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Laboratory studies on benthic foraminiferal ecology and geochemistry

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Laboratory experiments are performed in the Laboratory of Recent and Fossils Bio-Indicators at the University of Angers in order to qualify the ecological and geochemical responses of benthic foraminifera to the physico-chemical forcing of the ocean. By unravelling vital and environmental effects a better understanding of the response to anthropic and climatic forcing will be established.

Since about 20 years, the isotopic composition, and trace element ratios of foraminiferal shells have served to retrace past climatic changes. But unfortunately, the relations between the composition of the foraminiferal shell and the specific physico-chemical parameters of the environment inhabited by the organism when it calcifies are still poorly understood. Studies in natural environments, comparing the ecology of recent benthic foraminifera with the stable isotopic composition and trace element ratios of their shells, have been performed, but the results are often ambiguous. This is mainly due to the fact that race element partitioning and isotope fractionation during calcification are influenced by numerous interfering factors. Studying foraminifera under controlled laboratory conditions potentially allows us to separate the effects of single environmental parameters on the isotopic composition and trace element ratios of the foraminiferal shell.

Furthermore laboratory studies can also help to understand the ecological responses of benthic foraminifera to specific events such as hypoxic to anoxic events which can result of anthropic impact and/or climatic changes.

At present, in our laboratory, experiments under controlled conditions are focussed to study specifically:

1) The temperature effect on the oxygen isotopic fractionation (ä^{18}O). Growth experiments with *Bulimina marginata/aculeata* are carried out at various temperatures (8, 10, 12, 14°C). Living adult specimens

marked with calcein are isolated and incubated at different temperatures. Food (dried green algae) is added in order to stimulate reproduction. After 4 months, the ä^{18}O and Mg/Ca ratio of specimens which were grown under controlled conditions are analysed.

2) The salinity effect on the trace element partitioning in the foraminiferal shells. Experiments using *Ammonia tepida* intend to obtain formation of new chambers at various salinities (range between 10 to 45 ‰). Chambers added under controlled conditions are analysed using LA-ICP-MS at the Utrecht University (The Netherlands).
3) The influence of the oxygen-depleted conditions. Hypoxic to anoxic conditions will be simulated to see the effect on the composition of the foraminiferal assemblages. This will determine specific species or assemblages which could act as bio-indicators of oxygen-stress related to environmental change. Fluorescent-marker methods are applied for accurate determination of the living versus dead number of specimens. This is needed since the traditionally used Rose Bengal stain is not suitable for repetitive sampling in a low oxygen context, where protoplasma may be preserved for a prolonged period of time.