

Research Advances

First Biological Records of Palaeoecology Changes Inferred from Pollen since 4800 cal. a B.P. in Alahake Saline Lake of North Xinjiang

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Objective

As the resource treasury of desert biodiversity, the wetland of *Betula halophila* has fragile ecologic system and low stability, which causes the sudden reduction of wetland area. The Alahake Saline Lake is known for an endangered species, *Betula halophila*. However, palaeoecology changes of the Alahake Saline Lake have been little documented. Therefore, it is necessary to strengthen the research on biodiversity evolution in the Alahake Saline Lake. A 140-cm deep section of drilling was collected at Alahake Saline Lake for the first time. Using the data of Pollen and ¹⁴C, we reveal the vegetational evolution of Alahake Saline Lake since 4870 cal. a B.P., which could provide the reference frame for ecological civilization construction.

Methods

We collected 140 pollen samples at 1 cm intervals in the section (47°41'37.7"N 87°32'40.5"E), which is located at about 60 km west of Altay City in northern Xinjiang. Pollen samples were treated with HF and HCl to extract pollen (Wang Zixi et al., 2017). All samples were identified under an Olympus CX31 light microscope at 400x magnification. The average number of pollen grains in each sample were counted above 200 (Fig. 1b; representative sample of pollen). Digital graphs were made using a Tilia-Graph software package (Grimm, 1990).

Meanwhile, six radiocarbon data (¹⁴C) were conducted at the Peking University AMS laboratory.¹⁴C samples taken from the depths of 14–16 cm, 40–42 cm, 65–67 cm, 88–90 cm, 114–116 cm and 138–140 cm calibrated to 500±25 cal. a B.P., 1075±105 cal. a B.P., 1260±40 cal. a B.P., 2795±35 cal. a B.P., 3430±60 cal. a B.P. and 4845±25 cal. a B.P., respectively. The age-depth model was developed on the basis of linear interpolating.

Results

We could divide the pollen diagram into four pollen assemblage zones (Fig. 1c).

Zone I (140–120 cm; 4870–3670 cal. a B.P.) revealed high mean percentages of herbs, average 61.61%, and dominated by Compositae (8.72%–27.36%) and Chenopodiaceae (2.11%–23.88%). The arboreal pollen was dominated by *Pinus* (5.74%–27.36%) and *Picea* (1.9%–23.21%). The percentage of *Betula* was 1.61% on average. Shrubs pollen was dominated by *Ephedra* (2.75%–12.50%). The fern spores were all occasionally present (mean 0.43%). The trees (mean 27.34%) and shrubs (mean 10.47%) both reached their peak values. The AP/NAP ratio was also at its highest value (mean 0.4).

Zone II (119–75 cm; 3670–1790 cal. a B.P.) was characterized by an increase in herbs (mean 73.27%) and dominated by Chenopodiaceae (19.14%–50.99%) and Compositae (5.91%–34.30%) pollen percentages. The percentages of trees (mean 20.56%) began to decrease. And the shrubs were decrease to average 5.71%. The AP/NAP ratio was about 0.3.

Zone III (74–20 cm; 1790–580 cal. a BP) was more stable than zone II. The percentage of herbs and trees were slowly but surely changing. Herbs reached to minimum 56.44% and *Betula* declined to average 0.95%. The AP/NAP ratio was 0.27.

Zone IV (19–1 cm; 580–230 cal. a B.P.) was marked by an increase in herbs pollen (mean 91.94%). It was dominated by Chenopodiaceae (31.02%–76.34%) and followed by *Artemisia* (2.68%–43.06%). The trees pollen was characterized by a dramatic decreased to 4.92% average, some period even to 0.45%. *Pinus* (0–9.43%), *Picea* (0–6.58%) and *Betula* (mean 0.33%) were marked by decrease. The AP/NAP ratio reached their lowest values (mean 0.05) in this zone.

The biological records from the Alahake Saline Lake presented here reveal some distinct changes in the pollen

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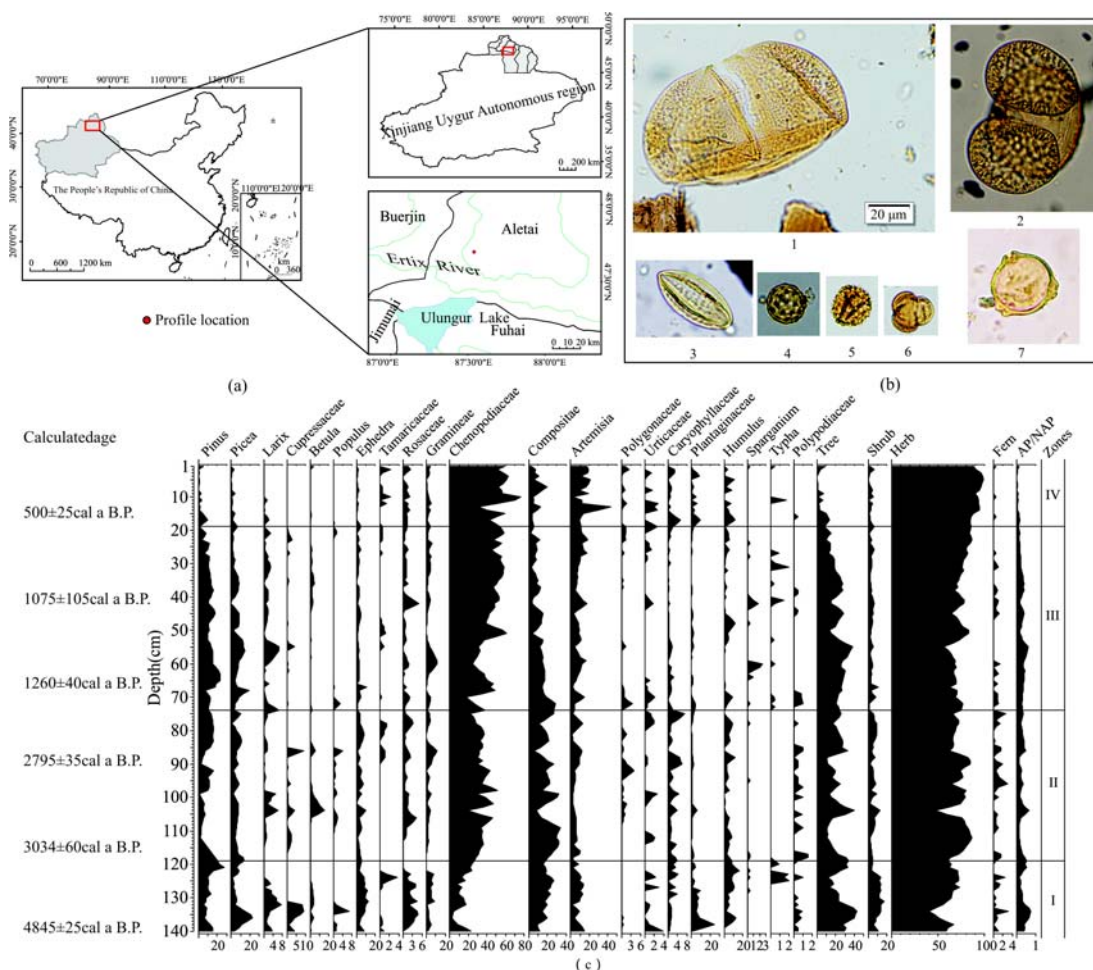


Fig. 1. (a) Location of study area in northern Xinjiang, China. (b) The representative sample of pollen (1, *Picea*; 2, *Pinus*; 3, *Ephedra*; 4, *Chenopodiaceae*; 5, *Compositae*; 6, *Artemisia*; 7, *Betula*). (c) Pollen percentages and ^{14}C of the Alahake Saline Lake profile, Xinjiang.

assemblages, suggesting changes in the regional vegetation cover during the past 4870 years. From 4870 to 3670 cal. a B.P., the vegetation was dominated by *Compositae* and *Chenopodiaceae* steppe and sporadic forest (composed mainly of *Pinus-Picea-Betula*) in the surrounding. During the period from 3670 to 580 cal. a B.P., trees began to fall away, while *Chenopodiaceae* showed a sharp increase. The Alahake Saline Lake was facing environmental degradation. From 580 cal. a B.P. to the present, the percentage of trees decreased markedly, even extinction. And the vegetation types were characterized by a stably high proportion of *Chenopodiaceae*, similar to the modern period.

Conclusion

From 4870 to 3670 cal. a B.P., it had relatively good environment with a percentage of trees and relatively varied vegetation types. During the period from 3670 to 580 cal. a B.P., trees began to fall away, while

Chenopodiaceae showed a sharp increase. The Alahake Saline Lake was facing environmental degradation. Until 580 cal. a B.P., the percentage of trees decreased markedly, even extinction. Vegetation types were similar to that in the modern period.

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