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Abrupt climate changes of the Late Glacial and seasonality: Evidences from varved lake sediments of Western Europe

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Composite sediment profiles derived from two small lakes situated in the northwestern lowlands and the Eifel region of Germany were investigated to develop a detailed high resolution description of lacustrine and climatic changes during the Late Glacial. Independent calendar year chronologies have been established for Lake Hämelsee (9˚19´E, 52˚46´N, 19.5 m a.s.l.) and Lake Meerfelder Maar (6˚52´E, 50˚07´N, 345 m a.s.l.) by varve counting and thickness measurements, and radiocarbon dating. Synchronisation of the records is controlled by the tephra time marker of the Laacher See volcanic eruption (12,880 years BP) and, where necessary, based on palynologically defined tie-points.

Stable carbon and nitrogen isotopes of sedimentary organic matter describe lacustrine primary production which reacts almost without a lag phase to environmental changes. Terrestrial organic matter had no remarkable influence on YD isotope transitions of Lake Meerfelder Maar (LMM). Interestingly, nitrogen isotopes show a dissimilar behaviour between the lakes and in the LMM record no clear YD excursion could be detected therein.

Despite differences in catchment geology and lake morphometry both lakes show synchronous changes during the Late Glacial within the dating uncertainties of 10-30 years. Rapid and intense proxy reactions mark start and end of the YD. Strongly enriched isotope values of nitrogen/carbon in both lakes show that the growth conditions for lacustrine algae were comparably favourable and indicate an increase in primary

productivity during the YD. This suggests that mean summer temperatures remained high with primary production strongly accelerated within a shorter growing season. Cooling had to be restrained to the winter months and the transitional seasons. In both archives the YD is characterized by an internal structure indicating more subtle environmental changes. Most prominent is the more than threefold increase in minerogenic accumulation in LMM, reflecting an abrupt onset of regular snow melt run-off in spring since 12,240 years BP. We conclude that the YD was caused by a major change of seasonality with mild to warm summer and cold winter months.

References:

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