SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Analytical, Environmental and Geo-Chemistry

has the honor to invite you to the public defense of the PhD thesis of

Niels de Winter

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Improving techniques and interpretations for reconstructing high-resolution paleoclimate in deep time from bivalve shells and tooth enamel

Promotor:

Prof. dr. Philippe Claeys

The defense will take place on

Friday February 22 2019 at 16:00h

in Auditorium D.2.01 at the campus Humanities, Sciences and Engineering of the Vrije Universiteit Brussel, Pleinlaan 2 - 1050 Elsene, and will be followed by a reception.

Members of the jury:

Prof. dr. Marc Elskens (chairman)
Prof. dr. Yue Gao (secretary)
Prof. dr. Wim Thiery
Prof. dr. Frank Dehairs
Prof. dr. Michel Crucifix (UCL)
Prof. dr. Wolfgang Müller (Goethe Univ. Frankfurt)
Prof. dr. Linda Ivany (Syracuse Univ., USA)

Curriculum vitae

Niels de Winter obtained his Master in Earth, Life and Climate in 2013 (Utrecht University). In 2014, he started his PhD research on reconstruction of fast climate change in the geological past at the AMGC research group.

As a result of this PhD research, nine articles were published in international peer-reviewed journals. Another four articles were submitted or are currently in review for publication. Furthermore, Niels supervised the analyses of trace elements using the AMGC's M4 microXRF scanner.

Abstract of the PhD research

Reconstructions of climate in the past teach us about climate variability during various periods in Earth's history. While many palaeoclimate studies have focused on climate reconstructions over long timescales (thousands to millions of years), the effect of climate change on short-term (years to decades) variability must be better understood to improve our models for future climate change. In order to obtain a more complete understanding of high-resolution climate variability during more extreme climates, we need to look at climate variability millions of years in the past (in deep time). The shells of bivalves and the enamel of fossil teeth are ideal candidates for this purpose. The research presented in this thesis takes a critical look at the potential of teeth and shells for preserving their original chemical composition in the fossil record, and how chemical proxies in these archives can be used as a proxy for climate.

In order to test chemical proxies in shells and teeth for climate reconstruction, multi-proxy studies were carried out on modern and fossil specimens. The combination of multiple proxies on the same archive allowed isolation of the effect of various climate parameters on chemical proxies in the archives. More importantly, such proxy comparison studies shed light on the link between climate, environment and chemical proxies in shells and teeth, such as trace element concentrations. The multi-proxy approach was applied on shells from different species of bivalve and vertebrate teeth to test whether links between proxy and environment are different between species. These studies allow the abundant fossils of extinct groups such as rudist bivalves to be used for high-resolution palaeoclimate research.

Several new techniques and measurement strategies for obtaining high-resolution climate data were developed within the scope of this research. The new microXRF technique was applied for screening carbonate samples for diagenetic alteration and for quantitative trace element profiling. State-of-the-art trace element and stable isotope measurements were combined in a multi-proxy approach to solve our questions about high-resolution climate change in the past.