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Holocene palaeoenvironmental change in NE Germany: the multi-proxy record from Sacrower See

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Despite a large number of glacial lakes in north-eastern Germany, lacustrine archives have rarely been used to reconstruct the regional environmental history. Recently, a 17 m long lacustrine sediment record from the deepest part of Sacrower See close to Potsdam, Germany, was retrieved for a multi-proxy environmental study including sedimentological, geochemical, and biological analyses. The main objective is to reconstruct climatic and anthropogenic forcing factors on lake sedimentation during the Holocene.

Sacrower See (ca. 1 km^2; max. depth 38 m) is a dimictic and holomictic hard-water lake. Today, bottom waters are anoxic except during periods of holomixis. There is hardly any surface inflow and Sacrower See receives most of its water from groundwater seepage. The sediment sequence has been divided into 4 lithostratigraphical units. The lowest unit, which consists of homogeneous, slightly graded sands with occasional lignite fragments, is interpreted as a slump deposit and was not examined

in detail. From 13,000 to ca. 8000 cal. BP, a finely laminated, organic-rich, calcareous gyttja accumulated. After 8000 cal. BP the sediment becomes more homogeneous and enriched in biogenic silica. The top of the record is characterized by formation of biochemical varves. Time control is given by 12 AMS ^{14}C dates of terrestrial plant fragments, the identified Laacher See Tephra and the known onset of historical varve formation at AD 1870.

The beginning of the Holocene is characterized by large changes in C/N ratios, total sulphur, δ^{13}C of bulk organic matter and in K, Si and Ti records in response of the lake system to climatic amelioration. Increased vegetation cover led to a reduced influx of detrital and terrestrial organic matter into the lake. The Holocene record has a typical regional pollen sequence, with the first evidence of human impact documented by the occurrence of anthropogenic indicator pollen at 5500 cal BP. Until then, sedimentological and geochemical parameters indicate relatively stable environmental conditions. During the period of human impact, peaks in Ti and K occur at 3200, 2800 and 1100 cal. BP which are related to increased soil erosion due to forest clearing during Bronze Age, Slavic Times and Middle Ages, respectively. In general, a higher variability of most proxy parameters is observed during these times.

The steady rise of biogenic silica accumulation rates during the Holocene indicates increasing productivity of Sacrower See until diatoms are outcompeted by other algae. The stable isotope records (δ^{13}C and δ^{15}N) show alternating correlations with C/N and Fe/S ratios which underline the dependency of these proxies to the quality or source of organic matter and to degradation processes under changing redox conditions. Our results highlight that, regardless of a wealth of available parameters, the discrimination between natural and anthropogenic forcing factors remains challenging.