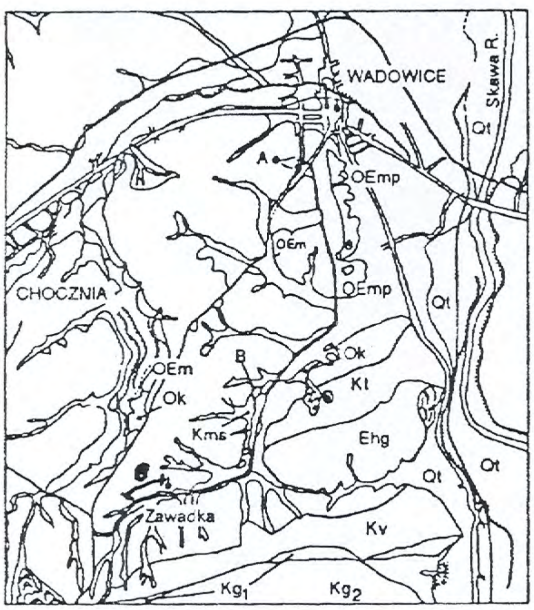
Detritic limestones: *1* – with grading or massive; *2* – horizontally laminated; *3* – cross-laminated (in cosets or in a single set); *4* – outsized intraclasts. Pelitic deposits: *5* – calcilutites (pelitic limestones); *6* – marlstones; *7* – marly claystones. Sole markings: *8* – extensive scours; *9* – current marks; *10* – biohieroglyphs; *11* – load structures

Malik, 1986

Small agglutinated, autochthonous foraminifers occur in marly shale intercalations. These are characterized by the following forms: *Hyperammina gaultina* Dam, *Psammosphaera* sp., *Saccammina* sp., *Ammodiscus cretaceous* Reuss, *Glomospira charoides* (J. et P.), *G. gordialis* (J. et P.), *Glomospirella gaultina* (Berthelin), *Hormosina* sp., *Kalamopsis* sp., *Hippocrepina depressa* Vasicek, *Reophax helveticus* Haeusler, *Reophax* sp., ? *Recurvoides* sp., *Verneuilinoides* sp., ? *Gaudryina* sp., *Pseudoreophax cisovnicensis* Geroch, *Trochammina* sp., *T. quinqueloba* Geroch.

The uppermost part, with thicker, coarse grained and conglomeratic limestones, is seen in the main, abandoned quarry. Their coarse, basal part consists of organic detritus of fragmented shells of lamellibranchs, aptychi, crinoids, urchin spines and algae.

Exposure 16. Zawadka



Geological map of the area south of Wadowice, redrawn after Książkiewicz (1951). O^k - Krosno Beds, OEm - Menilite beds, K^{ms} - Senonian variegated shales, K^t - Szydlowiec bryozoan - Lithothamnia sandstones, E^{hg} - Gorzen glauconitic sandstones. Q^t - Quaternary terraces. A - Grzybowski's locality, B - Neotype locality in Zawadka.

At Zawadka, SE from Wadowice along the creek of Dąbrówka, the Subsilesian marls and shales crop out in several small exposures. 15 metres down from the bridge (on the road from the bus stop) there are red and green marls which represent Early and Middle Eocene. A few metres farther, a contact with turbiditic sandstones is visible. These turbidites represent the lower tectonic units (External Flysch - ? Skole Unit). Going upstream from the bridge, on the right side of the creek, variegated and green marls of the Campanian and Santonian age are visible.

On the other side of the creek, a succession of the Paleocene variegated marls and yellowish green marls with red intercalations are visible, passing to the right into yellowish-green marls of the Maastrichtian age. After passing several small exposures of Palaeocene and Maastrichtian variegated marls and grey siltstones and shales from the External Flysch Nappe the excursion party will see, in the creek bed the red Turonian shales, variegated Santonian marls, green and red Campanian marls.

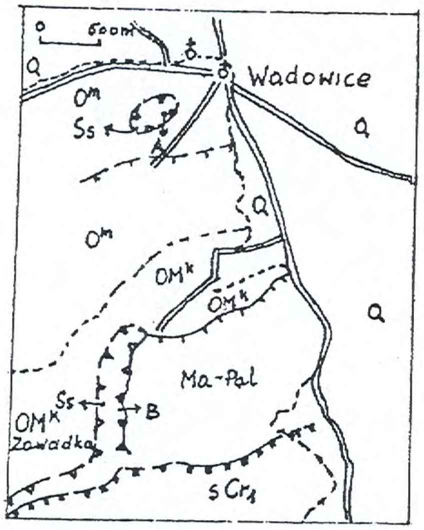
The Campanian variegated marls contain microfauna similar to that described by Grzybowski (1896) but scarce. Planktonic specimens are very rare and agglutinated forms comprise more than 50% of the assemblage. Characteristic foraminifers are: *Reussella szajnochae* (Grzybowski), *Tritaxia subparisiensis* (Grzybowski), *Spiroplectammina subhaeringensis* (Grzybowski), *Dorothia crassa* (Marsson), *Hormosina ovulum* (Grzybowski).

Maastrichtian green marls display a numerical dominance of planktics and approximately a one to one ratio between agglutinated and calcareous benthic foraminifers. Paleocene greenish and variegated marls contain less than 15% of planktonic specimens. Characteristic agglutinated species are:
Glomospira grzybowskii Jurkiewicz, *Hormosina ovulum* (Grzyb.), *H. velascoensis* (Cushman), *Rzehakina epigona* (Rzehak), *Dorothia crassa* (Marsson), *Remesella varians* (Glaessner).

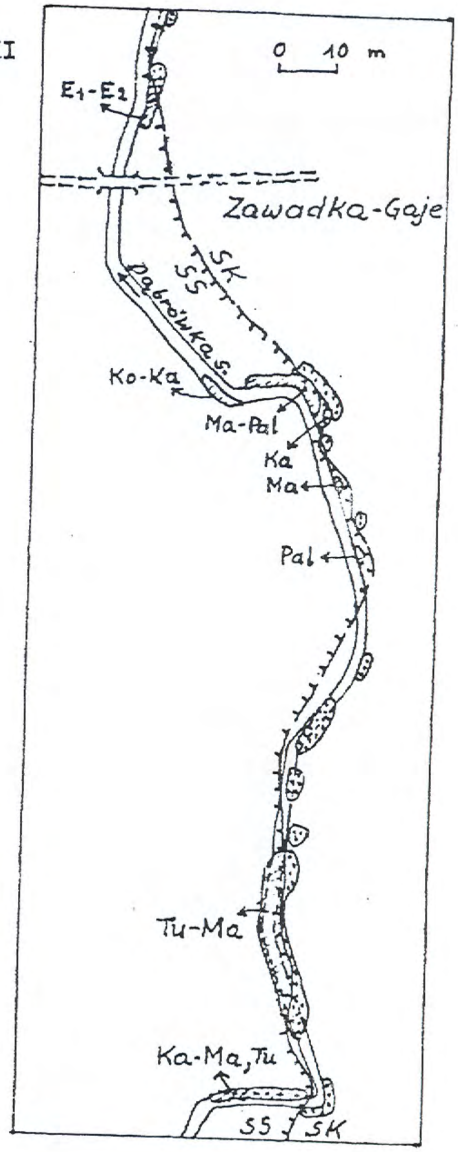
The Early and Middle Eocene assemblages from red and green marls comprise mostly over 90% of planktonic specimens. Characteristic agglutinated species are: *Spiroplectammina spectabilis* (Grzyb.), *Karrerulina conversa* (Grzyb.), *Dorothia* div. sp., *Gaudryina* div. sp. and *Reticulophragmium amplectens* (Grzyb.). Higher up a contact between the Early Campanian red, marly shales and a turbiditic complex from the External Flysch Nappe is visible.

Figure 40

I



II



I. Geology south of WADOWICE /compiled by L.Koszarski/

sCr1 - Silesian nappe /early Cretaceous flysch/, Ss - Sub-Silesian thrust sheets /pelagites/:
A - Grzybowski's pit /Campanian,Paleocene/
B - Neotype locality at Zawadka /Turonian-Oligocene
External Flysch /?Skole nappe/:
OM^k - Krosno shales and sandstones /late Oligocene - early Miocene/, O^m - Menilite beds /bituminous shales, silex, sandstones /Oligocene/, Ma-Pa - Maastrichtian - Paleocene flysch /Szydłowiec and Gorzen beds/

II. Part of the section at ZAWADKA

Sk - External Flysch /Paleocene part/, Ss - Sub-Silesian thrust sheet - variegated marls and shales /Tu - Turon., Ko -Coniac. and Santon.,Ka Campan., Ma - Maastricht., Pal - Paleocene, E_1-E_2 - early and middle Eocene/.

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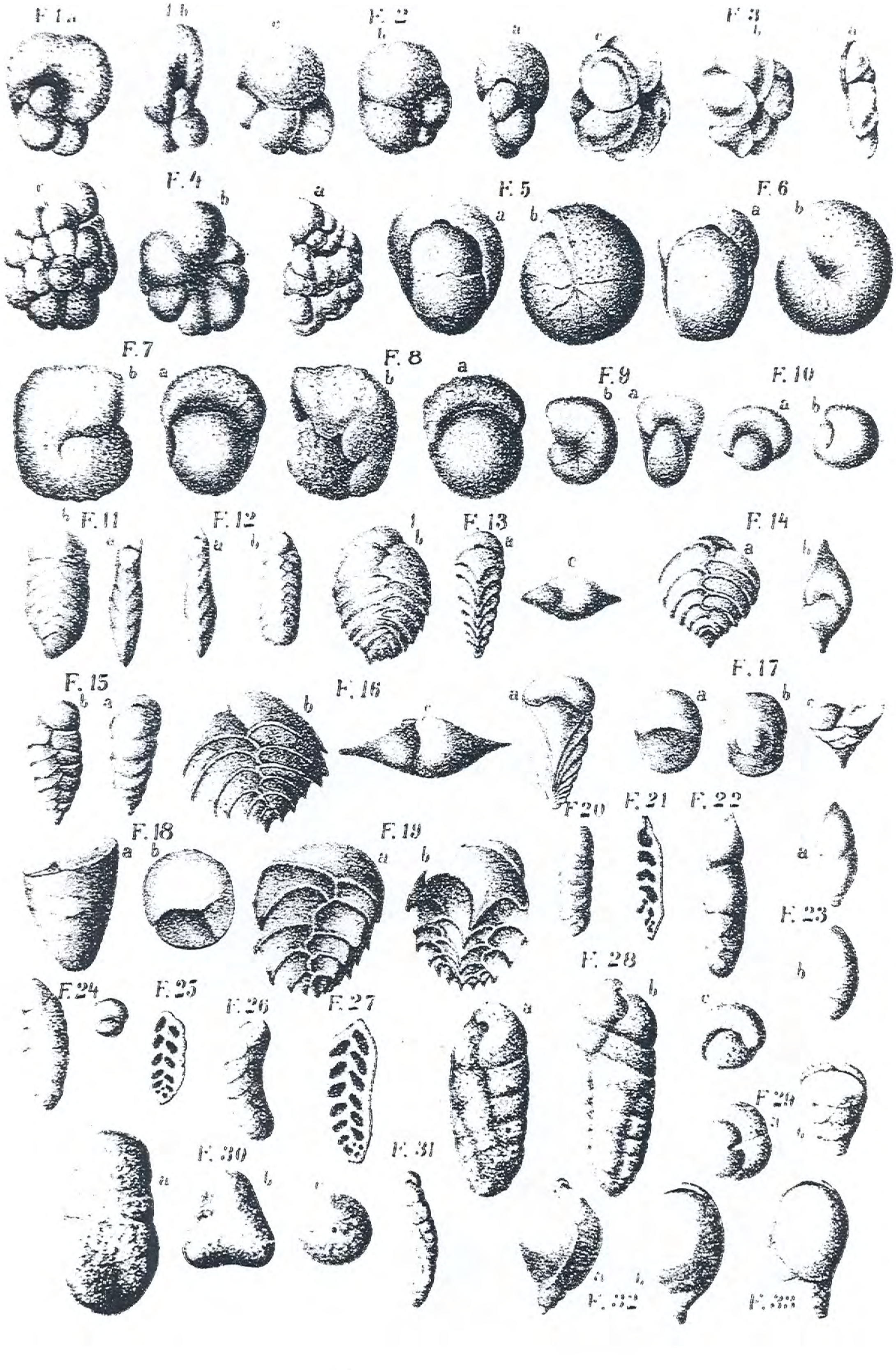
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