

Application of stable isotope ($\delta^{13}\text{C}$ and $\delta^{18}\text{O}$) composition of mollusc shells in palaeolimnological studies - possibilities and limitations

Karina Apolinarska (1), Mariusz Pełechaty (2), Annette Kossler (3), Eugeniusz Pronin (2), and Daria Noskowiak (1)

(1) Institute of Geology, Adam Mickiewicz University, Poznań, Poland (karinaap@amu.edu.pl), (2) Department of Hydrobiology, Faculty of Biology, Adam Mickiewicz University, Poznań, Poland, (3) Institute of Geological Sciences, Branch Palaeontology, Freie Universität Berlin, Berlin, Germany

Carbon ($\delta^{13}\text{C}$) and oxygen ($\delta^{18}\text{O}$) stable isotope analyses are among the standard methods applied in the studies of past environment, including climate. In lacustrine sediments, $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values can be measured in fine carbonate fraction (carbonate mud), in charophyte encrustations, ostracod carapaces and mollusc shells. Application of the stable isotope record of each of the above-mentioned components of the lake sediment requires knowledge about possibilities and limitations of the method. The present research discusses the most important results of the studies carried out between 2011 and 2013, concentrated on the stable isotope composition of snail shells, primarily, the species commonly preserved in central European Quaternary lacustrine sediments. The stable isotope studies involved also, the zebra mussel (*Dreissena polymorpha*), one of the most invasive freshwater species in the world. The research involved shell isotope studies of both recent (Apolinarska, 2013; Apolinarska et al., 2016; Apolinarska and Pełechaty, in press) and fossil molluscs derived from the Holocene sediments (Apolinarska et al., 2015a, b).

Shell $\delta^{13}\text{C}$ values were species-specific and among the gastropods studied the same order of species from the most to the least ^{13}C -depleted was observed at all sites sampled. Shell $\delta^{18}\text{O}$ values were more uniform. The wide range of $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values were observed in population and subpopulation, i.e. when live snails were sampled live from restricted area within the lake littoral zone. Carbon and oxygen stable isotope values of the mono-specific shells sampled from 1 cm thick sediment samples were highly variable. Those intra-specific differences ($n=20$) were as large as several permill. Such significant variability in $\delta^{13}\text{C}$ and $\delta^{18}\text{O}$ values indicates that stable isotope composition of single shells is unlikely to be representative of the sediment sample.

In conclusion, samples of freshwater molluscs for stable isotope analyses should be monospecific and composed of at least several shells. The number of shells being dependent on the difference between the minimum and maximum values within the sediment layer.

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