



Vegetation and soil dynamics under climatic to anthropogenic forcing through the Holocene in Eastern France

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Small lakes with little catchment areas, and high resolution Holocene sediment infilling, offer the interest to record mainly local perturbation and to study the switch from climatic to anthropogenic forcing.

Two cores were extracted from Lake Antre in the Jura Mountains (Eastern France, 798 m a.s.l) and Lake Moras located on a low-elevated plateau from the upper Rhone valley (Eastern France, 304 m a.s.l). Cores taken from the deep zone of the lakes present continuous sedimentary series from the Late-glacial (15 000 cal. BP) for Lake Moras and from the Atlantic chronozone (6000 cal. BP) for Lake Antre. Several archaeological excavations and investigations around Lakes Antre and Moras give evidence of major human occupation during Gallo-roman period, while former settlements are indicating by Pre- and Protohistoric archaeological artifacts.

Multi-proxy reconstructions with high temporal resolution were undertaken: vegetation dynamics by pollen analysis, fire history by the quantification of microscopic charcoal and soil erosion by magnetic susceptibility measurements.

Before the anthropogenic forcing, during the mid-Holocene environment of both lakes are constituted mainly by a dense mixed oak forest.

The first palaeoecological signs of anthropogenic impact on the two sites appear to have been discontinuous and limited. They appear at the early Neolithic (ca 6000 cal. BP) for Lake Moras and during the Bronze Age (4000 to 3000 cal. BP) for Lake Antre.

For the both sites, all the proxies indicate an acceleration of human impact around 3000 to 2700 cal. BP i.e. at the transition between the Bronze Age and the beginning of the Iron Age. The dense forest and the *Alnus* dominated vegetation on borders of lakes are affected by several clearances. The influx of micro-charcoal increases due to the use of the fire for clearing and manage settlements. The development of Poaceae and Anthropogenic Pollen Indicators (API) suggest an expansion of pastures, whereas the farming practices remained low as shown by rare *Cerealia*-type pollen. This resulted in increasing soil erosion.

Afterward, the Gallo-roman settlement is in the continuity of the Iron Age occupation. The intensification of the land use is marked by an increase in Poaceae and API as well as in detritic influx, but percentages values of *Cerealia*-type stay low. The landscape appears to be not dedicated to cultivation activities.

At the end of the Gallo-roman period (ca 1700 cal. BP), the anthropogenic indicators decrease and the landscape is reforested (expansion of *Carpinus* and *Alnus* on lake shores).

At the beginning of Middles Ages (ca 1450 cal. BP), anthropogenic impact reinforced around these two lakes. An intensive farming activity developed particularly around Lake Moras with crops (*Cerealia* type and *Secale* type), walnut (*Juglans*) and hemp (*Cannabis*-type). From medieval times to the 18th century, human activities appear to be relatively stable. Then hemp, walnut, rye and crops farming, decrease due to grassland expansion until nowadays.

To conclude, the present-day landscape seems to directly result from several millennia of human exploitation since the Bronze Age. Vegetation dynamics appears to have been forced by successive activities in these areas.