This PhD project focuses on the determination of biomineralization processes related to brachiopod shell formation and their impact on geochemical proxies, in order to evaluate the potential use of brachiopods as chemical proxies of paleo-seawater. We aim at deciphering the influence of the vital effects superimposing the original proxy record thereby improving proxy calibration and paleo-environmental reconstructions.

**Brachiopods as potential paleoenvironmental proxies.**

Fossil brachiopods have been extensively used to reconstruct physicochemical conditions and secular chemical variations of ancient oceans (Veizer et al., 1986), because their low-magnesium calcite shells is the diagenetically more stable polymorph of calcium carbonate and resistant to all except the most aggressive diageneric processes. Most of the studies assume that brachiopods incorporate stable isotopes and trace elements into their calcitic into shell calcite into or near equilibrium. However, the use of brachiopod shells as paleoenvironmental archives is problematic due to the biological processes of the organism (the so called “vital effect”), which cause their chemical and isotopic compositions to be significantly different from inorganic calcite precipitated in isotopic equilibrium with ambient seawater.

**Goal of the study**

To unravel which brachiopod taxa and/or portions of the shells and brachiopod taxa are most reliable as paleoenvironmental proxies. We will determine the transport, the elemental discrimination and isotope fractioning processes of trace elements and their isotopes from seawater to the site of calcification.

We will measure in situ, at least, Oxygen, Carbon, Boron, Lithium, Magnesium and Calcium isotope compositions using the ion microprobe technique and trace element contents by LA-ICPMS of shells from modern environment and from culture specimens. Latter measurements will be combined with scanning electron microscopy to study the brachiopod shell structure.

**Brachiopods. Shell structure.**

- **a. Terebratalia transversa**
- **b. Notosaria nigricans**
- **c. Lepidorella neapolitana**

**What do we know so far**

**δ¹⁸O values in brachiopod shells.**


**δ¹⁴C and δ¹⁸O values in brachiopod shells.**

Penman et al. (2013). Boron, carbon, and oxygen isotopic composition of brachiopod shells: Intra-shell variability, controls, and potential as a paleo-pH recorder.

**Vital fractionation effects**

Disequilibrium between brachiopod shells and seawater. Why?

**Kinetic effect?**

Kineticeffect have been observed for these elements in inorganic calcite experiments.

Still need to be tested the potential use of these isotopic and elemental ratios in brachiopods as reliable paleoenvironmental proxies.

**Bibliography**


