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First reconstruction of last millennium flooding activity on Kerguelen archipelago (50°S, sub-Antarctic Indian Ocean) from Lake Armor sediment: implications for southern hemisphere cyclonic circulation changes

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Subantarctic Indian Ocean, above 50°S, is one the places in the world where past atmospheric circulation patterns remain completely unknown. This is an important lack in scientific knowledge of past climate changes as this region is one of the key places of the climate machine. In particular, we do not know the impact of Holocene climate variability on extreme south cyclonic circulation.
Lake Armor is a fjord-type lake, 98m maximum depth, located on the eastern edge of Kerguelen mainland central plateau. A first reconnaissance survey, including seismic imaging and short cores retrieving, was led here in November 2006. Seismic and bathymetric data reveal the existence of two depocentres submitted to river inputs (Heirman et al., 2007 ; Arnaud et al., 2007). The southern one is submitted to strong underwater currents and is not suited for paleoclimate reconstruction. On the contrary, the northern one exhibits finely stratified Holocene deposits which were cored in the aim of reconstructing the evolution of river floods on Kerguelen archipelago.
We led on the retrieved short cores a high resolution sedimentological study, including micro-grainsize, colour, physical properties (Geotek multi-track sensor), and geochemistry (XRF core scanning, major and trace elemental composition, infrared spectrometry). In the case of lake sediments in which detrital inputs are diluted by an autochthonous biogenic fraction, such an approach permits a high resolution reconstruction of flood history (Arnaud et al., 2005; Arnaud, 2005), taking account of both sediment source and river activity evolutions. Using an XRF core scanner, we established high resolution geochemical profiles on a short 14C-dated core, spanning the last 1200 years. We here interpret the Si/Rb ratio as an indicator of biogenic silica abundance, in opposition to Rubidium-bearing detrital inputs. We hence evidenced a series of high and low terrigenous inputs, corresponding to high and low flooding activity, respectively. Our results were compared with the only available climate-related information for Late Holocene on Kerguelen archipelago: a series of two 14C ages interpreted as evidences of glacier retreat (Frénot et al., 1997). Both records match together, as the 1100-1350 AD minima of flood activity corresponds to the younger age of glacier retreat. We hence evidence three periods of wetter conditions at ca. 800-1100, 1350-1750, 1880-1940 AD, which are interpreted as periods of enhanced cyclonic circulation, compared to the present-day situation. Those results show the potential of Lake Armor sediments to establish the first Holocene palaeohydrological record in southern Indian Ocean.

References

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