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Sediment physical properties and organic geochemical evidence of lacustrine environmental change in Western Europe during OIS 3 and 2.

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During the last glacial cycle the North Atlantic region experienced extreme climatic and environmental instability with cyclic shifts from glacial to interstadial conditions on millennial time-scales. Initially defined in marine and ice-core records, these Dansgaard-Oeschger cycles (D-O) are now also evident in a growing number of terrestrial climatic archives. Here we present a new high-resolution sedimentological and geochemical record of environmental changes for Western Europe during Oxygen Isotope Stages 3 and 2 from the site Les Echets (France).

Our results show that the cyclic change in lithology between thick clayey-silts and highly compacted gyttjas is associated with distinct variations in sediment physical and geochemical properties. Very low organic matter content, but high bulk density and magnetic susceptibility values characterize the clayey-silty horizons. In addition, the high sedimentation rate of these layers may indicate pronounced slope instability in the catchment and increased sediment delivery to the basin as a result of cold/dry environmental conditions. In contrast, the marked increase in organic matter content and the distinct decrease in bulk density and magnetic susceptibility values in the gyttja horizons point to more stable conditions at the time of deposition.

The geochemical data set, such as organic carbon (C_{org}), total nitrogen (N_{total}), stable

carbon and nitrogen isotopes (bulk $\delta^{13}C_{org}$, $\delta^{15}N_{total}$), as well as C_{org}/N_{total} ratio replicate these fluctuations nicely. C_{org} and $\delta^{13}C_{org}$ have low values in the clayey silty sediments, but increase distinctly in the gyttja layers, in concert with N_{total} and $\delta^{15}N_{total}$ values. The C_{org}/N_{total} ratio is 4-10% in the clayey-silty horizons and reaches up to 20% in the organic-rich sediments. The overall low C_{org}/N_{total} ratio indicates that algal production was probably the main source of organic matter in the former lake. However slightly higher values in the organic-rich sediments point to a contribution of terrestrial plant material, which may have been washed into the lake during warmer intervals. The preliminary age-depth model suggests that the analyzed sequence extends between 45 and 15 kyr BP, i.e. it covers parts of OIS 2 and 3. We hypothesize that the observed millennial-scale fluctuations with sharp transitions between colder and warmer conditions correspond to the D-O stadials/interstadials of OIS 3.

We conclude that the distinct variations in physical and geochemical properties clearly show that the study region experienced major environmental changes between 15-45 kyr BP, possibly as a response to D-O climate variability. The ongoing dating effort, based on combined AMS ^{14}C measurements of organic matter and on OSL dating of clastic material, will allow to secure an independent geochronology for this site, which will in turn make it possible to correlate the observed environmental changes in detail to ice core and marine records.