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Geochemical Analyses of Macrophytes (Potamogeton sp.) and ancient DNA from Lake Karakul, Tajikistan

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Mountain ecosystems are very sensitive towards changes in moisture and temperature and therefore most likely to be affected by climate change. To be able to get a closer insight into the alpine system of the Pamir Mountains, a 11.25 m long core was retrieved from the eastern basin of Lake Karakul (3,929 m asl), Tajikistan, in 2012.

In order to gain insights into changes in the paleo-productivity of Lake Karakul over the last 29 cal kyrs BP, we investigate temporal gradients of elemental content (TOC, TN) and stable isotopes (δ13C, δ15N) of macrophyte remains (Potamogeton sp.) and plant communities obtained from ancient sedimentary DNA along the core.
For the geochemical analyses we make use of the ability of submerged macrophytes, such as Potamogeton, to use HCO_3- for photosynthesis in times of CO_2 shortage and implement our results in a transfer function for paleo-productivity inferences. No data are available from 20 to 7 cal kyrs BP as no macrophyte remains are preserved, indicating unfavourable conditions for plant growth at the coring site or poor preservation conditions during this time. Biogeochemical analyses show signi[U+FB01]cant variations from core base until approx. 20 cal kyrs BP with TOCPotamogeton 25-45 %, TNPotamogeton 0.5 % - 1.5 %, δ13CPotamogeton below -9 ‰ and δ15NPotamogeton of below 3.5 ‰ suggesting a cooler climate and re[U+FB02]ecting the last glacial maximum. Sediments in the upper 4.5 m (approx. 6.7 cal kyrs BP) are rich in macrophyte remains. TOCPotamogeton and TNPotamogeton values from this part of the core are higher, and an enrichment of heavier isotopes with δ13CPotamogeton up to -7 ‰ and δ15NPotamogeton up to 6 ‰ indicating a higher productivity within the lake due to more favourable conditions for macrophyte growths on the lake floor. We assume shifts towards a warmer climate and changes in lake level as the dominating causes.
Ancient sedimentary DNA was extracted from selected sediment slices and a metabarcoding approach (using universal plant primers) with subsequent Illumina sequencing was applied to characterize the plant community changes through the core. In total we identified 37 diverse plant taxa in the core sediments, of which 35 are of terrestrial origin. However, the DNA sequences were dominated by two aquatic plant taxa (Potamogeton sp. and Characeae). The sequences of the identified aquatic taxa were used for a semi-quantitative evaluation of aquatic plant composition and show a reversal in abundance between 20 and 13 cal kyrs BP. This is coherent with changes obtained by the biogeochemical analyses and thus both methods complement and verify each other and re[U+FB02]ect shifts in the living environment at the lake bottom from the LGM to the Late Holocene.

The obtained results enable a better understanding of ecological responses in the Pamir Mountains since the LGM.