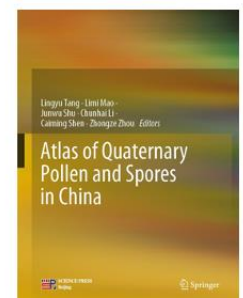
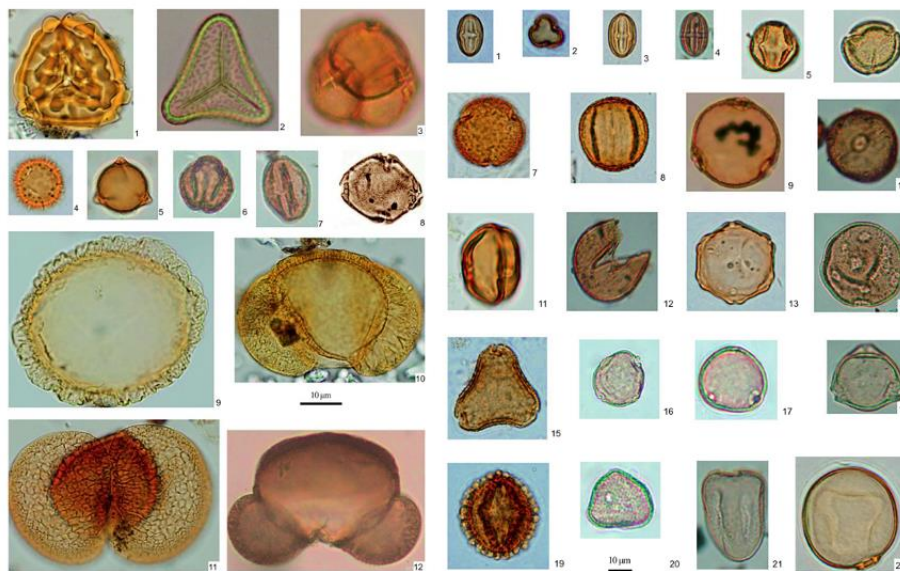


Draft information for Jenni's project

Papers related to pollen morphology from China:

- 1) Tang, L., Mao, L., Shu, J., Li, C., Shen, C. (2020). Overview of Modern and Quaternary Vegetation in China. In: Tang, L., Mao, L., Shu, J., Li, C., Shen, C., Zhou, Z. (eds) Atlas of Quaternary Pollen and Spores in China. Springer, Singapore. https://doi.org/10.1007/978-981-13-7103-5_1

A review of past environmental records from a variety of vegetation types from forest to grassland and desert as well as from tropical rain forest to cool coniferous forest and alpine tundra occur in China's vast territory. The book presents the first-ever overview of the morphology of fossil pollen and spores from Quaternary sediments. It includes more than 400 top-level plates illustrating typical fossil pollen and spores and offers a comprehensive review of Quaternary pollen assemblages in various regions of China.



- 2) Mao, L. "Key to mangrove pollen and spores of southern China: an aid to palynological interpretation of Quaternary deposits in the South China Sea" *Review of Palaeobotany and Palynology* 176–177 (2012) 41–67.

*Illustrations of, and keys to, mangrove pollen and spores from extant taxa are essential to studies of tropical Quaternary palynology and palaeoecology of estuarine and marine deposits. In this paper the authors present a pollen morphological "atlas" and identification keys for most of the mangrove flora of the coastal areas of south China, including an interspecific key to the major mangrove elements *Rhizophora* and *Sonneratia*. The morphology of the pollen and spores of 38 species of living mangrove and associated plants is described and illustrated by transmitted light photographs and scanning electron micrographs. These descriptions will aid palynological analyses of Quaternary*

mangrove and associated estuarine and marine deposits, particularly in the South China Sea and surrounding regions, but also elsewhere in tropical and subtropical regions.

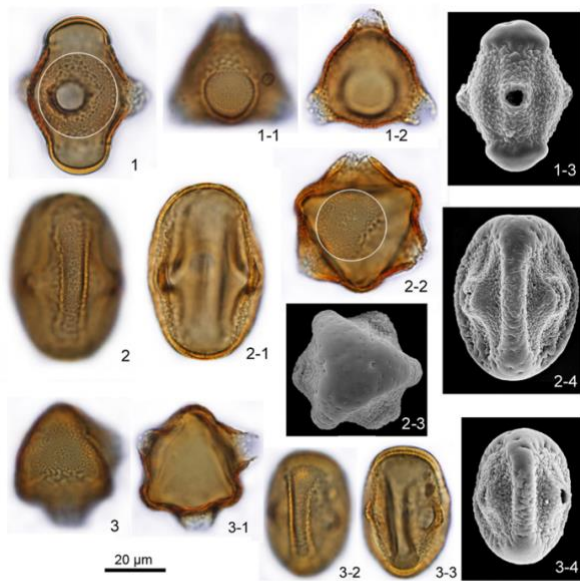


Plate III. Triplicate pollen (see also Plates IV and V).

1. *Someratis casareola*. 1, equatorial view showing distinct optical section of polar cap and abrupt discontinuity adjacent to equatorial field, with view of sculpture of equatorial region and pore inset; 1-1, 1-2, polar view showing rounded-triangular shape and protruding apertures; 1-3, pilate polar cap under SEM.
2. *Someratis alba*. 2, equatorial view showing distinct meridional ridge; 2-1, optical section; 2-2, polar view showing hexagonal outline with view of polar surface inset; 2-3, pilate polar cap under SEM; 2-4, distinct meridional ridge under SEM.
3. *Someratis homanensis*. 3, 3-1, polar view in high and mid focus showing hexagonal outline; 3-2, equatorial view showing distinct meridional ridge; 3-3, optical section; 3-4, distinct meridional ridge under SEM.

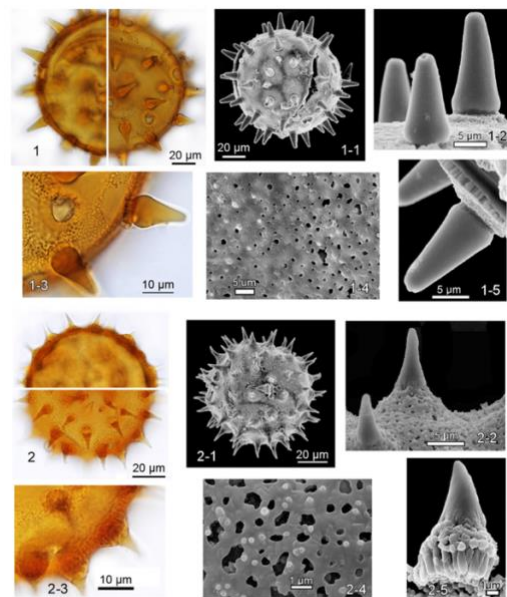


Plate IIII. Polyoporate pollen.

1. *Hibiscus siliocornis*. 1, 1-3, composite image of apertures in upper and mid focus showing spine texture and granulate surface, and close-up of aperture, spine and spines respectively; 1-1, whole specimen under SEM; 1-2, 1-3, 1-4, 1-5, showing close-up of apertures with rounded tips and basal constriction under SEM; 1-4, close-up of perforated section bearing scattered granules under SEM.
2. *Thespesia populnea*. 2, 2-3, composite image of apertures in upper focus and optical section, showing spine texture and granulate surface, and close-up of aperture, spine and spines respectively; 2-1, whole specimen under SEM; 2-2, 2-3, 2-4, 2-5, showing close-up of apertures with pointed tips and basal constriction under SEM; 2-4, close-up of perforated section bearing scattered granules under SEM.

Xaimen pollen records spanning the present through to the Miocene (~15Ma)

- 1) Limi Mao, Yulan Zhang, and Hua Bi "Modern Pollen Deposits in Coastal Mangrove Swamps from Northern Hainan Island, China," *Journal of Coastal Research* 2006(226), 1423-1436, (1 November 2006). <https://doi.org/10.2112/05-0516.1>

Paper on the palynology of coastal deposits south of the Xaimen area. Pollen analyses of surface sediment samples collected from the coastal mangrove swamps were undertaken in order to reveal the relationship between modern pollen deposits and their source plants, and to provide a basis for reconstructing the Holocene history of mangrove ecosystem dynamics. Surface pollen spectra show close linkage between pollen and local vegetation. Notably, Rhizophora, Ceriops, Bruguiera, and Avicennia are well represented and localized. Nevertheless, our results also suggest that other common mangroves are poorly represented by their pollen in the surface sediments, including species of Excoecaria, Aegiceras, Clerodendrum, Kandelia, Xylocarpus, and Scyphiphora. These results provide a basis for interpreting paleoecological analyses of below-surface pollen samples from the same mangrove swamps, and are crucial for further paleoecological and paleoenvironmental studies in tropical marshes.

- 2) L. Zhao et al. "Holocene vegetation dynamics in response to climate change and human activities derived from pollen and charcoal records from southeastern

Paper on the palynology of peat deposits just north of the Xaimen area exploring the relationship between the Holocene evolution of the East Asian summer monsoon (EASM) and human activities. Reports on pollen records from two sediment cores from the Daiyun Mountain Nature Reserve (Fujian Province) suggests EASM controlled subtropical climate conditions that were wetter and warmer than present over the early and middle Holocene. After 5700 years ago, steadily increasing non-arboreal pollen and fern spore percentages imply an attenuation of the EASM. The general climate trend is interrupted by several century-scale changes in composition and concentration of arboreal pollen taxa around 8200, 7200, 6300, and 4400 years ago, coinciding with weaker precipitation (and lower temperature) as suggested by the EASM oxygen isotope record. These results further support the hypothesis that the natural vegetation cover of southern China was not markedly affected by human activities until 3000 years ago. The pollen records suggest a quick decrease in the forest cover ca. 3000–2450 years ago followed by a generally open (agricultural) landscape and spread of secondary pine forests. This pattern is in line with a major population growth promoted by the southward expansion of rice-based agriculture across the region.

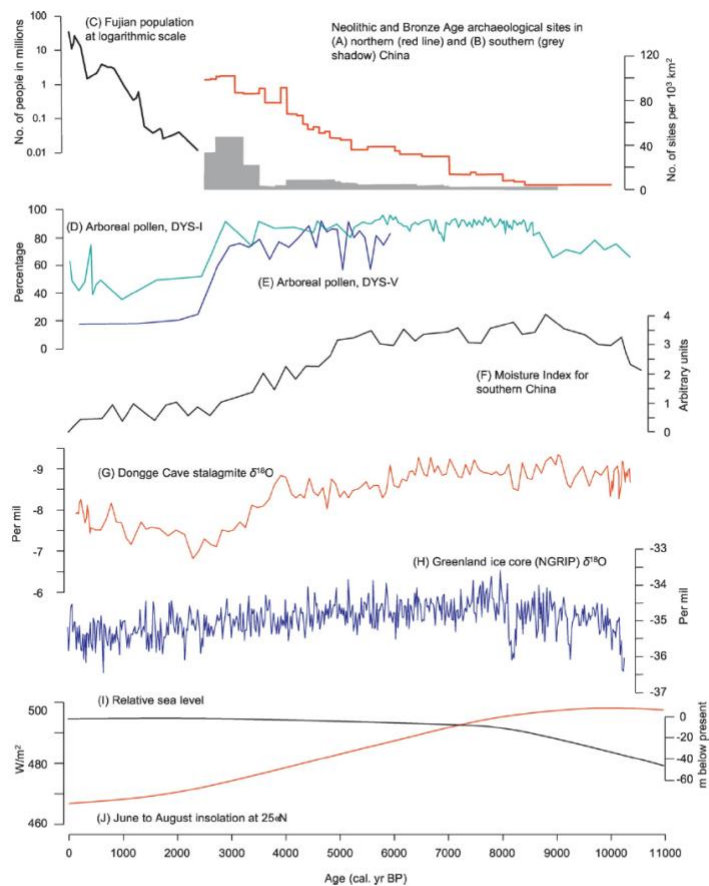


Fig. 8. Selected results of this study highlighting the past climate and human population changes in southeastern China along with published proxy records discussed in the text. Locations of the records are given in Fig. 1. The graphs A–J demonstrate: changes in archaeological site numbers in northern (A) and southern (B) China during the Neolithic and Bronze Age (after Hosner et al., 2016); (C) changes in Fujian population since ca. 2400 cal. yr BP (after Chen, 1984 and Biraben, 2003); changes in arboreal pollen (AP) percentages in the DYS-I (D) and DYS-V (E) records (this study); (F) the regionally-averaged moisture index for southern China (after Bian and Feng, 2013); (G) oxygen isotope record from the Dongge Cave stalagmite D4 (after Yuan et al., 2004); (H) the NGRIP ice core oxygen isotope record (after Svensson et al., 2008); (I) the reconstructed changes in relative global sea level (after Waelbroeck et al., 2002); and (J) June to August insolation at 25°N (Berger and Loutre, 1991).

- 3) Y.F. Yue, Z. Zheng, K.Y. Huang, M. Chevalier, B.M. Chase, M. Carré, M.P. Ledru, R. Cheddadi “A continuous record of vegetation and climate change over the past 50,000 years in the Fujian Province of eastern subtropical China” *Palaeogeography, Palaeoclimatology, Palaeoecology*, 365-366 (2012), pp. 115-123.

*Paper on the palynology of peat deposits in the Xaimen area – over 50,000 year old record. A 425 cm core was collected from the Gantang subalpine peat bog, in Pingnan County, Fujian Province of Southern China. Today, Fujian province is located in the eastern part of middle subtropical zone where the dominant vegetation is evergreen broadleaved forest that receives its precipitation from the East Asian Monsoon. The pollen record shows that the vegetation in Fujian varied between subtropical evergreen and warm temperate deciduous forests during the last glacial-interglacial cycle. It appears that during Marine Oxygen Isotope Stage 3 (~50,000-29,000 years ago), this area was covered with broadleaved forest suggesting warm and wet subtropical condition. The Last Glacial Maximum is distinguished by an increase in warm temperate deciduous taxa, particularly *Fagus* and *Alnus* accompanied by abundant *Ericaceae*, implying a spatial shift of zonal vegetation during this coldest episode in the world. Local swamp developed soon after the Younger Dryas (~12,700 years ago) event coinciding with the formation of peatlands in the Northern Hemisphere possibly linked with atmospheric carbon accumulation. A rapid increase in evergreen broadleaved taxa that dominated the local forest occurred at ~ca. 8200 years ago, indicating the inception of the regional thermal maximum during the Holocene, which was generally characterised by more humid conditions. The middle to late Holocene sees a progressive decline in arboreal elements, and an increase in grasses and *Ericaceae*, at a time of general weakening of the East Asian Monsoon during the Holocene.*

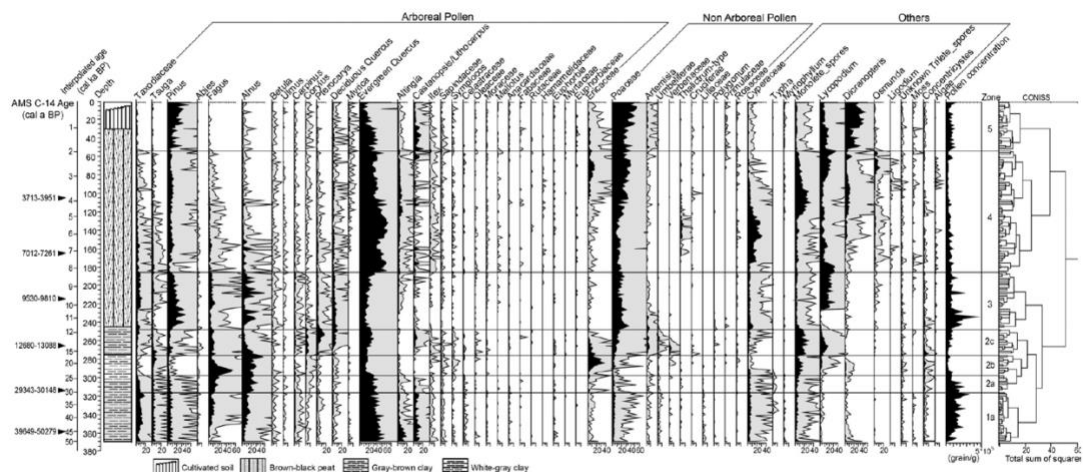
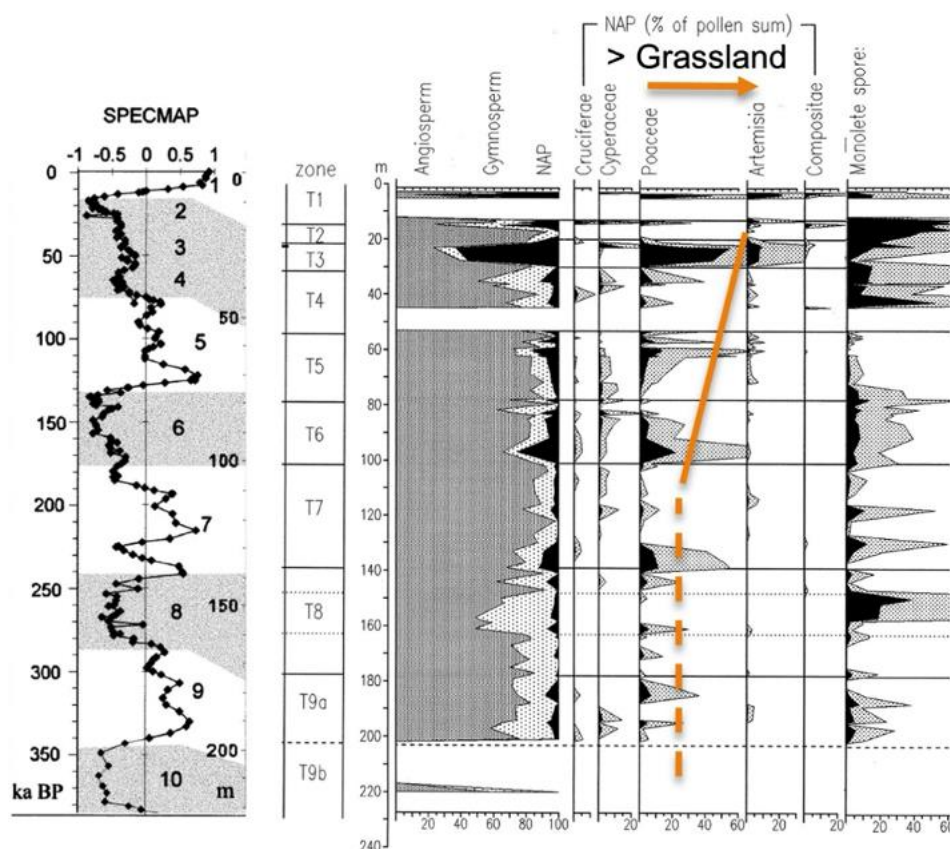


Fig. 3. Pollen percentage diagram showing the arboreal pollen (AP), non-arboreal pollen (NAP) and others (including Cyperaceae, aquatics, ferns, moss and algae). The shadows are exaggeration of pollen percentage. The pollen zones are achieved by clusters result of TILIA software.

- 4) Zheng and Lei “A 400,000 year record of vegetational and climatic changes from a volcanic basin, Leizhou Peninsula, southern China” *Palaeogeography, Palaeoclimatology, Palaeoecology* 145 (1999) 339–362.

Paper on a long pollen record spanning the last 400,000 years from a region to the south of Xaimen (Leizhou Peninsula) that shows the progressive drying of the climate in SE China in the last 250,000 years. Over 200 m of diatomaceous mud and clay were deposited in the last 400,000 years in Tianyang Lake. The pollen record spans the last four glacial–interglacial cycles. During most of the glacial phases, Fagaceous monsoon forest was replaced by altitudinal vegetation, indicating a regional landscape transformation responding to cooling and warming on the peninsula, with temperature estimated to be more than 4°C lower than present during glacial periods. More temperate forest elements appear after 250,000 as cooler and drier climates become more prevalent during the glacial periods. During the Last Glacial Maximum, this mixed forest subsequently gave way to the Poaceae grassland, a savanna vegetation type favored by drier and cooler climatic conditions. It is inferred that the weakening of summer monsoon was more significant towards the end of the Late Pleistocene particularly during the Last Glacial Maximum (LGM).

Note that there is no discussion on the role of people in the expanded grassland environments during the last late glacial period.



- 5) Shi and Li “A fossil fruit wing of *Dipterocarpus* from the middle Miocene of Fujian, China and its palaeoclimatic significance” *Review of Palaeobotany and Palynology* 162 (2010) 599–606.

*Paper on the seed fossils from the Xaimen region showing tropical climates and forests in the region during the Miocene (~15 million years ago). The occurrence of the fruit wing of *Dipterocarpus*, together with palynological evidence, indicates unequivocally that a tropical climate and tropical rain forest occurred in Zhangpu during the middle Miocene, in a warmer and more humid than at the present day. In the middle Miocene, *Dipterocarpaceae* had spread to Southeast China because of the warm climate. Subsequently global climate became cooler and dryer, the family retreated southward to its present distribution.*

