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Soil development as trigger for lake productivity in a high alpine ecosystem

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In high alpine catchments, soil development significantly affects the lake's biogeochemistry and productivity. Here we present a Holocene multi-proxy sediment record of an oligothrophic high alpine lake. The multi-proxy analyses include geochemistry, mineralogy, magnetic properties, pollen, diatoms, chironomids, and pigment records. The sediment cores cover the entire lake history from the last deglaciation to present. The lake is located at 2800 m a.s.l., far above the potential tree line. Currently the catchment consists of bare rocks and scree and discontinuous small patches of thin soil. Alpine herbs and cushion plants account for the major part of the vegetation.
After deglaciation, during a warm and presumably dry climate, the lake was rapidly colonized as seen from the diatom and chironomid record. However, it took over 2000 years (until 8000 cal BP) until the lake became more productive as reflected in an increase in organic carbon content and algae and chironomid concentrations. During this period the climate was still warm but wetter. The increase in productivity is consistent with a shift from a plankton dominated C/N ratio (between 9 and 12) to a higher C/N ratio that reflects a higher input of organic matter from terrestrial plants. This increase also triggered the development of anoxic - alkaline bottom water conditions and thus affected the whole biogeochemistry of the lake. With the onset of a colder period around 4500 cal BP, the C/N ratio decreased again and the lake became less productive. Although the catchment had only a scarce and thin soil layer, the development of a slightly more productive soil layer during favorable climatic conditions had significant effects on the lake properties.