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Insight into past hydrological conditions through signatures of stables isotopes in Holocene Loire River fluvial sediments (France)

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Multi-proxy indices (δ18O, δ13C, granulometry, mineralogy) in the sediments from a channel infill in the Middle Loire alluvial plain are used to highlight some aspects of the basin evolution over the period from 0 to 10000 yr. BP. The Loire River in central France is 1010 km long and drains an area of 117,800 km2. The catchment is composed of plutonic rocks (500 - 300 Ma), a large volcanic area in the upstream section and carbonate deposits (200 - 6 Ma old) in the central part. During the Late-glacial and Holocene, the lacustrine carbonate substratum in the Middle Loire alluvial plain was incised by the Loire River and numerous oxbows and channels related to meander migration have been identified. We investigated a channel fill that spans part of the Boreal, the Atlantic, the Subboreal and probably a large part of the Subatlantic through sediment coring.
The channel fill consists mainly of fine clayey sediments deposited during flooding of the river; there is a total absence of coarse clastics and sandy materials in the 5m core excepted in the lower part. The distribution of particle sizes shows an up-core decrease with a coarser fraction occurring in the first 2/3th of the record. Semi-quantitative XRD analysis of the sediment showed that quartz, K-feldspar, plagioclase and calcite are the main mineral components and that the <2μm fraction is dominated by illite-smectite and kaolinite. The distribution of the clays highlights an up-core increase of the illite-smectite fraction.
The historical record of isotope ratio variations together with the distribution of particle sizes allows to constrain the evolution of the river dynamics. The strong decrease of the δ13C of carbonates in the upper part of the record has been ascribed to the progressive closure of the meander and thus the control of the C isotope signature by biological activity in a local environment. Furthermore, we can postulate that the variations in the carbonate δ18O are related to the respective contribution of river water and groundwater, being less dependent of the meander evolution than carbon isotope signatures. The isotope record of the river dynamics also agrees with the variations in the clay-mineralogy.