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Stable oxygen Isotopes in freshwater Mussels (Unionidae) as a Proxy for late Holocene floods and droughts of Rhine and Meuse

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The rivers Rhine, Meuse and their branches are the major river systems in the Netherlands. Both rivers can cause damaging flood events in a large part of their catchments. Such events happened in the 1990s and may become more frequent as discharges have increased over the last 100 years due to increased precipitation. Each river has its own characteristic seasonal oxygen isotope pattern reflecting rain water and meltwater input. Insight in past river conditions and flood frequencies is crucial to predict impacts of future climate change. The project (BSIK - Climate changes Spatial Planning) aims at the reconstruction of late Holocene discharge patterns of the Rhine and Meuse rivers through geochemical analyses on growth increments of freshwater mussels.

We studied three species of large freshwater bivalves: *Unio crassus*, *U. pictorum* and *U. tumidus* (Unionidae). These are found naturally in the rivers Rhine and Meuse; however *U. crassus* has been extinct in the Netherlands since 1968. A dataset comparing river water δ^{18}O and shell δ^{18}O for the period 1990-2005 shows that these species precipitate their aragonite shell in isotopic equilibrium with the ambient water. There is no difference between the species. The rivers' characteristic seasonal δ^{18}O pattern can be extracted from the shell δ^{18}O records. As such Unionid shell δ^{18}O can serve as a proxy for past river composition and wet and dry periods.

In order to examine the relationship between water chemistry and shell chemistry at higher resolution and with smaller error a monitoring experiment was set up. The

Unionids were kept in cages in both rivers for periods up to 18 months. Temperature was measured continuously and pH and alkalinity were measured every 14 days when also water samples were taken. In advance shells were stained with calcein so that a fluorescent growth line was precipitated. After 12 months and 18 months shells were taken out of the cages and sampled at high resolution. We establish the relation between shell δ^{18}O and water δ^{18}O and make an attempt to calculate back river water composition and discharge from the δ^{18}O records.

Finally an extrapolation to the past is made. We show records of shells from archaeological finds and we present reconstructions of river water composition and possibly climate for time slices in the Neolithic, Roman times, Middle Ages and Little Ice Age.