Attachment 2. Palynological analysis

Chemical processing and palynological study were carried out for 29 samples. Distribution of taxa and their age were established; additionally, paleo-ecological data were obtained.

1. Methods of palynological research

Palynological analysis is a time-consuming method, which requires chemical treatment of the samples and microscopic study of the resulting macerate. Standard methods of processing of palynological samples, adopted in the laboratory of paleo floristry of GIN RAS, were used.

1) Samples were treated with 10% HCl to remove carbonates;

2) Samples were washed in distilled water up to neutral reaction;

3) Samples were treated with 5% Na_2HPO_4 (aqueous) for separating the precipitate from the clay particles;

4) The resultant precipitate was centrifuged in a solution of heavy liquid [$K_2(CdI_4)$] for fossil palynomorphs extracting;

5) The resulting organic macerate was washed from heavy liquid;

6) The resulting macerate was treated by concentrated hydrofluoric acid to remove the siliceous minerals.

7) The resulting organic macerate was washed in distilled water to neutral reaction

8) Collecting of the resulting macerate in tubes (kept in glycerol).

A drop of resulting macerate was placed on a glass slide in a mixture of glycerin-gelatin and covered with a cover glass to study fossil palynomorphs.

Palynological study was carried out with optical microscope Axiostar plus (Carl Zeiss), at operating magnification × 400 and × 600.

All available types of spores and pollen, especially markers were determined in samples. Minimum quantitative value counted in the sample - 200 copies. In a case of a small number of palynomorphs all encountered instances were counted.

The stratigraphic distributions of spores, pollen and dinocysts are given in Tables 1-3. Pictures of specific taxa are shown in Tables 6-8

2. Palynological analysis

Area 1.

Subarea 1.1.

Reshetnikova River

Location No 14AP.

Samples 14AP-16, 14AP-20, 14AP-22 (Table 1). Among the group of higher plants palynomorphs a pollen of gymnosperms are predominant; less abundant are angiosperm pollen and spores. In the lower part of the section Taxodiaceae-Cupressaceae dominates among gymnosperms pollen, which replaced in 14AP-22 by pine pollen. Angiosperms are not diverse and represented by Tricolporopollenites cingulum, Tricolporopollenites spp., Pistillipollenites mcgregorii, and pollen which moving closer to modern Betulaceae, Alnipollenites sp., Carya simplex, Platycarya sp., Pterocarya sp., Juglans sp., Liquidambar grandiporea, Ulmodeipites tricostatus, Myrica sp., Araliaceae, Hamamelidaceae. Spores also vary and only in 14AP-20 achieve significant qualities, mainly due to the presence of spores of ferns.

Spectrum of 14AP-26 sample is dominated by pollen of angiosperms, which represented by thermophilic taxa pointing to a warm and humid climate, close to subtropical, during the sedimentation.

Palynological spectra of samples 14AP-16, 14AP-20, 14AP-22, 14AP-26 can be compared with the spectra of Kengdey and Tastastah palynocomplexes of regional horizons (Grinenko et al., 1998) pointing to the Early Eocene age of sediments.

The presence of cysts of dinoflagellates (dinocysts) and marine acritarch Paralecaniella indentata was established in the samples 14AP-16, 14AP-20 and 14AP-22 claims that the sediments were formed in coastal marine paleoenvironment. The nature of the distribution of marine phytoplankton indicates the regressive phase of basin development with only freshwater algae are present in 14AP-26 samples indicating the lake depositional environments.

Complex of dinocysts (sample 14AP16) is mainly represented by taxa having wide spread in the Paleogene and only some of them have narrow stratigraphic distribution. The first appearance of the Wetzeliella articulata, Wetzeliella cf. samlandica and Cerebrocysta bartonensis, which were found in the samples, is reported from West Siberia and Europe not earlier than Ypresian (Luterbacher et al., 2004; Iakovleva, Heilmann-Clausen, 2010; Yakovleva et al., 2012; Yakovleva and Alexandrova, 2013). Thus, the first appearance of these taxa in West Siberia basin is confined to the Dracodinium varielongitudum (Yakovleva and Alexandrova, 2013) zone of the middle of Ypresian. Based on the absence of younger dinocyst taxa the age of the basal layers of the 14AP section can be as a Middle Ypresian.

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Table 1. Distribution of palynomorphs in section 14AP.

Sample	14AP			
No	26	22	20	16
Age	Early Eocene			
Pollen of gymnosperms				
Taxodiaceae-Cupressaceae	67	9	81	85
Abies sp.				1
Picea sp.			1	
Cedrus sp.		1	2	
Pinus subgen. Haploxylon	3	9	10	7
Pinus subgen. Diploxylon		2	8	1
Pinus sp.		12	24	
Pinaceae	2	24	44	23
Podocarpus sp.	2	2	1	2
Araucariacidites sp.		1		3
Sciadopitys sp.	1		2	1
sum	**75**	**60**	**173**	**123**

Pollen of angiosperm				
Tricolporopollenites cingulum				2
Tricolporopollenites spp.	1			5
Pistillipollenites mcgregorii	3			1
Betulaceae				5
Alnipollenites sp.	5			1
Carya simplex	32	4		4
Platycarya sp.	3	1		1
Juglans sp.	5	2		1
Ulmodeipites tricostatus	3			2
Myrica sp.				1
Araliaceae				1
Pterocarya sp.	1		1	
Hamamelidaceae			1	
Liquidambar grandiporea		1		
~~Betula sect. Albae древ~~.				
~~aff. Betula sect. Nanae~~				
Nyssa sp.	1			
Engelhardtia sp.	1			
Hamamelis sp.	6			
Quercus sp.	5			
Comptonia sp.	11			
Tricolpites sp.	3			
Triporopollenites sp.	1			
Triatriopollenites plicoides	5			
Tricolporopollenites eschweilereinsis	2			
Retitricolpites sp.	4			
sum	**92**	**7**	**2**	**24**
Spores of mosses and ferns				
Laevigatosporites sp.	87	2	19	1
Osmunda sp.	16		3	3
Salviniaceae		1	8	
Gleicheniaceae		1	1	
Lycopodium sp.	1	1	3	
sum	**104**	**5**	**34**	**4**
Dinocysts, acritarchs, freshwater algae				
Paralecaniella indentata		2	1	42
Heteraulacacysta-Dinopterygium group		1		4
Deflandrea cf. oebisfeldensis				1
Cyclopsiella elliptica				9
Diphyes colligerum				1
Phthanoperidinium sp.				15

Fromea laevigata			1
Hystrichosphaeridium tubiferum			1
Spiniferites ramosus			2
Spiniferites sp.			1
Cribroperidinium tenuitabulatum			1
Senegalinium obscurum			2
Wetzeliella articulata			2
Wetzeliella cf. samlandica			1
Areoligera coronata			1
Areoligera senonensis			1
Areoligera sp.			1
Cerebrocysta bartonensis			1
Elytrocysta brevis			1
Thalassiphora delicata			1
Cordosphaeridium sp.			1
Cerodinium striatum			1
microforaminiferal linings			3
Mycrhystridium sp.			1
acantomorph acritarch			5
Ovoidites sp.	1		
Sigmopollis sp.			
Pterospermella sp.			
Schizosporis sp.	8		
sum	**9**	**1**	**100**
Mesozoic palynomorphs			
Baculatisporites sp.			2
Foveosporites cenomanicus		1	1
Cicatricosisporites tersus			
Perinopollenites elatoides			1
Cerebropollenites sp.			1
Vitreisporites pallidus			1
Piceaepollenites mesophyticus		1	1
Piceaepollenites sp.			
Abietaepollenites sp.			
Alisporites similis			
Alisporites equalis			
Alisporites rotundus			
Alisporites sp.			
Podocarpidites multesimus			
Podocarpidites major			
Podocarpidites sp.			
Phyllocladidites sp.	2		
Pinuspollenites minimus			
Pinuspollenites sp.			
Pinus cf. aralica		3	

Disaccites				
Cedripites sp.				
Araucariacidites australis				
Dipterella oblatinoides				
Gingkocycadophytus sp.				
Quercus sparsus				
Tripartina variabilis	1			
sum	3	2	5	7

Subarea 1.2.

Incised valley near Shlupochnaya River

Palynomorphs are unevenly distributed. Representative spectra were obtained only in samples 12V14-1 and 12V14-3 (Table 2). These spectra are characterized by the dominant role of angiosperm pollen, with less involvement of the pollen of gymnosperms. Among angiosperm pollen group dwarf birch and alder form are dominated, with subordinate amount of tree form, as well as sedge and heather. The few species of relatively thermophilic pollen was reported (Corylus, Carpinus, Elaeagnus, Lonicera). Pollen of gymnosperms consists mainly of coniferous pine; dark coniferous (Picea, Abies, Tsuga) are rarely found. Sphagnum mosses and ferns prevailed in the group and characterized by the presence of Selaginella sanguinolenta. Pollen of herbaceous varied but not numerous (except sedge, which is most likely due to local water-rich localities and also reflected in the frequent discovery of freshwater algae).

Studied spectra has no differences from the spectra of Begunov horizon palynocomplex of regional stratigraphic schemes of Paleogene and Neogene sediments of the North-East (Fradkina, 1995; Grinenko et al., 1998), which allows to date this locality (No 12V14) as Pliocene.

Table 2. Distribution of palynomorphs in section 12V14.

Sample	12V14				
No	7	6	3	2	1
Age	Pliocene				
Pollen of gymnosperms	-	-	-	-	-
Abies			1		1
Picea	2		7	4	3
Pinus subgen. Diploxylon			1		2
Pinus subgen. Haploxylon	5	5	74	17	42
Pinaceae			9		17
Tsuga crispa			1		3
Tsuga sp.			5		4
Larix			1		1
sum	**7**	**5**	**99**	**21**	**73**
Pollen of angiosperm					
Betula arboraceous			18	2	31
Betula sect. Nanae	1		31		51
Alnus			3		3
Alnaster		1	12	1	27
Carpinus					2
Corylus			3		9
Salix					9
Eleagnus	4		1		2

Lonicera			1		
Myrica			4		2
Ericales	2		15		9
Poaceae			5		4
Chenopodiaceae			1		1
Cyperaceae			58		54
Cichoriaceae					7
Artemisia			1		
Ranunculaceae					2

Area 2

Subarea 2.1

The northern part of Tas-Ary Island

Location No 22V14 and 29-v14.

The studied samples are characterized by a very similar taxonomic and quantitative composition. Palynological complex is dominated by gymnosperm pollen reaching 60% of the total number of palynomorphs (Table 3). All samples contain prasinophytes - Cymatiosphaera sp., Paralecaniella indentata (Deflandre et Cookson) Cookson et Eisenack, Pterospermella sp., which indicate the deposition of sediments in heavily watered, probably lagoon environments. Redeposition of poorly preserved Paleozoic-Mesozoic spores and pollen is also noted. Samples 29-v14-1, 22-v14-5, and 22-v14-3 contain redeposited dinocysts Sverdrupiella spp. which are typical for the Carnian-Norian deposits of Arctic Canada and Alaska (Wiggins, 1973; Bujak and Fischer, 1976; Felix, Burbridge 1978).

The group of gymnosperm pollen is dominated by the pollen of Pinus s/g Haploxylon et Diploxylon and Taxodiaceae-Cupressaceae; there are Tsuga canadensis (L.) Carrière, T. crispa Zakl., T. torulosa Zakl., T. sp., Abies sp., Picea sect. Omorica Willk., P. sect. Eupicea Willk., P. tobolica Pan., Sciadopitys sp., Podocarpus sp. The angiosperm pollen is dominated by representatives of Juglandaceae (Juglans polyporata Vojc., J. sieboldianiformis Vojc., J. nigripites Wodehouse, J. sp., Carya glabraeformis C. spackmania, Pterocarya stenopteroides Vojc., P. sp.) and Fagace spp.., Fagus sp., F. tenella, F. orientaliformis, F. grandifoliiformis, other taxa, including Betulaceae, were found in few samples. Spores are rare and are represented by Polypodiaceae, Lycopodium sp., Osmunda spp., and rare Sphagnum sp., Sporites durabilis (Dokt.-Hreb.).

The predominance of gymnosperm pollen and presence of such angiosperm taxa as Juglans polyporata, J. sieboldianiformis, Pterocarya stenopteroides, Carya glabraeformis, Carya spackmania, Fagus grandifoliiformis F. tenella, make it possible to date the palynological complex as Early Oligocene (Panova, 1971; Volkova, Kulkova, 1980, 1984; Prakticheskaya ..., 1990). According to palynological data, the vegetation of coniferous-deciduous forests is being reconstructed.

Table 3. Distribution of palynomorphs in section 29-v14 и 22-v14

Samples	29-v14-4	29-v14-3	29-v14-2	29-v14-1	22-v14-5	22-v14-4	22-v14-3	22-v14-2	22-v14-1
Oligocene									
Spores of mosses and ferns									
Sphagnum sp.	1								
Lycopodium sp.	1	1	1						
Polypodiaceae	2	2	2	2	3	1	3		2
Osmunda spp.	1	2	1			2	2	1	1
Sporites durabilis		1		2					
sum	**5**	**6**	**4**	**4**	**3**	**3**	**5**	**1**	**3**
Pollen of gymnosperms									
Podocarpus sp.	1	1	1	2	1	1		1	
Abies sp.	1	2	4		1		3	2	4
Tsuga spp. (T. canadensis, T. crispa, T. torulosa, T. sp.)	3	2	3		1		6	4	
Picea spp. (P. sect. Omorica, P. sect. Eupicea, P. tobolica)	2	1	2				1	1	
Pinus s/g Haploxylon et Diploxylon	51	87	61	40	80	29	103	88	71
Sciadopitys sp.	3	2					4	3	
Taxodiaceae-Cupressaceae	90	102	79	58	68	38	74	89	99
sum	**151**	**197**	**150**	**100**	**151**	**68**	**191**	**188**	**174**
Pollen of angiosperm									
Potamogeton sp.	1		1				1		
Myrica spp.	2	1	4	2	4		1	2	7
Comptonia sp.				2			1		3
Juglandaceae	1	2	4	2	6	3	5	3	6

Platycarya sp.									
Carya glabraeformis	4	5	3	6	4	1	4	4	11
Carya spackmania	2							1	2
Juglans sp.	4	7	8	6	6	10		1	2
Juglans nigripites	2				3			1	
Juglans polyporata	6	4	4	2	5	4	2	3	3
Juglans sieboldianiformis	11	9	1		4			1	
Pterocarya sp.	1	2		2			1		3
Platycarya sp.						1			
Corylus sp.	1	2				3	1	1	
Carpinus sp.	1		1			2		1	
Ostrya sp.								1	
Betula sp.	1	1	1	1	1	1	1	1	
Alnus sp.	4	3	4	2	5		2	1	5
Fagaceae							2		
Fagus orientaliformis				4	8	1	1	1	8
Fagus grandifoliiformis	1	2		4	2				
Fagus sp.			5		1				
Fagus tenella	9	3							
Castanea sp.					1				1
Castanopsis sp.	1		1		1			1	
Quercus spp.	36	30	34	22	34	6	8	11	18
Ulmus sp.	4	2	2	1	4	1	2	2	5
Moraceae	1				1		1		1
Hamammelidaceae	5	2	2	2		2			5
Liquidambar sp.	3	1	1	1	1	2		1	1
Rhus sp.	1								
Rhoipites cf. granulatus		1		3					

Acer sp.	1								
Tilia sp.		1	2	1	1				
Nyssa sp.			1	1					1
Cercidiphyllum sp.	1	1	1		1				
Araliaceae	1								
Ericales	2	1	1		1			1	1
Sapotaceae								1	
Rosaceae	2	1	1		1				
Oleaceae					1				
Triporopollenites sp.				1					
Tricolpopollenites sp.	3	2	7			5	1	1	3
Tricolporopollenites pseudocingulum				1			1		5
Tricolporopollenites sp.		2	2		1			1	1
Momipites sp.	6	5	5	1	1	1		1	
sum	**118**	**90**	**96**	**67**	**98**	**43**	**35**	**42**	**92**
REWORKING									
spores and pollen PZ-MZ	4	2	1	3	2	1		4	5
prasinophytes PZ-MZ	1	1		1	5		2	3	6
acritarchs PZ-MZ	1	1	4	2	3	1	1	2	12
Sverdrupiella spp.				6	3		3		
sum	**6**	**4**	**5**	**12**	**13**	**2**	**6**	**9**	**23**
PRASINOPHYTES									
Cymatiosphaera sp.				1	1				1
Ovoidites sp.	1								1
Paralecaniella indentata	3	2						1	
Pterospermella sp.		1			1			1	
sum	**4**	**3**	**0**	**1**	**2**	**0**	**0**	**2**	**2**

Cenozoic deposits have been studied in the central part of Tas-Ary

Location No 18V14.

Spectra of studied samples are close to each other, which allows to combine them into a single palynocomplex (Table 4). A slight prevail of contents of angiosperm pollen over gymnosperms pollen is typical for the studied samples. Main species in palynocomplex are Pinus subgen. Haploxylon, Pinus sect. Cembra, Pinaceae, Tsuga spp., birch and alder ~~wood~~ tree forms, with subordinate amount of pollen of shrub forms. Pollen of thermophilic angiosperms (Corylus, Myrica, Juglandaceae, Ulmus, and others) takes a subordinate position. Spectra characterized by the presence of pollen of Taxodiaceae. Studied palynocomplex is similar to Onkuchah palynocomplex of regional horizon (Fradkin, 1995; Grinenko et al., 1998), indicating that the age of occurrence 18V14 is Late Oligocene.

The dynamics of increasing of quantity of organic-microplankton upwards in the section shows transgressive trend of the basin development at that time. So, most of the samples characterize heavily watered (lake) paleoenvironment, and sample No 18V14-8 characterizes shallow marine paleoenvironment, as evidenced by the presence of dinocysts Chiropteridium cf. galea, Alterbidinium sp., Cordosphaeridium cf. inodes (Table 4). It should be noted that the Chiropteridium cf. galea is zonal species of western European zone D13 (Vandenberghe et al., 2012), and it first appearance is dated as the Early Rupel. The Chiropteridium partispinatun (= C. Galea) is established in the sediments of the Late Rupel - Hutt in the south of the European part of Russia and Ukraine (Zaporozhets, 1999; Andreyeva-Grigorovich et al., 2011; unified ..., 2015). The disappearance of these species is observed in the Lower Aquitanian.

Thus, the data indicate the Late Oligocene age of the 18V14 section deposits.

Table 4. Distribution of palynomorphs in section 18V14.

Sample	18V14				
No	8	6	4	3	1
Age	Late Oligocene				
Pollen of gymnosperms					
Taxodiaceae-Cupressaceae	17	1	31	7	6
Abies	1	1	1	2	2
Picea	2	1	1	4	3
Pinus subgen. Diploxylon	1		1	3	1
Pinus subgen. Haploxylon	28	5	4	18	4
Pinus sect. Cembrae	13	10	3	29	41
Pinaceae	12	13	5	18	11
Podocarpus sp.	3		1		
Tsuga crispa	3	2	1	2	2
Tsuga canadensis	9	4	2	10	11
Larix	1				1
Sciadopitys sp.		1			
Cedrus sp.	1				
sum	**91**	**38**	**50**	**93**	**82**
Pollen of angiosperm					
Betula (tree forms)	8	12	12	16	39
Betulaceae	5	2	5	1	2
Betula sect. Nanae					4
Alnus	10	31	23	7	6
Alnaster		3	1	1	4
Carpinus			1	1	
Corylus	4	20	10	1	4
Myrica	1	7	8	9	5
?Comptonia sp.		4	9	1	4
Ulmus sp.	1	1	1	1	1
Fagaceae	1	1		1	1
Dipsacaceae	1	1	1	1	1
Ericales	32	51	58	51	32
Juglans polyporata	1	1	2	1	
Juglans sp.					2
Herbae	1	1	1	1	
Triporopollenites sp.		1	4	1	
Tricolpites sp.	1		1	1	
Rhoipites sp.				1	
?Elytrante sp.				1	
Fagus sp.	1	1	1	1	
Carya sp.	4			1	
Cyperaceae	1	1		1	

Aldrovanda sp.	1	1	1		1
Onagraceae					2
Polygonaceae				1	
Valerianaceae	2				1
Liliaceae	1	1	1	1	
Lonicera	1	1	1	1	
Diervilla sp.	1	1	1	1	1
Trapa			1	1	1
Potamogeton	12	16	13	8	15
Rutaceae		1	2		
Quercus graciliformis			1		
Quercus forestdalensis		1	1		
Quercus sp.	1	3	3		
Liquidambar sp.	1	1	1		
Ilex sp.	1		1		
Pterocarya sp.	2	1			
Rosaceae	1				
Moraceae	1				
Araliaceae	2				
Hamamelidaceae	2				
sum	**101**	**165**	**165**	**113**	**126**
Spores of mosses and ferns					
Sporites durabilis	1	2		1	1
Sphagnum	4	4	7	3	7
Pteridaceae	8	4	4	4	4
Lycopodiella inundata	1	1	1	1	
Selaginella cf. selaginoides		1	1	1	
Polypodiaceae	45	113	62	67	63
Lycopodium spp.	8	18	7	7	7
Osmunda	3	12	4	10	4
Salviniaceae	1			1	
Ricchia	1	1		2	1
Husperzia sp.		1	1		
Selaginella cf. rupestris	1				
sum	**73**	**157**	**87**	**97**	**87**
Dinocysts					
Alterbidinium sp.	1				
Chiropteridium cf. galea	1				
Cordosphaeridium cf. inodes	1				
sum	**3**	**0**	**0**	**0**	**0**
Freshwater algae					
Botryococcus				1	
Sigmopollis	1	7	2		1

Incertae sedis	6		1		
Pediastrum	1			2	
Ovoidites	1	1	1	1	3
Schizocysta sp.	1		1	1	1
Acritarch		1	1	1	
Zygnemataceae		1			
sum	10	10	6	6	5
Paleozoic and Mesozoic palynomorphs					
Dictyoplyllidites sp.			1	1	
Araucaria sp.		1			
Nudopollis sp.	1	1			
Tripartina variabilis		1			
Podocarpidites sp.		1			
Quadriculina sp.		1			
Disaccites	1				

Subaraea 2.2.

Durnaya Lagoon

Location No 24V14.

In this locality diverse spectra obtained from the samples No 24V14-16 and 24V14-25. The rest of the samples contain a minor amount of palynomorphs (Table 5). Palynomorphs are are broken and corroded. Also, small numerous relatively rounded carbonaceous particles are present, which were probably redeposited. The presence of redeposited Jurassic-Cretaceous taxa is reported throughout the section, the number of which varies from 29% to 77%.

Gymnosperm pollen dominates and are represented mainly by Pinus sect. Cembrae and Pinus subgen~~,~~ Haploxylon, Picea and subordinate quantity of dark coniferous pollen - Abies and Tsuga. Podocarpus, Taxodiaceae-Cupressaceae and Pinus protocembra, which are likely to be redeposited, are observed sporadically. Dwarf birch and Alnaster pollen occurs frequently among angiosperms. Grass pollen is scarce and monotonous. It is represented mostly by sedge and clove and in a less degree by cereals. The spore part is dominated by sphagnum mosses and polypod ferns. Selaginella and Lycopodium are rarer there.

Established composition of spectra allows one to reconstruct the forest-tundra vegetation grows in a relatively warm boreal climate. In general, this type of vegetation is established in the Arctic region for the deposits not younger than the Late Pliocene (Fradkina, 1983, 1995).

Fixed part of the spectra is close to Kutuyah horizon of regional stratigraphic scheme; thus, the age sediments could be restricted as Pleistocene.

Table 5. Distribution of palynomorphs in section 24V14.

Sample	**24V14**				
No	**25**	**21**	**19**	**17**	**16**
Age	**Pleistocene**				
Pollen of gymnosperms					
Abies	1		1		6
Picea	12	3			8
Pinaceae	13	7	3	6	28
Pinus protocembra			4		2
Pinus sect. Cembrae	14		1	3	10
Pinus subgen. Haploxylon	15	9			13
Podocarpus					3
Tsuga sp.	2				1
Taxodiaceae-Cupressaceae		2		1	1
sum	**57**	**21**	**9**	**10**	**72**
Pollen of angiosperm					
Betulaceae				2	5
Betula древ.	2				5
Betula sect. Nanae	12			2	5
Alnus sp.					1
Alnaster sp.	11				2
Ericales				1	5
Poaceae	1				1
Cyperaceae	3		1	1	1
Caryophyllaceae	2				1
Carpinus sp.			1		
Salix sp.	4		1		
Equisetum	6				
Corylus sp.	1				
sum	**42**	**0**	**3**	**6**	**26**
Spores of mosses and ferns					
Sphagnum sp.	4			1	6
Lycopodium sp.					2
Osmunda sp.			4		4
Polypodiaceae	7				3
Selaginella rupestris	1				1
Selaginella sanguilolenta	1		1		
Lycopodium cf. lagopus	2				
Lycopodium alpinum	1				
Ophioglossum sp.	1				
Riccia sp.	1				
sum	**18**	**0**	**5**	**1**	**16**

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Photo tables

Table 4.

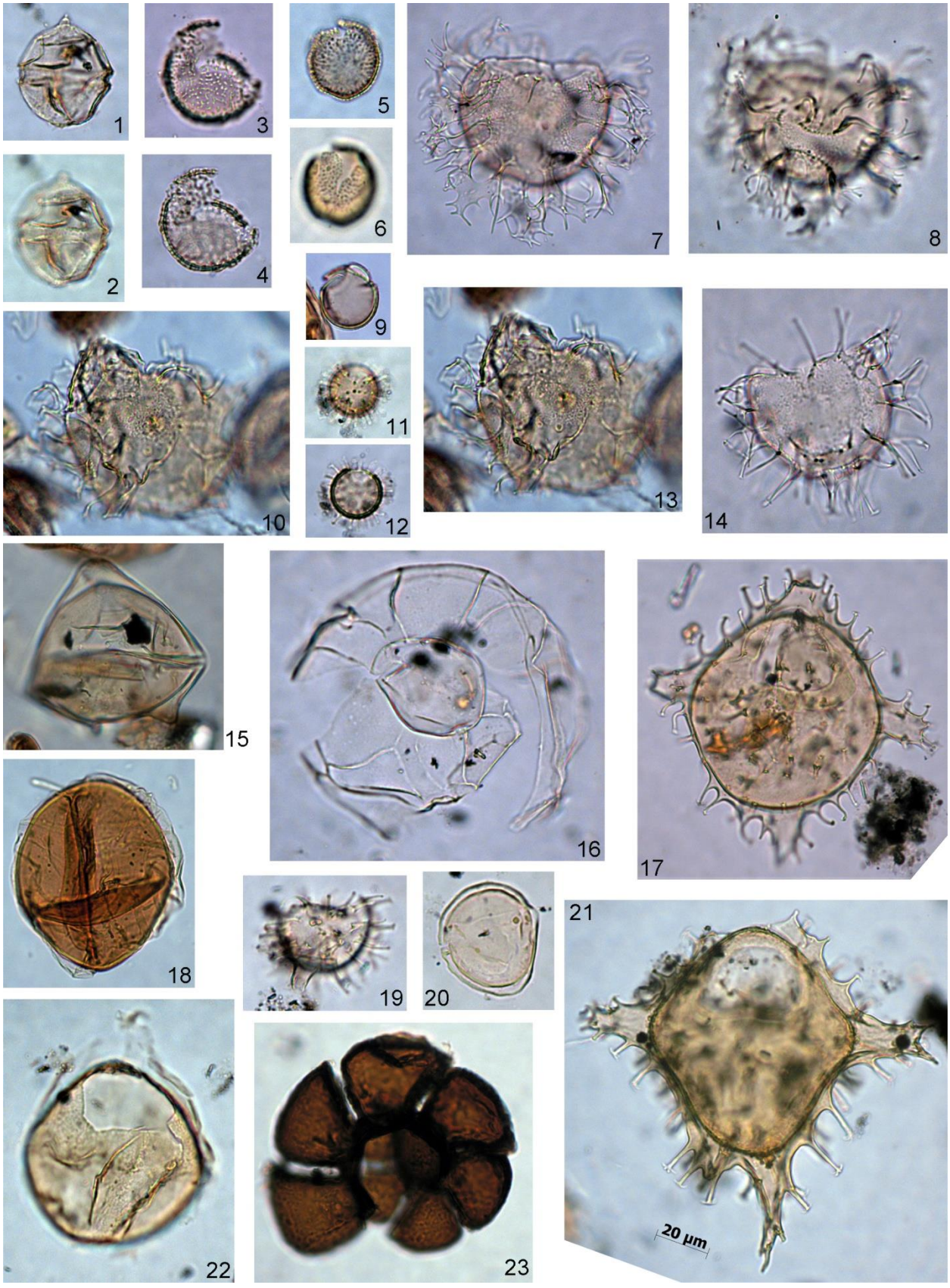

Table 4. **1-2** – *Phthanoperidinium* sp., sample 14AP-16; **3-4** – *Cerebrocysta bartonensis* Bujak, sample 14AP-16; **5-6** – *Elytrocysta brevis* Stover et Hardenbol, sample 14AP-16; **7-8** – *Areoligera coronata* (Wetzel) Lejeune-Carpentier, sample 14AP-16; **9** – *Sigmopollis* sp., sample 18V14-8; **10, 13** – *Chiropteridium* cf. *galea* (Maier) Sarjeant, sample 18V14-8; **11-12** – acantomorph acritarch, sample 14AP-16; **14** – *Areoligera senonensis* Lejeune-Carpentier, sample 14AP-16; **15** – *Alterbidinium* sp., sample 18V14-8; **16** – *Thalassiphora delicata* Williams et Downie, sample 14AP-16; **17** – *Wetzeliella articulata* Wetzel, sample 14AP-16; **18** – Incertae sedis, sample 18V14-8; **19** – *Diphyes colligerum* (Deflandre et Cookson) Cookson, sample 14AP-16; **20** – *Paralecaniella indentata* Deflandre et Cookson, sample 14AP-16; **21** – *Wetzeliella* cf. *samlandica* Eisenack, sample 14AP-16; **22** – *Deflandrea oebisfeldensis* Alberti, sample 14AP-16; **23** – microforaminiferal linings, sample 14AP-16. Magnification x500.

Table 5.

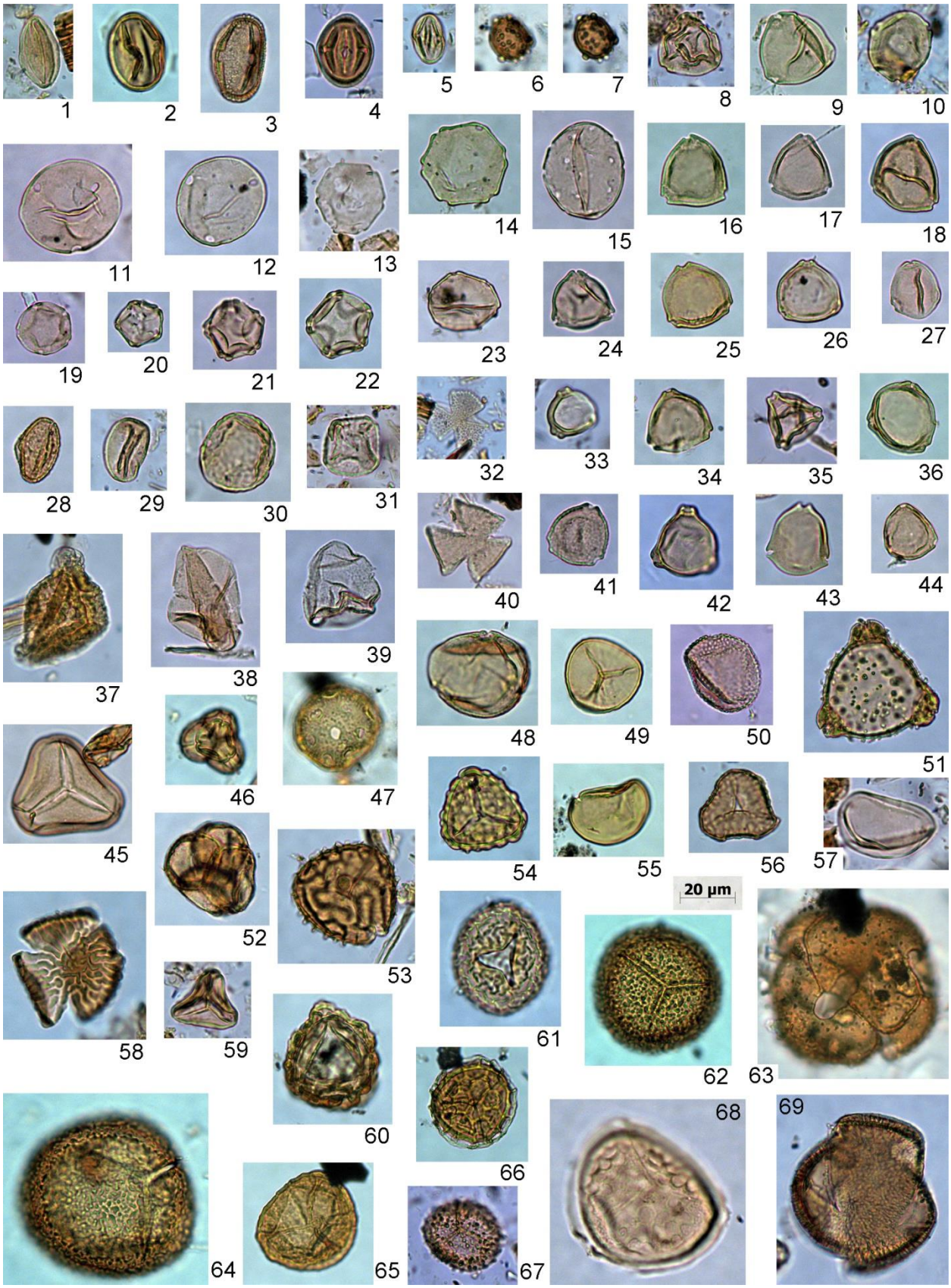

Table 5. **1** - *Tricoplites* sp., sample 14AP-26; **2** – *Tricolporopollenites ecshweilerensis* Th. et Pfl., sample 18V14-1; **3** – Araliaceae, sample 18V14-3; **4** – *Rhoipites* sp., sample 18V14-3; **5** – *Tricolporopollenites* sp., sample 14AP-26; **6-7** – *Pistillipollenites mcgregorii* Rouse, sample 14AP-16; **8** – *Triatriopollenites plicoides* Zakl., sample 14AP-26; **9** – *Triatriopollenites* sp., sample 18V14-4; **10** –

Triatriopollenites sp., sample 14AP-26; **11** – *Carya* sp., sample 18V14-8; **12** – *Carya* sp., sample 18V14-3; **13** – *Pterocarya* sp., sample 14AP-26; **14** – *Pterocarya* sp., sample 18V14-4; **15** – *Juglans polyporata* Voic., sample 18V14-3; **16** – *Myrica* sp., sample 18V14-8; **17-18** – *Corylus* sp., sample 18V14-3; **19** – *Alnaster* sp., sample 18V14-1; **20** – *Alnaster* sp., sample 18V14-3; **21-22** – *Alnus* sp., sample 18V14-3; **23** – *Juglans* sp., sample 14AP20; **24** – *Myrica* sp., sample 18V14-3; **25** – *Betula* sect. *Nanae*, sample 12V14-3; **26-27** – *Betula* sect. *Nanae*, sample 24V14-25; **28** – *Quercus* sp., sample 18V14-3; **29** – Fagaceae, sample 14AP-26; **30** – *Ulmus* sp., sample 18V14-3; **31** – *Ulmodeipites* sp., sample 14AP-26; **32** – *Hamamelis* sp., sample 14AP-26; **33** – *Betula* sp. (древовидных форм), sample 24V14-16; **34-35** – *Betula* sp. (древовидных форм), sample 18V14-1; **36** – *Betula* spp. (древовидных форм), sample 18V14-3; **37** – *Trapa* sp., sample 18V14-1; **38-39** – Cyperaceae, sample 18V14-8; 40 – *Acer* sp., sample 18V14-4; **41** – Canabaceae, sample 18V14-3; **42** - *Betula* sp. (древовидных форм), sample 18V14-6; **43** – Betulaceae, sample 18V14-8; **44** – Betulaceae, sample 18V14-1; **45** – Pteridaceae, sample 18V14-3; **46** – Ericales, sample 18V14-1; **47** – Caryophyllaceae, sample 24V14-16; **48** – *Fagus* sp., sample 18V14-3; **49** – *Sphagnum* sp., sample 18V14-1; **50** – *Potamogeton* sp., sample 18V14-1; **51** – *Diervilla* sp., sample 18V14-3; **52** – Ericales, sample 18V14-3; **53** – *Lycopodium* sp., sample 18V14-1; **54** – *Ophioglossum* sp., sample 18V14-3; **55** – *Laevigatosporites* sp., sample 14AP-20; **56** – *Huperzia* sp., sample 18V14-4; **57** – Polypodiaceae, sample 14AP-26; **58** – *Sporites durabilis* D.-Hrebn., sample 18V14-3; **59** – Gleicheniaceae, sample 14AP-16; **60** – *Selaginella sanguinolenta* (L.) Spring, sample 24V14-19; **61** – *Lycopodiella inundata* (L.) Holub, sample 18V14-8; **62** – *Osmunda* sp., 14AP-20; **63** – *Aldrovanda* sp., sample 18V14-6; **64** – *Osmunda* sp., sample 18V14-1; **65** – *Selaginella rupestris* (L.) Spring, sample 24V14-16; **66** – *Lycopodium* sp., sample 14AP-20; **67** – *Osmunda* sp., sample 14AP-26; **68** – *Riccia* sp., sample 18V14-3; **69** – Dipsacaceae, sample 18V14-3. Magnification x500.

Table 6.

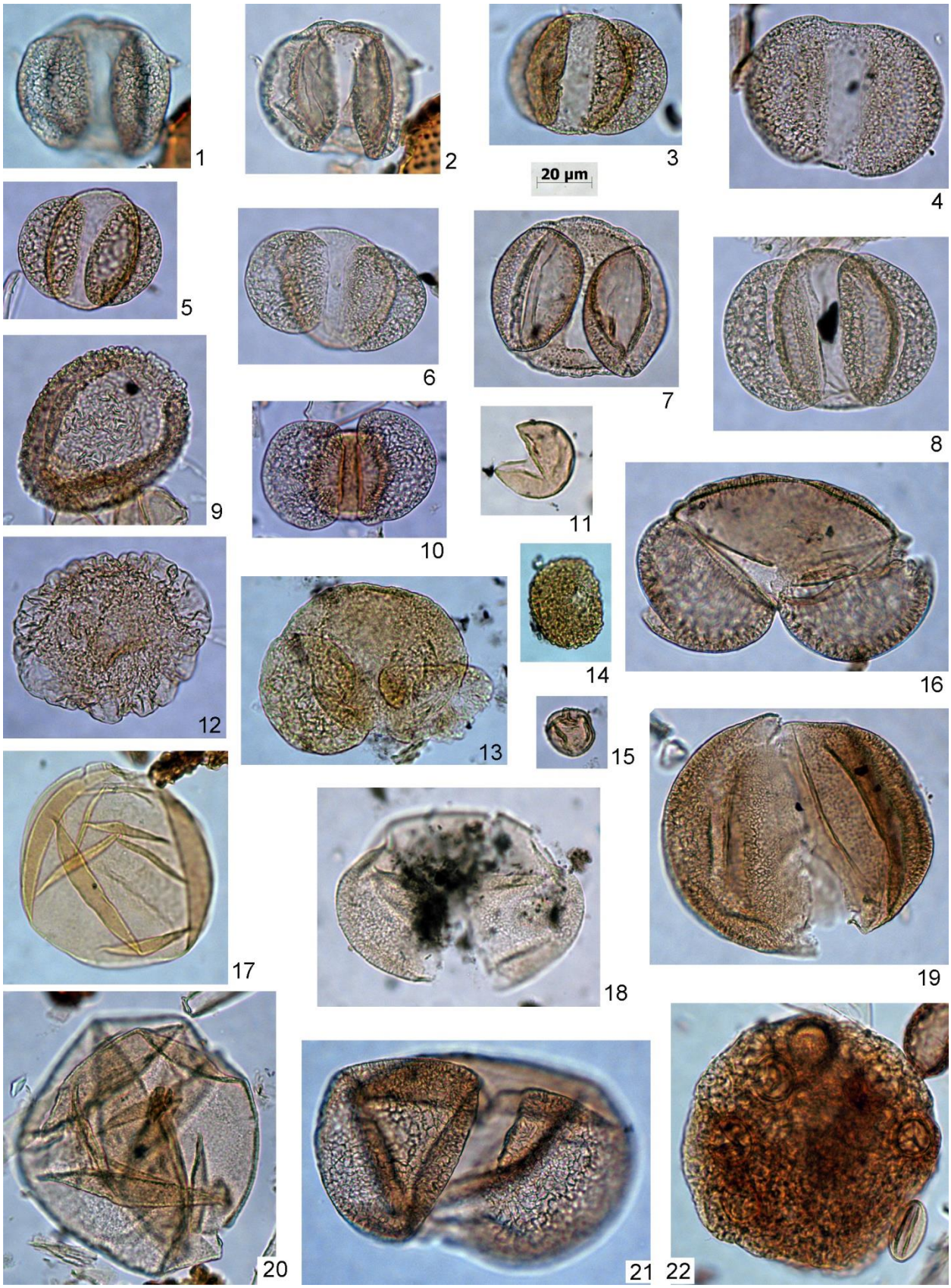

Table 7. **1-2** – *Pinus* sect. *Cembrae* (= *Pinus pumila* (Pall.) Regel), sample 18V14-1; **3** – *Pinus* sect. *Cembrae* (= *Pinus sibirica* Du Tour), sample 18V14-1; **4** – Pinaceae, sample 18V14-3; **5-6** – *Pinus* subgen. *Diploxylon*, sample 18V14-3; **7** – *Pinus* sect. *Cembrae*, sample 18V14-3; **8** - *Pinus* subgen. *Haploxylon*, sample 18V14-3; **9** – *Tsuga canadensis* (L.) Carrière, sample 18V14-3; **10** – *Podocarpus* sp.,

sample 18V14-4; **11** – Taxodiaceae-Cupressaceae, sample 14AP-20; **12** – *Tsuga crispa* Zakl., sample 18V14-8; **13** – *Pinus* sp., sample 14AP-20; **14** – *Sciadopitys* sp., sample 14AP-20; **15** – Taxodiaceae-Cupressaceae, sample 18V14-8; **16** – *Abies* sp., sample 18V14-3; **17** – *Larix* sp., sample 18V14-8; **18** – *Picea* sp. (sect. *Omorica*), sample 24V14-25; **19** – *Picea* sp. (sect. *Eupicea*), sample; **20** – *Araucaria* sp., sample 18V14-6; **21** – *Picea* sp. (sect. *Omorica*), sample 18V14-1; **22** – Salviniaceae, sample 18V14-8. Magnification x500. x500.

Table7.

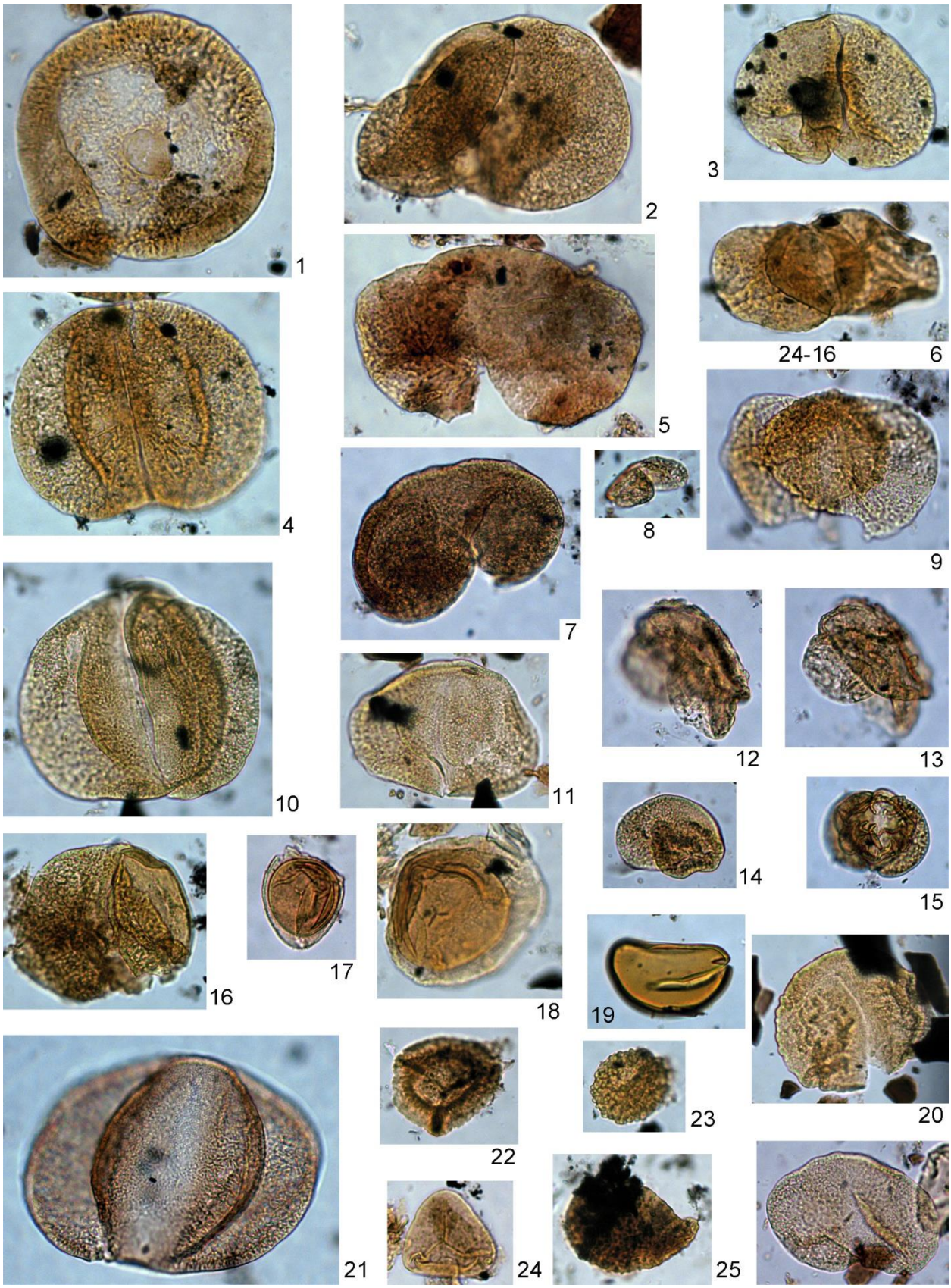

Table 7. **1** – *Cordaitina* sp., sample 24V14-16; **2** –*Piceaepollenites* sp., sample 14V14-23; **3** – Disaccites, sample 14V14-23; **4** – *Alisporites* sp., sample 24V14-16; **5** – *Piceaepollenites* sp., sample 14V14-23; **6** – *Podocarpidites* sp., sample 24V14-16; **7** – *Cedripites* sp., sample 14V14-23; **8** – *Pinus minimus* Zakl, sample 14V14-23; **9** – *Podocarpidites* sp., sample 24V14-25; **10** – *Alisporites* sp., sample

24V14-25; **11** – *Piceaepollenites* sp., sample 14V14-23; **12-13** – *Pinuspollenites* sp., sample 24V14-25; **14** – *Cedripites* sp., sample 14V14-23; **15** – *Pinus* cf. *aralica* Bolkh., sample 14V14-23; **16** – Disaccites, sample 24V14-25; **17-18** – Salviniaceae, sample 24V14-16 ; **19** – *Laevigatosporites* sp., sample 14V14-23; **20** – Disaccites, sample 14V14-23; **21** – *Alisporites* sp., sample 14V14-23; **22, 25** – неопределенные споры ; **23** – *Cerebropollenites mesozoicus* (Couper) Nilsson, sample 24V14-25; **24** - *Leiotriletes-Coniopteris* group, sample 24V14-25; **26** – Disaccites, sample 14V14-23. Magnification x500..