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Confronting a decadal-scale reconstruction of Holocene alpine hydrology to regional palaeoclimate data: implications for human societies

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Introduction

Climate-induced lake level fluctuations in perialpine areas have been evocated for many years as one of the main factors regulating the human settlement on lake shores (Magny, 1993; 2004). One may ask for the impact of Holocene climate variability onto human development in the Alps in general. To address this question requires to better know the Holocene climate variability in the alpine area. We present here a regional study of the last 7 ka hydrology in front of the Alps based upon a reconstruction of detrital input in Lake Le Bourget (Arnaud et al., 2005) compiled together with the same data from Lake Constance (Wessels, 1998) in order to establish a regional framework of the evolution of detrital supplies in the Alps. We thereafter confronted these data to results from various natural archives - lake level, glacier fluctuations, speleothem - acquired in NW Alps in order to test their reliability in term of regional climate proxy.

Study sites and method

Lakes Le Bourget and Constance are fed by two of the most important alpine rivers: the Rhône and Rhine, respectively and are thus representative of the NW alpine

area. Thanks to the particularity of perialpine lake sediments to be a mixture of autochthonous calcite and partly silici-clastic river-borne material, calcium concentrations may be considered as inversely proportional to the detrital input. The use of an XRF core-scanner allowed to establish in Lake Le Bourget a 3- to 8-years time-step series of Rhône river hydrological activity.

Results

Superimposed onto a long-term trend toward stronger river discharge, eight phases of enhanced detrital inputs are recognised in both lake records over the last 5.5 ka. They correspond to phases of higher lake-level elsewhere reported in Jura and French Prealps (Magny, 2004). Data from glacier fluctuations and speleothems, independently acquired in the vicinity of Lake Le Bourget, also confirm the climatic triggering of most of them.

Discussion / Conclusion

While they probably carry an hardly assessable anthropic part, the detrital input signals seem to be paced in first instance by hydrological changes. Nevertheless most of the detrital oscillations are synchronous of major cultural changes (Neolithic/Bronze age, Bronze/Iron age transitions) which should have driven changes in land-use and downstream, in soil erosion rates. But it is also possible that climatic changes accelerated the cultural transitionsĚ Our study evidences a complex interrelation between climate change, erosion rates and the development of organised human societies during the Late Holocene in the Alps. Disentangling human- and climate-triggered forcings within high resolution detrital signals remains thus a further step to be challenged in order to quantitatively reconstruct Holocene alpine hydrology and its potential influence on human organised societies.

References

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