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Upwelling events in Lake Tanganyika traced by Mn content in bivalve shells

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The productivity of Lake Tanganyika, Central Africa, is highly dependent on the seasonal southern end upwelling tuned by monsoon regime. In the present study, we investigated the potential of elemental Mn in lake surface waters as an upwelling tracer of anoxic deep waters. We also explored the potential of the freshwater bivalve *Pleiodon (Cameronia) spek*i as a geochemical archive of these periodic hydrological changes. Results of a two years monitoring of lake waters chemical composition were compared with high-resolution temporal profiles of Mn performed in the aragonitic shell of this bivalve by way of an in-situ Laser Ablation Inductively Coupled Mass Spectrometry (LA-ICP-MS). Those results were inter-calibrated with a microdrill sampling procedure associated with High Resolution Inductively Coupled Mass Spectrometry analysis (HR-ICP-MS). A mean individual growth rate over an eight month period was estimated from shell measurements and applied for dating the chemical profiles.

In surface waters, the significant rise of total Mn normalized to Al during the upwelling period (May to July) suggests a deep source of dissolved Mn whereas the concomitants rise of Mn and Al during the rainy period (October to January) reveals the particulate load supplied by rivers after rainfall weathering.

The chemical profiles (Mg, Mn, Sr) realized on two *P. spekii* collected in March 2003 from the same site (Mpulungu, Zambia) are similar. A sharp peak of Mn in July 2002 dominates the two profiles that perfectly match with the rise of the Mn/Al ratio in surface waters. In contrast, a very slight increase of skeletal Mn is related to the growth of detrital Mn during the rainy season, suggesting that the dissolved Mn is the bioavail-

able form with respect to the assimilation and the incorporation in the bivalve's shell. Our results support the hypothesis that *Pleiodon* shells record the chemistry of the solution in which they precipitate aragonite. Applying such geochemical archives should allow to describe the appearance and the intensity of past mixing events in Lake Tanganyika but also in other deep stratified African lakes where vertical water movements are tuned by monsoon regime. This study demonstrates that in hydrodynamically complex ecosystems, trace element variations in bivalve shells can provide a detailed record of short-term environmental changes.