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Research Advances

New Biological Records of Paleoecological Changes Inferred from Pollen Since 2500 cal. a B.P. in the Ebinur Lake Area, North Xinjiang

LI Yumei[1, 2, *], ZHAO Long[3], JIANG Hanchao[1], ZHANG Yun[4] and KONG Zhaochen[4]

[1] *State Key Laboratory of Earthquake Dynamics, Institute of Geology, China Earthquake Administration, Beijing 100029, China*
[2] *Development Research Center of China Earthquake Administration, Beijing 100036, China*
[3] *Beijing Institute of Geo-Environment Monitoring, Beijing 100195, China*
[4] *State Key Laboratory of Vegetation and Environmental Change, Institute of Botany, Chinese Academy of Sciences, Beijing 100093, China*

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Objective

Betula microphylla Bunge, as a resource treasury of desert biodiversity, is a pioneer plant in saline-alkaline soil amelioration. According to previous research, Ebinur Lake, north Xinjiang, is a representative saltwater lake with 92–131 g/L salinity (Li et al., 2006). However, surprisingly, our research team found a scrap of freshwater wetland, meadow bog gleied soil, with many birch trees of *Betula microphylla*. Why does *Betula microphylla* grow in freshwater wetland? Was *Betula microphylla* growing there in ancient times? Therefore, it is necessary to strengthen research into the biodiversity evolution in the Ebinur Lake area. By using the data from palynology and ^{14}C, we reveal the ecological evolution of the Ebinur Lake wetland area since 2580 cal. a B.P., which could provide a reference frame for ecological civilization construction.

Methods

We collected 61 pollen samples at 2-cm intervals in a section (44°32′42.7″N，83°47′36.7″E，altitude 388 m) located in the Xinjiang Ebinur Wetland National Nature Reserve. Three ^{14}C samples taken from depths of 25–30 cm, 73–78 cm, and 95–100 cm were investigated at the Peking University AMS laboratory and calibrated to 648 ± 20 cal. a B.P., 861 ± 65 cal. a B.P., and 1650 ± 30 cal. a B.P., respectively. All ^{14}C dates were calibrated to calendar years before present (cal. a; B.P. = 1950 AD) using the program CALIB 7.1 (http://calib.qub. ac.uk/calib/). The age-depth model was developed on the basis of linear interpolating. Meanwhile, pollen samples were treated with HF and HCl to extract the pollen. All samples were identified under an Olympus CX51 light microscope at 400× magnification. The average number of pollen grains in each sample was counted above 200. Digital graphs were made using the Tilia-Graph software package (Grimm, 1990).

* Corresponding author. E-mail: 48606786@qq.com

Results

We can divide the pollen diagram into four assemblage zones (Fig. 1):

Zone I (122−88 cm, 2580−1310 cal. a B.P.): reveals high mean percentages of herbs, average 71.13%. The arboreal pollen (19.96%) is dominated by Cupressaceae (9.33%), *Pinus* (4.46%) and *Picea* (1.90%). The percentage of *Betula* was on average 1.26%. The number of hydrophytic pollen was 7.89%, including Cyperuaceae, *Sparganium*, and *Typha*.

Zone II (88−44 cm, 1310−720 cal. a B.P.) was characterized by a decrease in herb pollen percentage (67.37%). The percentage of trees (25.07%) began to increase, including *Picea* (8.56%) and *Pinus* (7.46%), while the Cupressaceae and *Betula* decreased to their lowest values in this study, about 6.28% and 0.88%, respectively. The hydrophytic pollen was about 1.30%.

Zone III (44−14 cm, 720−360 cal. a B.P.) is characterized by an increase in trees (47.32%), dominated by *Pinus* (33.11%) and *Picea* (13.95%), and a decrease in herbs (47.26%), dominated by Compositae (10.38%) and Chenopodiaceae (9.76%). The percentage of hydrophytic pollen was 2.31%, reaching to its highest value at 26 cm.

Zone IV (14−0 cm, 360 cal. a B.P.–present) is marked by an increase in tree pollen (51.28%), dominated by *Betula* (16.99%), *Pinus* (16.73%) and *Picea* (10.16%). The herb percentage was 41.35%, dominated by Chenopodiaceae (13.77%). The hydrophytic pollen is about 2.71%.

From 2580 to 1310 cal. a B.P., the landscape was steppe and sporadic forest (composed mainly of *Picea*), with aquatic plants in the surrounds. During the period from 1310 to 720 cal. a B.P., the region was primarily covered with Gramineae and Chenopodiaceae, the typical vegetation of desert grassland, the timberline of spruce might have declined. From 720–360 cal. a B.P. there was a desert grassland to typical grassland vegetation transition type and during that period, the size of water area increased, as shown by the percentages of aquatic pollen

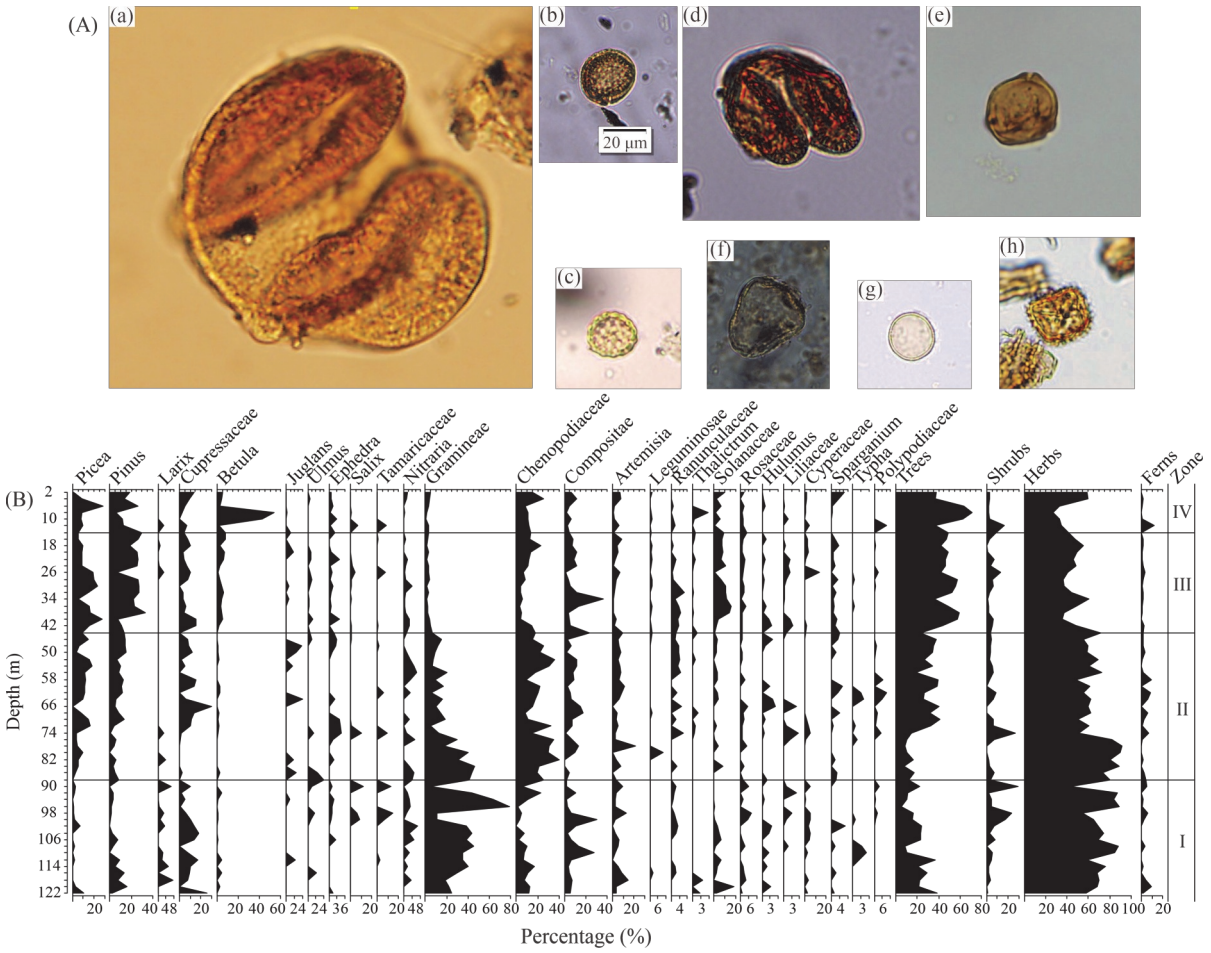

Fig. 1. (A) Representative sample of pollen from Ebinur Lake, north Xinjiang: (a) *Picea*; (b) *Sparganium*; (c) Chenopodiaceae; (d) *Pinus*; (e) *Betula*; (f) Cyperuaceae; (g) Cupressaceae; (h) Compositae; (B) pollen percentages of Ebinur Lake wetland profile.

(*Cyperus* + *Sparganium*). From 360 cal. yr BP to present, the tree species were characterized by a stable high proportion of *Betula*, especially during 220–180 cal. a B.P.

Conclusions

The ^{14}C and pollen record from Ebinur Lake wetland reveals some distinct changes in the *Betula* pollen assemblages over the past 2000 years. Especially during 180–220 cal. a B.P., the percentage of *Betula* reached its highest value, at 51.26%. According to historical records, more than 100 years ago, Ebinur Lake was also called Huashu Village based on the vast areas of *Betula*. Therefore, our results help to elucidate that *Betula* has outlived 2000 years with different percentages.

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