Methods

Pollen extraction

At the Sediment Laboratory of the Free University of Amsterdam a specific method was devised to extract pollen from gypsiferous beds following a modified version of a technique originally proposed by (Horowitz, 1992). The following procedure was performed. (1) 50 to 100 grams were selected from each sample and crushed, although complete crushing was avoided, this to keep pollen intact. (2) The samples were placed in 800 ml containers, submerged in diluted hydrochloric acid (10%), and heated to boiling point. The sediment was topped with demineralised water and left to rest for circa 12 hours. (3) The liquid was decanted, and refilled with water. This process was repeated for 4 to 5 times until the suspension became completely transparent. (4) The sample was then submerged in sodium pyrophosphate (1%) and heated to boiling point and then left to cool down and sieved over 8um screen. (5) The residue was split over 4 centrifuge tubes (15ml each), followed by heavy liquid separation (sodium polywolframate of density 2.0). This separation was repeated once and the eight floating parts were added together resulting in one pollen residue for each sample. (6) The residues were washed 4 times with demineralised water and finally mounted in 'Kaisers' glycerine-gelatine and sealed with paraffin. Slides were analyzed at the Institute for Biodiversity and Ecosystem Dynamics of the University of Amsterdam using a Leitz microscope mounted with a slide position coordinate indicator for accurate pollen counting.

Details of palynologic analysis

From the two sampled sections, 14 out of 15 sampled gypsum strata - provided quantifiable amount of pollen and spores. Six out of the seven sampled greenish siltstones in the upper part of the stratigraphy were barren of pollen. These and the unsuccessful gypsum sample were hampered by corrosion - probably due to oxidation in the sedimentary environment. The resulting 15 successful samples (8 from Shuiwan and 7 from Xiejia) were counted, and in spite of the high percentages of corroded material (up to 50%), sums of 300 to 400 were achieved (except for sample P377 of the Shuiwan section where a sum of 150 was reached). In total around 90 different pollen and spore taxa were observed of which 60 (Table DR1) were identified to existing references (e.g. (Frederiksen, 1983; Wang et al., 1986; Wang et al., 1990; Liu and Leopold, 1992; Frederiksen, 1994; Stuchlik, 1994; Shaw, 1998; Song et al., 2004). These were organized into 18 affinity types based on their ecological relationship (Wang, 1961; Hou, 1983; Ni et al., 2000) and relative abundances. For each sample, observed affinity types were plotted (Juggins, 2007) according to ages determined by magnetostratigraphy (Dai et al., 2006; Dupont-Nivet et al., 2007) (Table DR2; Fig DR1). Following assemblages found in present biomes (Ni et al., 2000; Yu et al., 2001), these 18 observed pollen and spore affinity types were then further grouped into seven vegetation types and represented in a cumulative diagram (Table DR3; Fig. 2).

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TABLE DR1. OBSERVED FOSSIL POLLEN AND SPORE TAXA

Xerophytic shrubland
1) *Ephedripites* group (*Ephedra*)
2) CAC group (Chenopodiaceae, Amarantaceae, Caryophyllaceae)
3) *Graminidites* (Poaceae)
4) *Compositoipollenites* (Compositae)

Conifer forest
5) *Pinuspollenites* (*Pinus*)
6) *Piceaepollenites* (*Picea*)
7) *Tsugaepollenites* (*Podocarpus*)
8) *Abiespollenites* (*Abies*)
9) *Ericipites* (Ericaceae, i.e. scrub)
10) *Podocarpidites* (*Podocarpus*)
11) *Cedripites* (*Cedrus*)
12) aff. *Larix*

Broad-leaved forest
13) Fagaceae group (*Quercoidites*, *Cupuliferoipollenites*, *Lithocarpus-Castanopsis* type)
14) *Zelkovaepollenites-Ulmipollenites* (*Zelkova-Ulmus*)
15) *Liquidambarpollenites (Liquidambar)*
16) *Carpinipites (Carpinus)*
17) *Pterocaryapollenites (Pterocarya)*
18) *Juglanspollenites (Juglans)*
19) *Ilexpollenites (Ilex)*
20) *Lonicerapollis (Lonicera)*
21) *Aceripollenites (Acer)*
22) *Myrtaceidites (Myrtaceae)*
23) *Salixpollenites (Salix)*
24) *Caprifoliipites* (aff. *Viburnum)*
25) *Tiliaepollenites (Tilia)*
26) *Betulaepollenites (Betula)*
27) *aff. Corylus*
28) *Psilatriporites (*aff. *Celtis)*
29) *Annutriporites* (aff. *Momipites)*
30) *Alnipollenites (Alnus)*

Subtropical-Deciduous forest
31) *Meliaceoidites* (Meliaceae) *&* *Rhoipites* (Anacardiaceae)

Tropical-Subtropical forest
32) *Sabelpollenites* (Palmae)
33) *Arecipites* (Arecaceae)
34) *Spinozonocolpites* (*Nypa*)
35) *Confertisulcites* (Palmae)
36*) Liliacidites (*Liliaceae)
37) cf. *Mauritiidites (Mauritia)*
38) *Rutaceoipollis* (Rutaceae)
39) *Corsinipollenites* (aff. Onagraceae)
40) *Psilatricolporites* (aff. Solanaceae)
41) *Retitricolpites* (Euphorbiaceae type)

42) *Psilatricolporites* (aff. Apocynaceae)
Other angiosperms
43) *Eleagnacidites*
44) *Retitrescolpites*
45) cf. *Catinipollis*
46) *Retitricolpites* group (aff. *Tamarix*, and 5 other types)
47) cf. *Porocolpopollenites*
48) Psilatricolporate (diverse types)
49) Psilatricolpate (diverse types)
50) Retitricolpate (diverse types)
51) Retitricolporate types (diverse types)
52) Stephanocolpate type
53) Granulate, tricolpate type
54) Striatricolporate type
55) Retitriporate type
56) Psilasyncolpate type
57) Inaperturate, reticulate type
Pteridophytes
58) *Lycopodiaceaesporis* (*Lycopodium*)
59) *Cicatricosisporites* (Schizaeaceae)
60) *Polypodiaceisporites (*Polypodiaceae*)*

Note. Pollen and spore taxa are listed with botanical affinity and grouped according to their occurrence in modern vegetation types (see Methods). Around 40 taxa remained unclassified and labeled as types. Single occurrences of dinoflagellates in some of the samples do not figure in the table.

TABLE DR2. VEGETATION TYPE ABUNDANCES

Sample	Level	Age	Vegetation types																	
			I	II	III	IV	V	VI	VII	VIII	IX	X	XI	XII	XIII	XIV	XV	XVI	XVII	XVIII
	(m)	(Ma)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
Xiejia section																				
P379	137.6	33.3	22.0	3.4	0.0	39.0	1.5	11.0	0.0	0.3	1.5	6.4	7.9	0.0	0.9	0.0	0.0	0.0	3.7	2.4
P382	115.9	33.9	41.5	0.8	0.5	29.1	0.8	2.5	0.0	0.5	1.1	3.6	4.1	0.3	8.2	0.0	0.0	0.0	4.4	2.5
P383	64.0	35.1	23.7	3.1	0.3	13.3	2.3	0.8	1.4	0.3	3.1	34.2	4.8	1.7	3.7	0.0	0.0	0.0	3.7	3.7
P384	27.8	37.3	18.8	0.0	1.0	12.3	0.3	8.7	0.6	1.0	1.0	37.9	5.5	1.6	3.9	0.0	0.0	0.0	0.6	6.8
P385	10.0	38.4	21.2	1.2	0.0	55.5	0.6	7.7	0.3	0.6	2.7	0.6	0.0	0.0	1.8	0.3	0.0	0.0	6.5	1.2
P386	-2.0	39.2	30.3	0.3	0.3	49.3	0.0	12.3	0.0	0.0	0.0	0.5	0.0	0.0	0.3	0.0	0.0	0.0	6.4	0.3
P387	-60.0	41.4	48.1	0.2	0.0	5.8	0.5	1.4	1.4	2.4	7.0	0.2	0.0	0.0	11.8	0.0	1.2	0.0	15.9	3.9
Shuiwan section																				
P372	144.0	33.7	19.3	1.9	0.0	41.7	1.6	6.7	0.3	1.3	2.1	7.5	2.4	0.5	4.8	0.0	0.0	0.0	5.6	4.3
P373	127.5	34.0	50.3	0.7	0.0	8.9	1.1	1.6	0.0	0.0	0.7	11.2	16.0	1.1	3.4	0.0	0.0	0.0	4.6	0.2
P374	99.9	34.5	37.8	4.4	0.0	10.0	2.2	10.3	8.1	0.0	2.8	6.4	3.6	0.0	7.2	0.0	0.0	0.0	6.4	0.8
P376	30.8	38.3	71.1	1.1	0.2	7.3	1.1	2.2	0.2	0.0	3.7	0.2	0.2	0.0	9.5	0.2	0.0	0.0	1.1	1.8
P377	1.3	39.8	39.6	0.0	0.0	0.0	7.1	39.6	0.0	0.6	2.6	1.3	0.0	0.6	1.3	0.0	0.0	0.0	0.0	7.1
P11	-22.5	41.1	20.2	0.0	8.0	3.3	4.5	11.3	4.5	1.2	7.1	0.0	0.0	0.0	29.7	2.1	0.9	0.0	3.9	3.6
P12	-35.0	41.0	9.8	0.0	0.3	12.1	5.5	7.8	4.6	6.6	5.5	0.0	0.0	0.0	28.5	2.9	6.9	0.9	8.1	0.6
P13	-37.0	40.6	42.0	0.0	0.0	22.4	5.7	2.6	0.6	0.6	1.4	0.0	0.0	0.0	10.3	0.6	10.1	0.3	2.9	0.6

Note. Pollen and spore types (each type includes taxa numbered in Table DR1) are I- *Ephedripites* group (1); II- CAC group (2); III- *Graminidites* & *Compositoipollenites* (3-4); IV- cf. *Meliaceoidites* & *Rhoipites* (31); V- Tropical-Subtropical forest (32-42); VI- Fagaceae group (*Quercoidites*, *Cupuliferoipollenites*, *Lithocarpus-Castanopsis*) (13); VII- *Zelkovaepollenites-Ulmipollenites* (14); VIII- *Lonicerapollis* (20); IX- Other blf taxa (15-19, 21-30); X- *Pinuspollenites* (5); XI- *Piceaepollenites* (6); XII- Other conifers (7-12); XIII- *Retitricolpites* group (46); XIV- *Retitrescolpites* (44); XV- *Eleagnacidites* (43); XVI- cf. *Catinipollis* (45); XVII- Other angiosperms (47-57); XVIII- Pteridophytes (58-60).

TABLE DR3. VEGETATION GROUP ABUNDANCES

Sample	Age	Vegetation groups						
		A	B	C	D	E	F	G
	(Ma)	(%)	(%)	(%)	(%)	(%)	(%)	(%)
P379	33.3	25.3	14.3	12.8	39.0	1.5	4.6	2.4
P372	33.7	21.1	10.4	10.4	41.7	1.6	10.4	4.3
P382	33.9	42.9	8.0	4.1	29.1	0.8	12.6	2.5
P373	34.0	51.0	28.4	2.3	8.9	1.1	8.0	0.2
P374	34.5	42.2	10.0	21.1	10.0	2.2	13.6	0.8
P383	35.1	27.1	40.4	5.6	13.3	2.3	7.3	3.7
P384	37.3	19.7	45.0	11.3	12.3	0.3	4.5	6.8
P376	38.3	72.5	0.4	6.2	7.3	1.1	10.8	1.8
P385	38.4	22.4	0.6	11.2	55.5	0.6	8.3	1.2
P386	39.2	30.8	0.5	12.3	49.3	0.0	6.7	0.3
P377	39.8	39.6	1.3	42.9	0.0	7.1	2.3	7.1
P11	40.6	28.2	0.0	24.0	3.3	4.5	36.5	3.6
P12	41.0	10.1	0.0	24.5	12.1	5.5	47.3	0.6
P13	41.1	42.0	0.0	5.2	22.4	5.7	24.1	0.6
P387	41.4	48.3	0.2	12.3	5.8	0.5	29.0	3.9

Note. Vegetation groups are A- Xerophytic shrubland (I-II); B- Conifer forest (X-XII); C- Broad-leaved forest (VI-IX); D- cf. *Meliaceoidites* and *Rhoipites* (IV); E- Tropical-Subtropical forest (V); F- Other angiosperms (XVII); G- Pteridophytes (XVIII).

Dupont-Nivet et al., Figure DR1

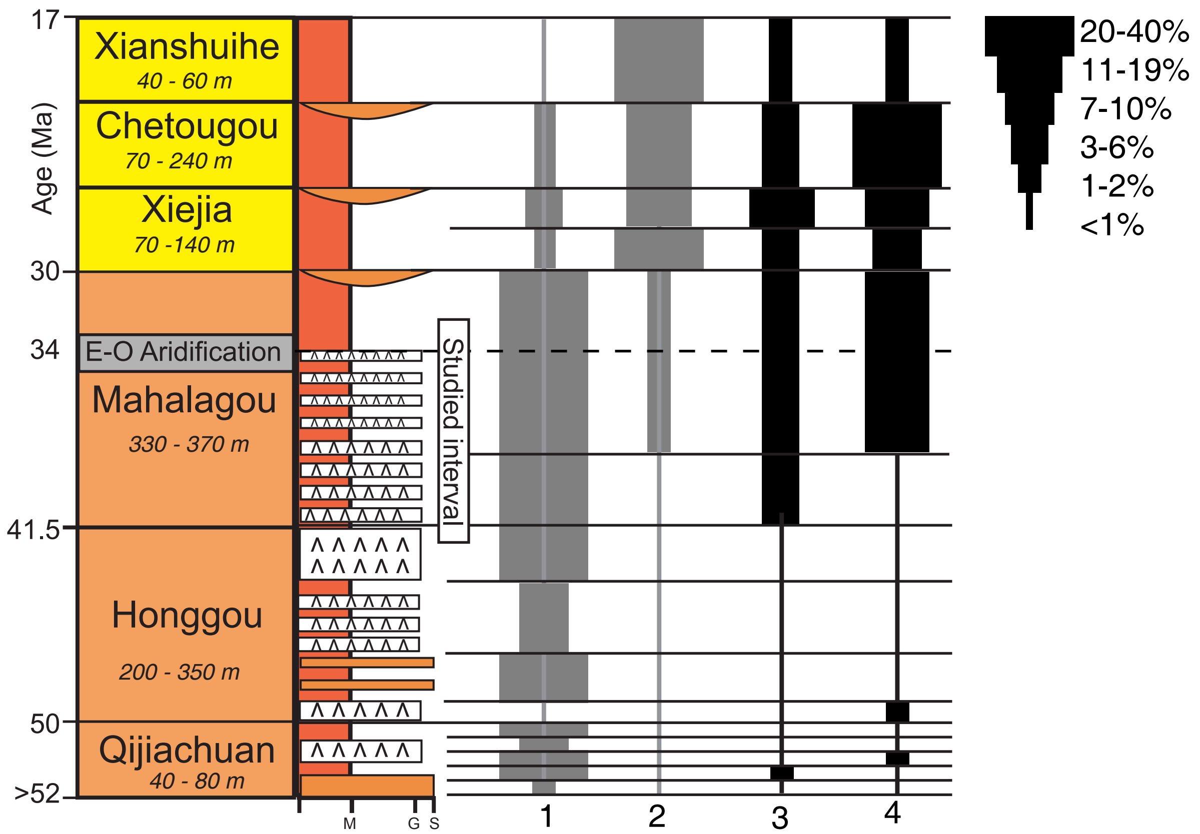

Figure DR1. Previously published palynology results from the Xining-Minhe basin (Wang et al., 1990) with abundances of diagnostic taxa. Grey bars indicate xerophytic and more arid taxa (1. *Ephedripites*; 2. *Chenopodipollis*); black bars indicate colder taxa (3. *Pinuspollenites*) and high-elevation (4. *Piceapollenites*). Dashed gray horizontal line marks the end of gypsum horizons at the Eocene-Oligocene transition. Formation ages from magnetostratigraphy (Dai et al., 2006; Dupont-Nivet et al., 2007) with general lithologies (M. Mud; G. Gypsum; S. Sand). The occurrence of *Ephedripites* throughout the record is interpreted as the persistence of a relatively arid environment.The appearance of *Pinus* suggests relative cooling followed by the appearance of the high-elevation *Picea* and of *Chenopodipollis* interpreted to reflect increased aridity. However, the low stratigraphic resolution of these previous results, does not allow correlating these changes to global climate or tectonism.

Dupont-Nivet et al., Figure DR2

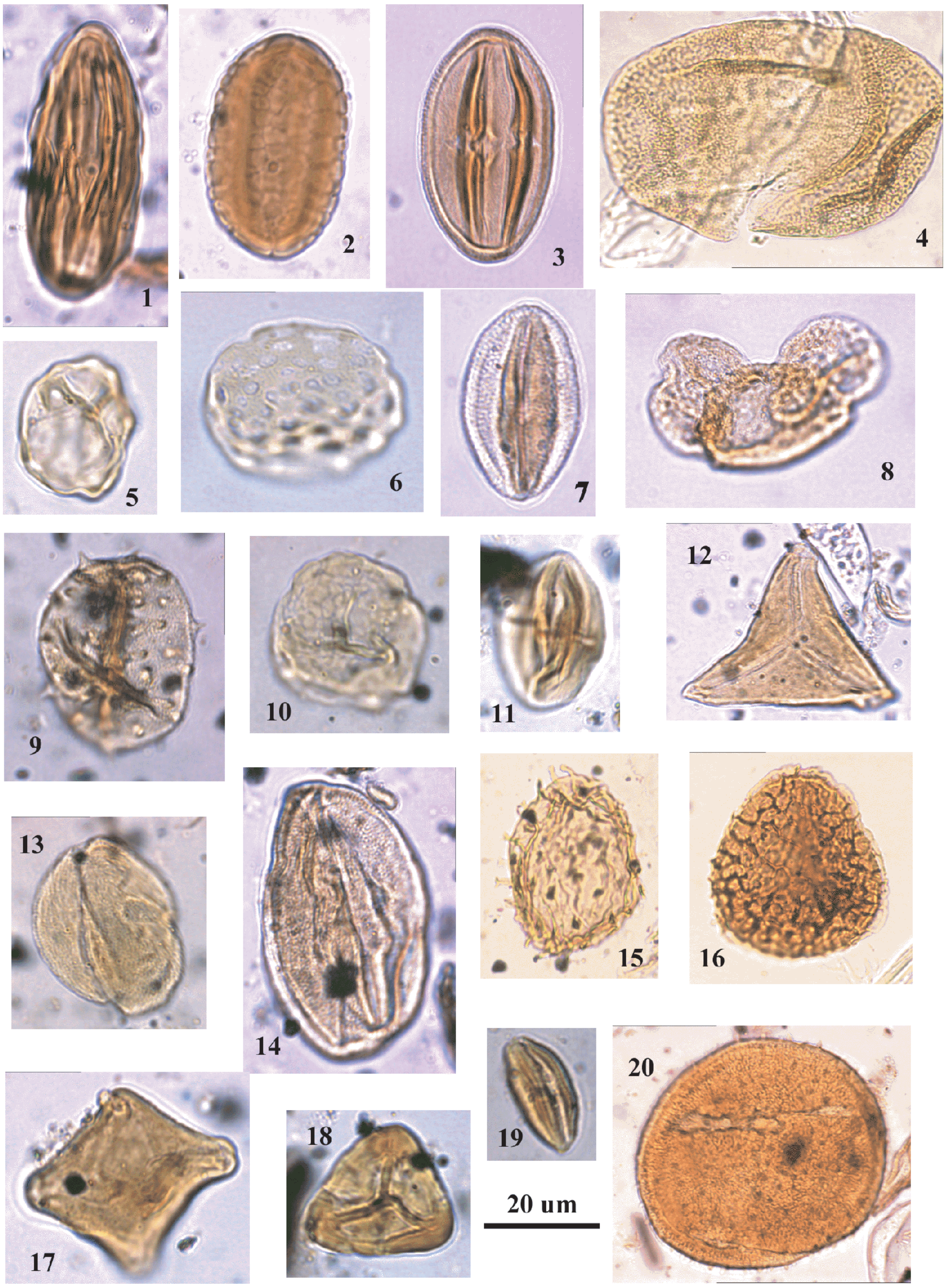

Figure DR2. Images of some of the most characteristic pollen and spore taxa found: *1- Ephedripites (790x), 2- Ephedripites (1000x), 3- Meliaceae-Anacardiaceae (790x), 4- Piceaepollenites (400x), 5- Alnipollenites (1000), 6-* Chenopodiaceae-Amaranthaceae *(1000x), 7-* reticulate, tricolpate aff. *Tamarix (1000x), 8- Pinuspollenites (630x), 9- Spinozonocolpites (790x), 10- Ulmipollenites-Zelkovaepollenites (1000x), 11- Rutaceoipollis (1000x) , 12- Eleagnacidites (630x), 13- Aceripollenites (790x), 14-* reticulate, tricolpate pollen *(790x), 15- dinoflagellate (500x), 16- Lycopodiaceaesporis (400x), 17- Myrtaceidites (1000x), 18- psilate, trilete spore (1000x), 19- Sabelpollenites (1000x), 20- Lonicerapollis (630x).*

Dupont-Nivet et al., Figure DR3

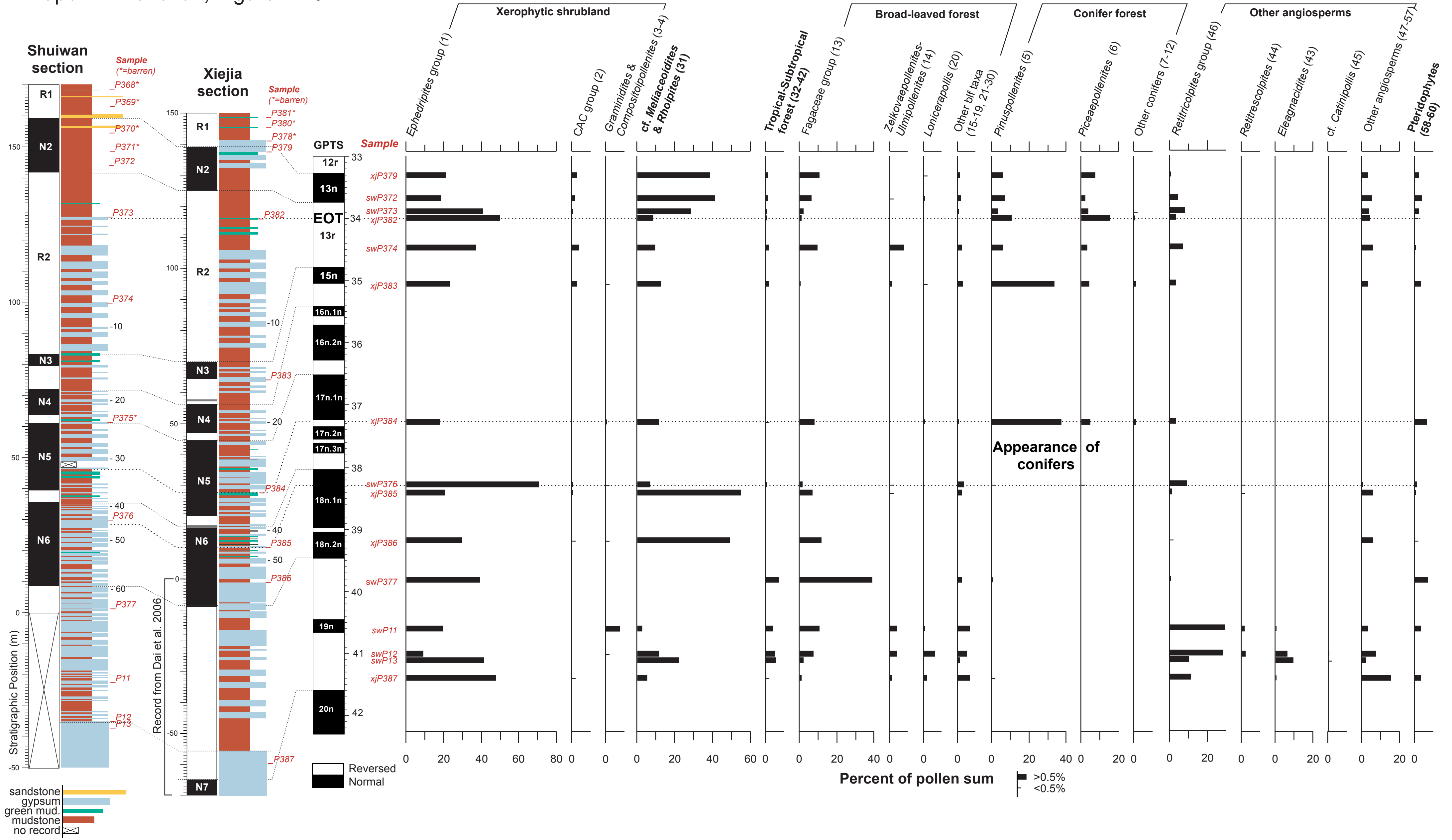

Figure DR3. Abundances of pollen and spores types (see Table DR2) keyed to the stratigraphic position of each sample in the samples Xiejia and Shuiwan sections. Existing magnetostratigraphic age control (Dai et al., 2006; Dupont-Nivet et al., 2007) is provided through correlation to the Geomagnetic polarity Time Scale (GPTS) (Ogg and Smith, 2005).