Experimental fossilisation of fishes

F. GÄB[1], C. BALLHAUS[1], S. GERSCHERMANN[1], A. KRAL[1], M. MENNEKEN[1], E. STINNESBECK[1]

[1] Institut für Geowissenschaften, Universität Bonn, fgaeb@uni-bonn.de

There are many world class locations where fishes are near-perfectly preserved. However, there are hardly any experiments that simulate conservation conditions. Intuitively, pressure, salinity, pH, redox potentials (Eh), and the presence of bacterial mats are important parameters. We have designed autoclaves that allow to control these parameters to document with time series experiments the decay of fishes.

Pressure is a fundamental parameter to promote the sinking of fish carcasses to the bottom of a water body and their deposition at the water-sediment interface. We have calibrated in pressure-salinity space for marine conditions the minimum pressure required for fish carcasses to sink to the bottom. Deposition in deep water also promotes preservation by preventing fermentation gases inside fish carcasses to expand. Reducing conditions have no fundamental influence on the conservation and the decomposition rate of fishes. A low Eh is, however, important to keep scavengers at bay before the carcass is covered by sediment. A critical parameter for the conservation of fishes in marine environments is the salinity of the solution. Experiments with 3.5, 7, 10, and 12 wt.% NaCl equiv. show that hypersaline waters delay decomposition and promote the preservation of soft tissue. At salinities three times seawater, applicable to closed, stratified epicontinental settings like the Jurassic Solnhofen basins, decay is stopped and soft tissues can remain virtually unchanged for any length of time until the carcass is covered by sediment. High pH values also promote preservation. It appears that a high pH slows down the internal decay of organic matter and supports mat-forming bacterial colonies that help isolate a carcass from its environment. Highly alkaline conditions are applicable to fossils in tuff crater lakes like Messel where hydrolysis reactions of tuff with water may have imposed pH values as high as 9 to 10.

Our experiments outline the conditions most favorable for conservation. They also suggest that the transformation of a fish carcass to a well preserved fossil may be a matter of a few months.