

**Figure 2.** Modern climate (boreal summer) and vegetation and core site positions of ODP Sites 677, 846, 851, 1000, 1239, 1241, Trident core TR163-38, and M772-056 mentioned in the text. **A.** Long-term monthly July precipitation in mm/day (CPC) and wind field (NCEP). July is the middle of the rainy season in northern South America, when the ITCZ is at its northern boreal summer position. Salinity estimates for the Caribbean indicate a position of the ITZC further north during the Pliocene. Direction of wind is not favorable for wind transport of pollen and spores to ODP Site 1239. **B.** Long-term monthly July sea surface temperatures (NODC), surface and subsurface currents of the eastern equatorial Pacific (Mix et al. 2003). NECC, North Equatorial Countercurrent; SEC, South Equatorial Current; PCC, Peru-Chile Current (continuation of the Humboldt Current); CC, Coastal Current; EUC, Equatorial Undercurrent; GUC, Gunther Undercurrent. **C.** Contours, bathymetry (ETOPO1), main rivers in Ecuador, and vegetation. Transport of pollen and spores in the ocean over the Peru-Chile Trench, which is very narrow east of the Carnegie Ridge, probably takes place in nepheloid layers. Páramo vegetation is found between 3200 and 4800 m, upper montane Andean forest (UMF) grows between 1000 and 2300 m, sub-Andean lower montane forest (LMF) between 1000 and 2300 m, and lowland forest (LR) below 1000m. The distribution of desert and xeric shrubs in northern Peru, drier broad-leaved forest, flooded grasslands, and mangroves in Ecuador and Colombia is denoted in different colors (see legend, WWF). Source areas of pollen and spores in sediments of ODP Site 1239 are sought in western Ecuador, northwestern Peru, and southwestern Colombia (see text).

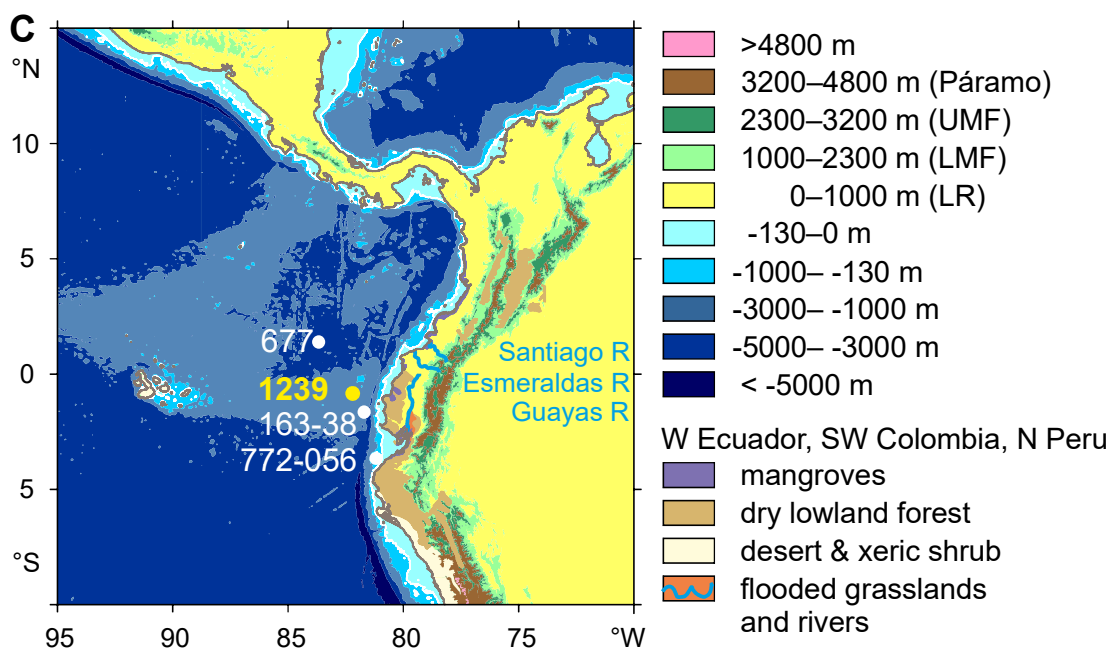
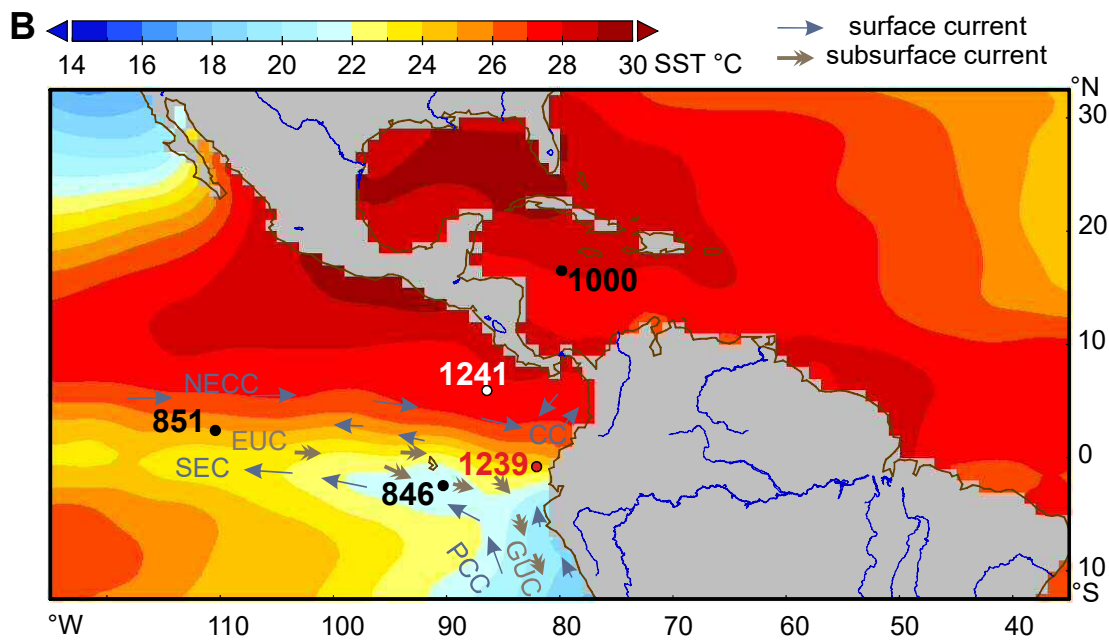
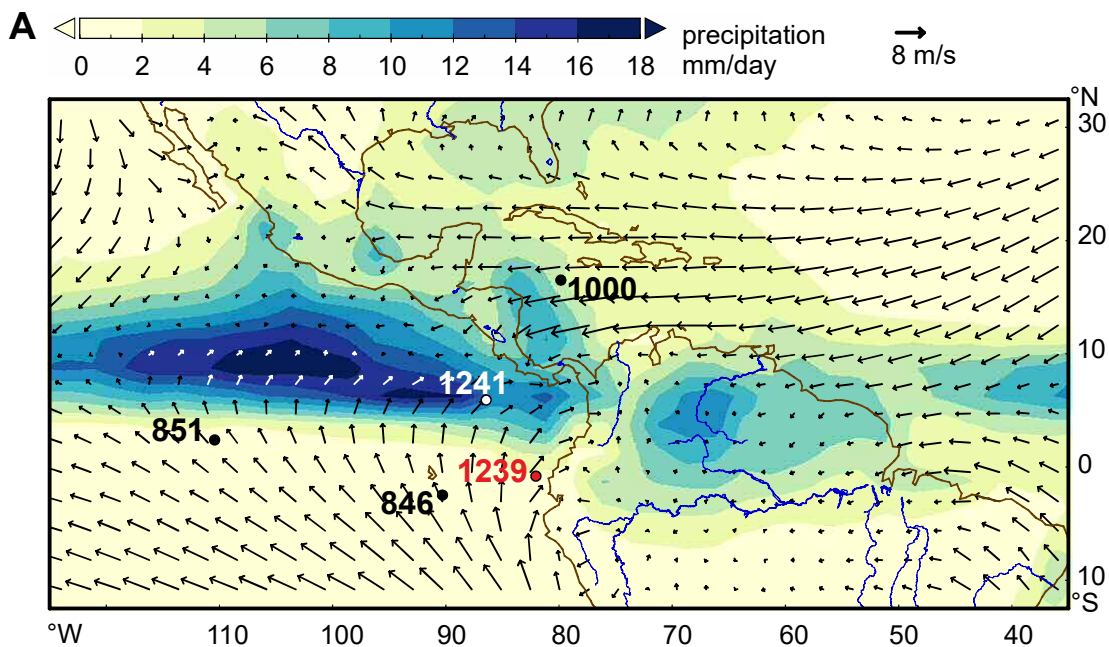
#### References:

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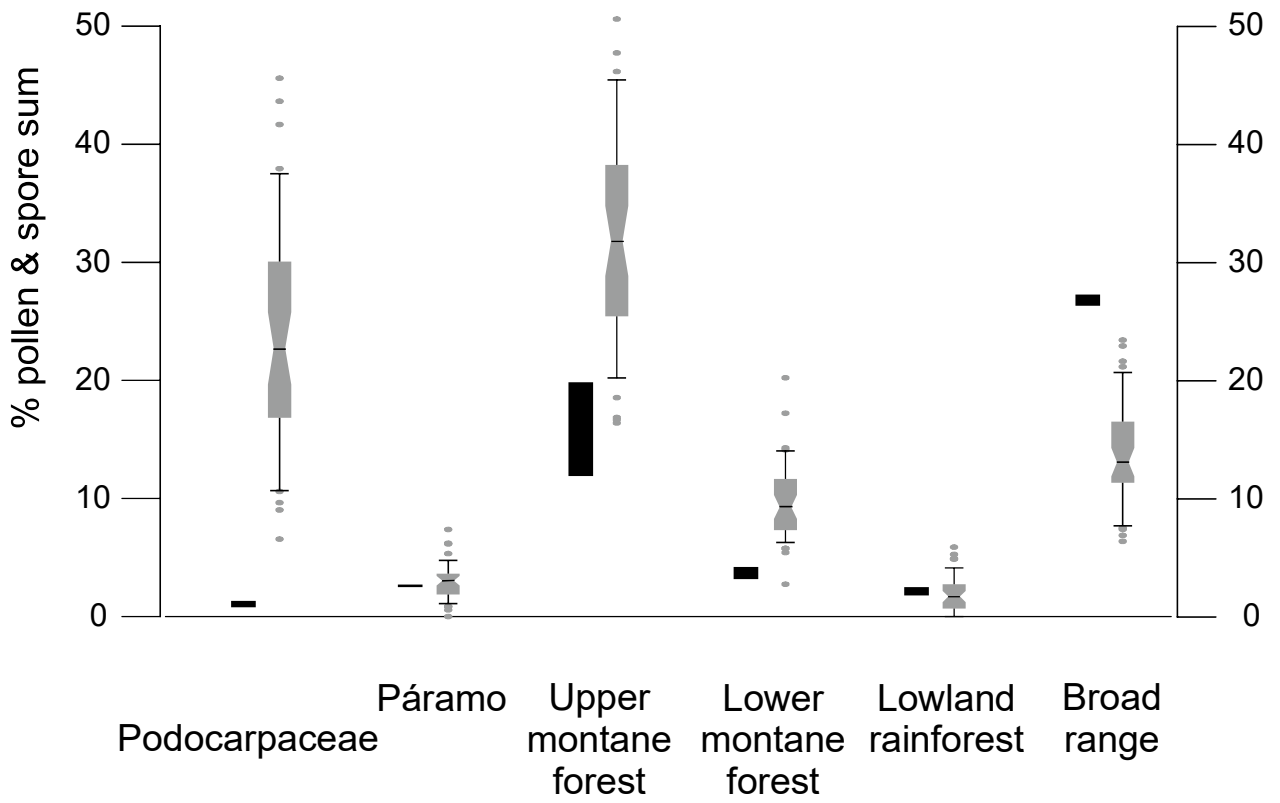
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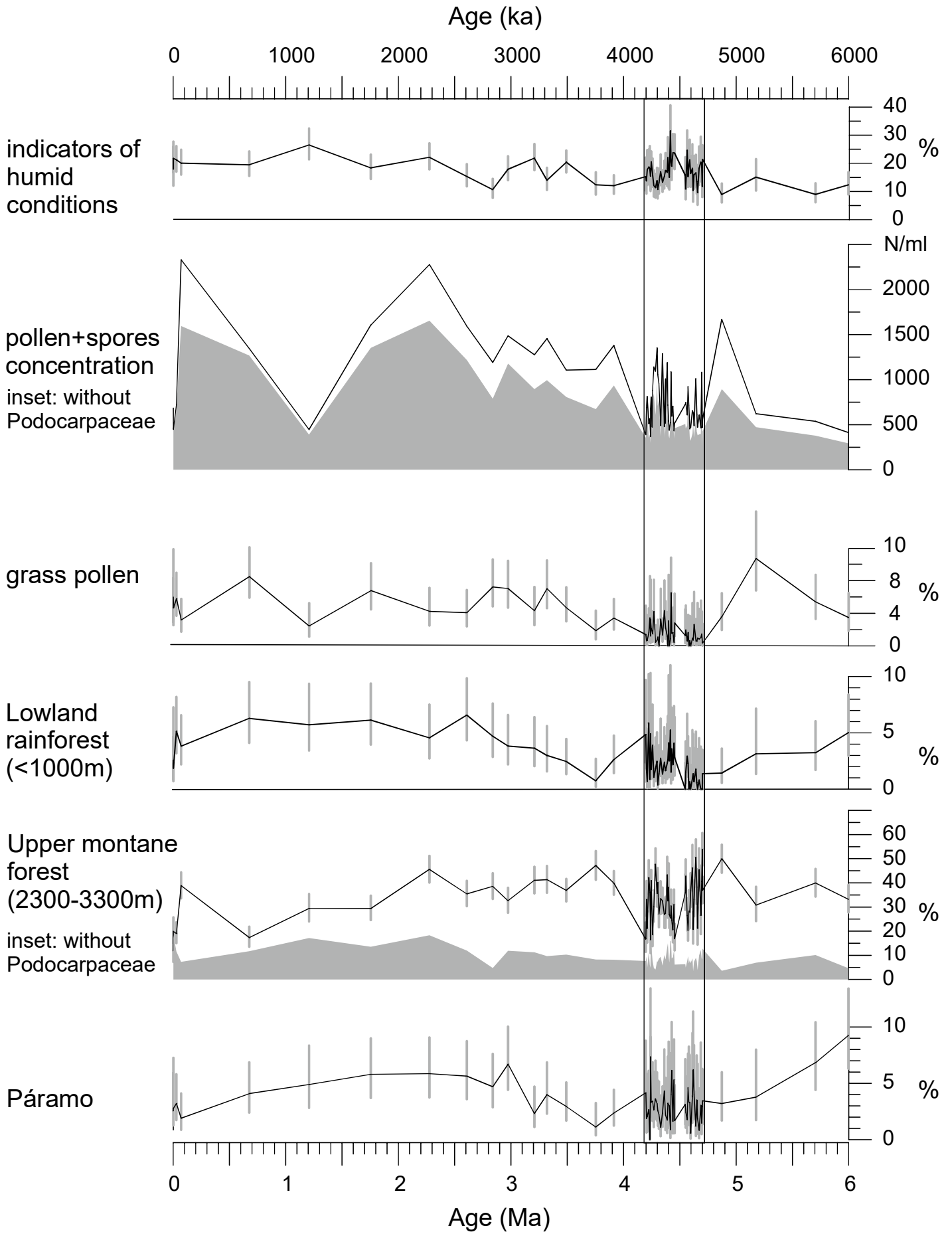


**Figure 3.** Comparison of the palynomorph percentages (based on total pollen and spores) of Podocarpaceae and the different vegetation belts between 2 Holocene samples (black) and Pliocene samples between 4.7-4.2 Ma (box-whisker plots).

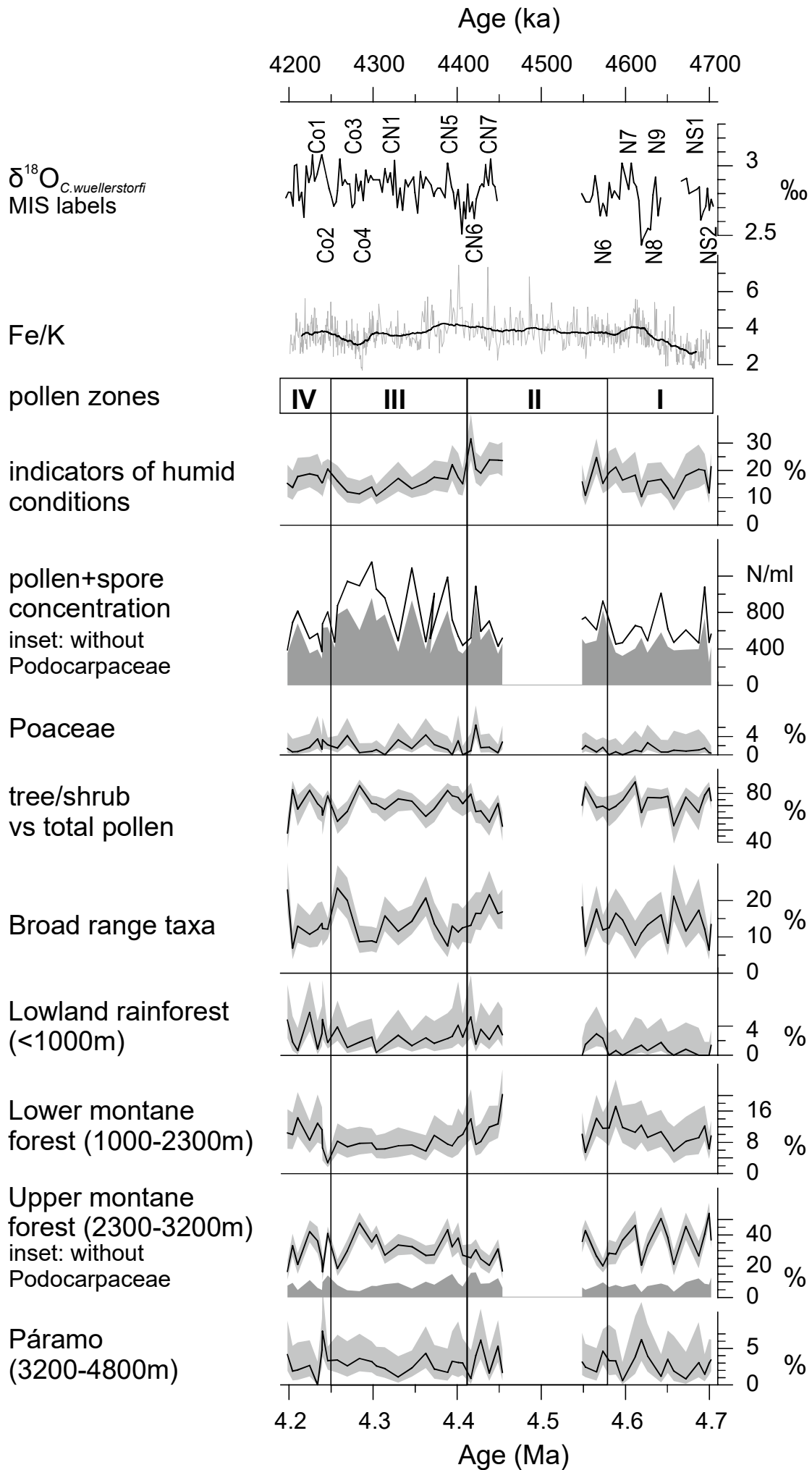


**Figure 4A (extra figure).** Pliocene and Pleistocene palynomorph percentages (based on the total of pollen and spores) of ODP Hole 1239A for three vegetation belts, humidity indicators, grass pollen and pollen and spore concentration per ml. 95% confidence intervals as grey bars after Maher (1972).

**Additional Results.** Percentages of humidity indicators hint to slightly drier conditions at the beginning of the Pliocene. A trend towards higher palynomorph concentrations is found for the period from 6 to 2 Ma. Grass pollen percentages remain low indicating mainly closed forest at altitudes below the Páramo. Representation of lowland rainforest was low around 4.7 Ma, increased by 4.5 Ma, declined again to low levels around 3.5 Ma, and rose to remain at higher levels during the Pleistocene. Continuous presence of pollen and spores from the Páramo indicates that the northern Andes had reached high altitudes in Ecuador before the Pliocene.



**Figure 4.** Palynomorph percentages of ODP Hole 1239A for the four vegetation belts and other groups from 4.7 to 4.2 Ma. Grey shading represents the 95% confidence intervals (after Maher, 1972). Vertical black lines delimit the pollen zones. At the top stable oxygen isotopes of the benthic foraminifer *C. wuellerstorfi* (Tiedemann et al., 2007) of ODP Hole 1239A, marine isotope stages (MIS), and elemental ratios of Fe/K from Holes 1239A and 1239B. Ages are from Tiedemann et al. (2007). A coring gap is present in Hole 1239A between 4.45 and 4.55 Ma.



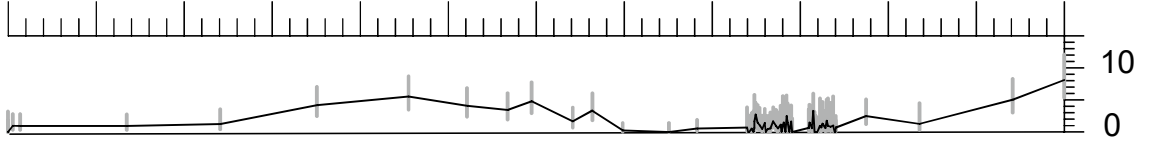


**Figure 5.** Palynomorph percentages of Páramo indicators and Asteraceae Tubuliflorae (excluding Ambrosia/Xanthium T) of the past 6 Ma indicating the presence of Páramo vegetation at least since the late Miocene. 95% confidence intervals (grey bars) after Maler (1972). Ages after Tiedemann et al. (2007).

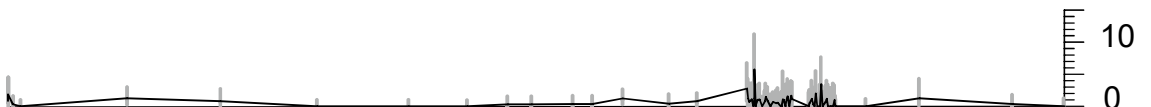
Age (ka)

0 1000 2000 3000 4000 5000 6000

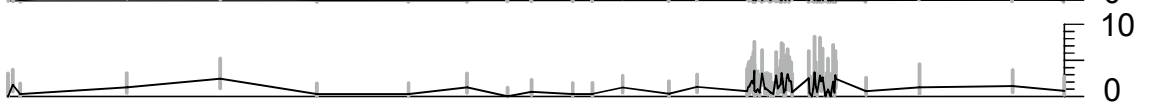
Polylepis/  
Acaena



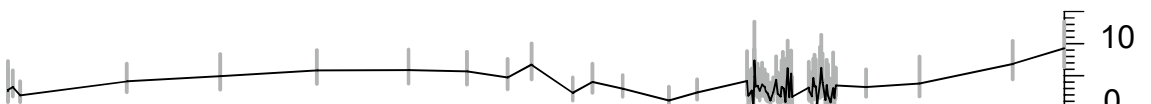
Huperzia



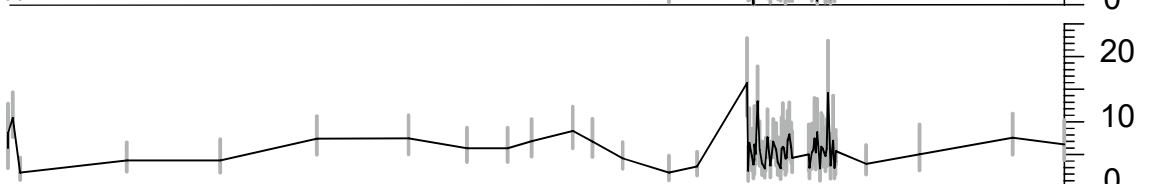
Jamesonia/  
Eriosorus



Páramo



Asteraceae  
Tubuliflorae



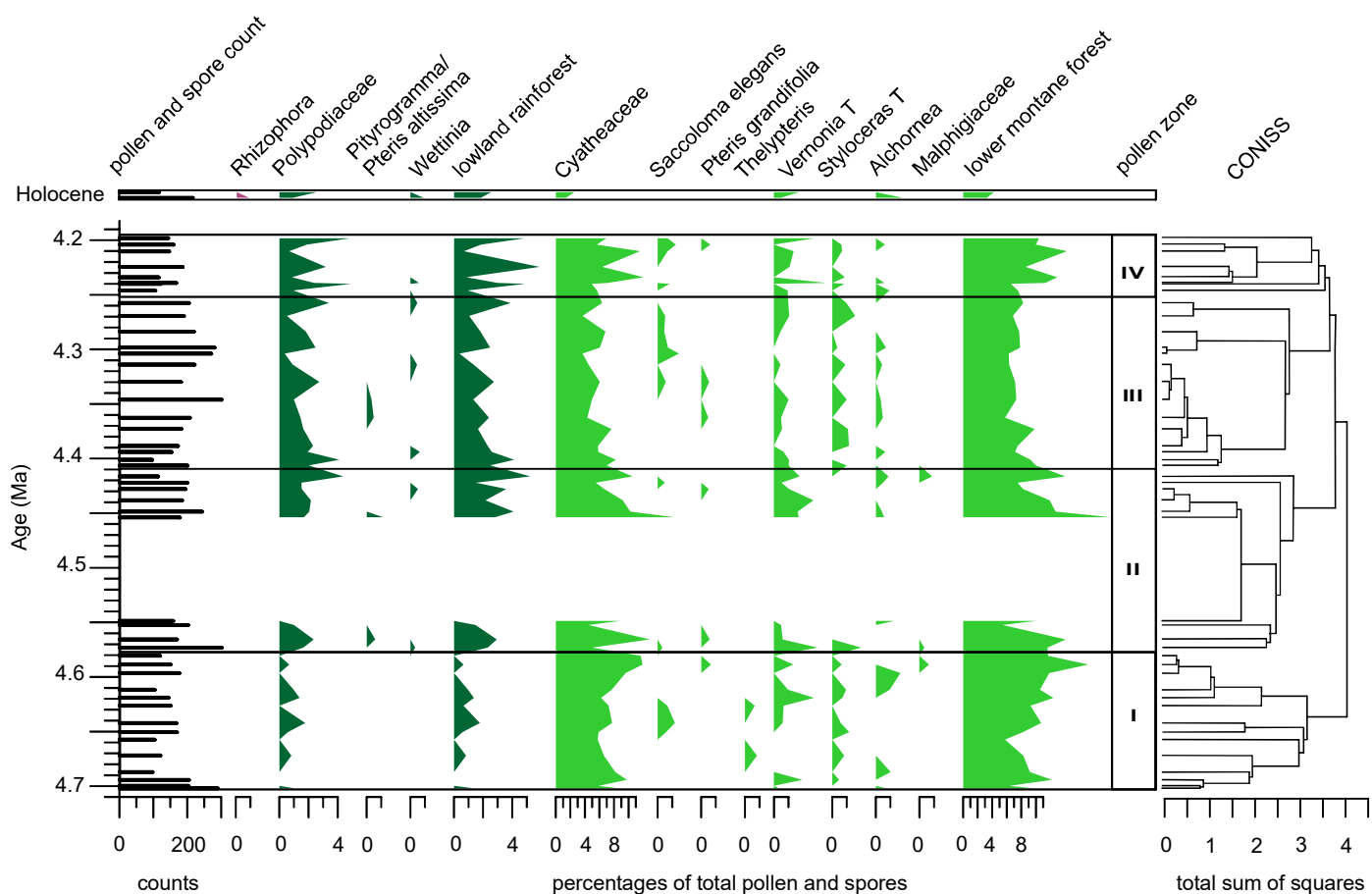
% pollen + spores

0 1 2 3 4 5 6

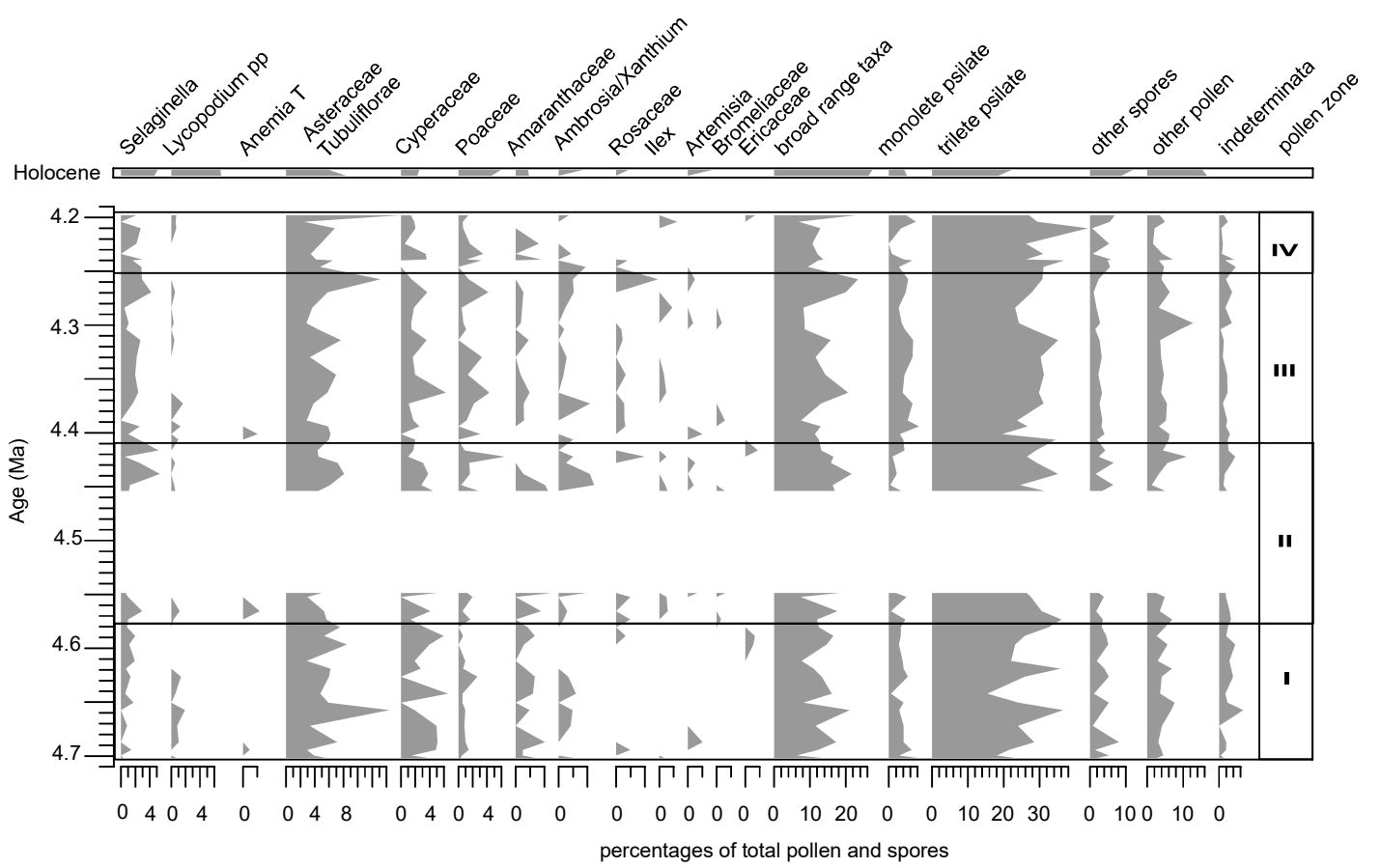
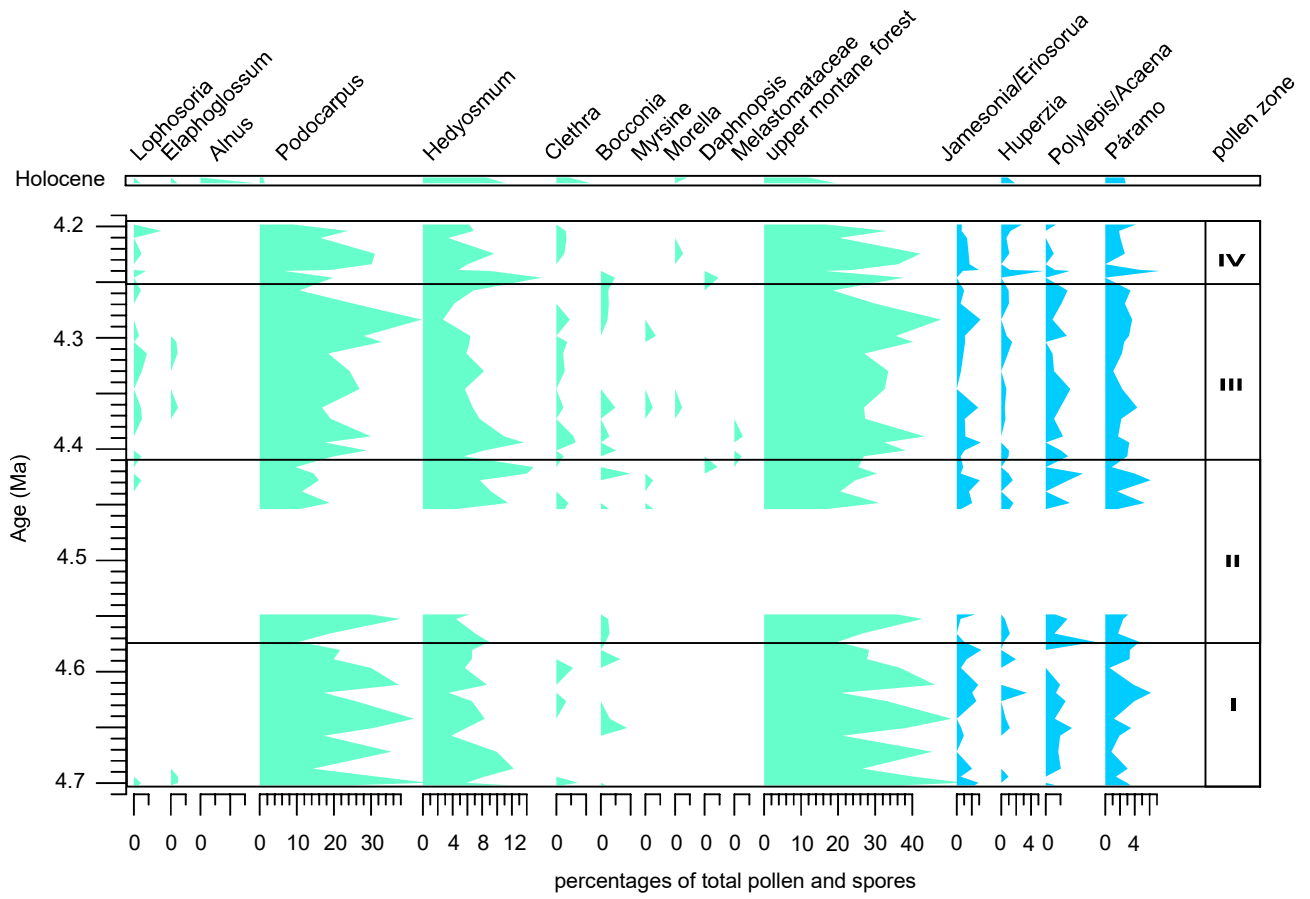
Age (Ma)

**Table 1.** List of identified pollen and spore taxa in marine ODP Holes 1239A (Pliocene samples) and 1239B 683 (Holocene samples, taxa in grey occurred only these samples) and grouping according to their main ecological affinity (Flantua et al., 2014; Marchant et al., 2002).

<b>Páramo</b>	<b>Upper montane forest</b>	<b>Lower montane forest</b>	<b>Lowland rainforest</b>	<b>Broad range taxa</b>	<b>Humid indicators</b>
<i>Polylepis/Acaena</i>	Podocarpaceae	Urticaceae/ Moraceae	<i>Wettinia</i>	Poaceae	Cyperaceae
<i>Jamesonia/Eriosorus</i>	<i>Hedyosmum</i>	<i>Erythrina</i>	<i>Socratea</i>	Cyperaceae	<i>Ranunculus</i>
<i>Huperzia</i>	<i>Clethra</i>	<i>Alchornea</i>	Polypodiaceae	Tubuliflorae (Asteraceae)	<i>Hedyosmum</i>
<i>Ranunculus</i>	<i>Morella</i>	<i>Styloceras T</i>	<i>Pityrogramma- Pteris altissima T</i>	Amaranthaceae	<i>Ilex</i>
<i>Draba</i>	Acanthaceae	Malpighiaceae		Rosaceae	<i>Pachira</i>
<i>Sisyrrinchium</i>	Melastomataceae	Cyatheaceae		<i>Ambrosia/ Xanthium</i>	<i>Myrica</i>
<i>Cystopteris diaphana T</i>	<i>Daphnopsis</i>	<i>Vernonia T</i>		Ericaceae	Malpighiaceae
	<i>Bocconia</i>	<i>Pteris grandifolia T</i>		<i>Artemisia</i>	Cyatheaceae
	<i>Myrsine</i>	<i>Pteris podophylla T</i>		<i>Ilex</i>	<i>Selaginella</i>
	<i>Lophosoria</i>	<i>Saccoloma elegans T</i>		<i>Thevetia</i>	<i>Pityrogramma- Pteris altissima T</i>
	<i>Elaphoglossum</i>	<i>Thelypteris</i>		<i>Salacia</i>	<i>Hymenophyllum T</i>
	<i>Hypolepis hostilis T</i>	<i>Ctenitis subincisa T</i>		Bromeliaceae	<i>Thelypteris</i>
	<i>Grammitis</i>			Malvaceae	<i>Ctenitis subincisa T</i>
	<i>Dodonaea viscosa</i>			Euphorbiaceae	<i>Alnus</i>
	<i>Alnus</i>			<i>Liliaceae</i>	<i>Cystopteris diaphana T</i>
				Lycopodiaceae excl. <i>Huperzia</i>	
				<i>Selaginella</i>	
				<i>Hymenophyllum T</i>	
				<i>Calandrinia</i>	



Supplementary figure. Pollen percentage diagram against age (Tiedemann et al., 2007), with total counts, percentages of single taxa and groups, pollen zones, CONISS clusters. On top two samples from the Holocene. Minor ticks denote 1%, major ticks 2%, unless stated differently. This panel shows pollen and spore taxa from mangrove, lowland rainforest and lower montane forest. Panels on the next page show the pollen percentages for taxa from the upper montane forest, Páramo, and broad range taxa.



Supplementary figure (continued)