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Laboratory and field-based calibration study for the use of freshwater bivalve shells as an archive of environmental and climatic conditions.

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The accretionary growth of mollusc shells makes it possible to obtain recordings of the life history of these organisms. Freshwater bivalves are common inhabitant of past and present rivers and lakes. The wide latitudinal distribution of the Unionidae allows their shells to be used as an archive of environmental variations. Physical and chemical record of the shells contains precious information on water temperature, rainfall or metal concentrations. We developed a coupled laboratory and field-based calibration study on freshwater bivalve shells to determine the ability to track water oxygen isotopes composition (18Ow), dissolved metal and temperature changes at a decadal to infra-annual time scale.

A genetically homogenous population of Anodonta cygnea and Corbicula fluminea have been cultured in the Seine River and in laboratory, under controlled conditions. Daily temperatures and semi-monthly 18Ow and trace metals (Mn, Cu, Zn, Cd, As, Pb, ...) were measured during the experiment. For the micro-sampling strategy, we have to establish a chronological time scale in the shell growth. Thus each month, an experimental 4 hours Mn2+ staining was performed to have a precise temporal marking during shell growth. Additionally, wild stocks of European and African Unionidae shells were analysed under microscopy and geochemical study.

Mn2+ markings can be recognized under cathodoluminescence (CL) analysis of cross section along the growth axis of the shells. Their identification on the two distinct groups (in vivo and in vitro experiments) helps us to determine the cyclicity of the natural fluctuations of the luminescence and the shell growth rate. The counting of annual growth increments reveals a life span over ten years, but micro-CL rhythms are also identified. This sclerochronologic approach is used to confront water physico-chemical changes with the biogenic carbonate geochemical records. First results show a latitudinal gradient (from France to South Africa) of 18O and 13C shells in respect with the climatic conditions (temperature and humidity).

This study contributes to fixe the interest of freshwater bivalve shells analyses for hydrological management (i.e. tracking of natural or anthropogenic dissolved metal pollution) as well as (paleo)climatic investigations.