

## **Lake sediments documented late Quaternary humid pulses in the Gobi Desert of southern Mongolia: Vegetation, hydrologic and paleoglaciation inferences**

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Considerable efforts have been devoted to decipher the late Quaternary moisture and thermal history of the arid central Asia. However, an array of paramount aspects has inhibited our complete understanding of the broad pattern and underlying mechanisms: (i) Biased or even contradictory conclusions may be achieved due to the interpretations of different proxies. (ii) Most of the works poured attention into Holocene period, only few records can extend back to earlier marine isotope stages. (iii) Substantial spatial heterogeneity is noteworthy in the area. Exceeding amounts of studies were carried out in Lake Baikal catchments, northern and western Mongolia, while only two works were hitherto conducted in southern Mongolia. (iv) It remains elusive with respect to how and to what extent have East Asian Summer Monsoon and Westerlies affected the thermal and moisture signals in this spectacular arid region.

To address this set of issues, two parallel cores (ONW I, 6.00 m; ONW II, 13.36 m) were retrieved from Orog Nuur, Gobi Desert of southern Mongolia. An array of multidisciplinary investigations involving geomorphologic mapping, radiocarbon dating, geochemical and biotic studies (i.e. palynological and ostracod valve analyses) provide a comprehensive data set for inferences of hydrological perturbations, vegetation development and phases of glacier expansions over the last ~50 ka. Orog Nuur catchment depicted a broadly vulnerable ecosystem that was dominated by *Artemisia* steppe community in the late Pleistocene, and *Chenopodiaceae* desert steppe in the Holocene. In addition, the Termination I is ideally documented in a complete suite of geochemical, palynological, and ostracod signatures. In general, the thermal and moisture history in the Gobi Desert were as follows: (i) MIS3 had a relatively warm temperature and sufficient moisture supply in particular between ~40 ka and ~26 ka; (ii) The MIS2 was subject to cold temperature and moisture deficit, which was interrupted by two exceedingly cold and dry playa phases related to the LGM and YD; (iii) The Holocene exhibited a cool to milder temperature and considerable sufficient moisture supply in particular the early Holocene.

In the eastern Khangai, the glacial expansion during MIS3 was slightly more notable than that during the LGM. The considerable humid pulse in the mid-to late-MIS3 may be the main driving mechanism for the MIS3 glacial advance. In central to southern Mongolia, rather than solely by the westerlies, the late Quaternary moisture and thermal history may be modulated, if not controlled, by coupled atmospheric components including both the westerlies and the penetration of the East Asian Summer Monsoon into the Asian interior. In addition, the two sand laminations (correspond to the LGM and YD event, respectively) recorded in the Orog Nuur may provide a potential opportunity to be regarded as chronological benchmarks for the lacustrine sequence in the Gobi Desert, albeit more investigations still need to be carried out to test its reliability in a larger spatial scale.