SCIENCES & BIOENGINEERING SCIENCES

The Research Group

Analytical, Environmental and Geo- Chemistry

has the honour to invite you to the public defence of the PhD thesis of

Matthias SINNESAEL

to obtain the degree of Doctor of Sciences

Joint PhD with Ghent University

Title of the PhD thesis:

Astronomical cycle identification methods and their application to high-resolution Ordovician stratigraphy

Promotors:
Prof. Dr. Philippe Claeys (VUB)
Prof. Dr. Thijs R.A. Vandenbroucke (UGent)

The defense will take place on

Friday, June 12, 2020 at 16:00

You can find the link and instructions to attend the defense here[1].

1:https://masinnes.wixsite.com/matthiassinnesael/phd-public-defense-12-june-2020

Members of the jury

Prof. Dr. Steven Goderis (VUB, chairman)
Prof. Dr. Marc De Batist (UGent, secretary)
Prof. Dr. Bradley Cramer (The University of Iowa, USA)
Prof. Dr. Linda Hinnov (George Mason University, USA)
Prof. Dr. Klaudia Kuiper (VU Amsterdam, NL)

Curriculum vitae

Matthias Sinnesael (1991) completed his B.Sc. and M.Sc. in Geography at the Vrije Universiteit Brussel and KU Leuven. He studies the history of life and climate on Earth and is especially interested in the temporal dimensions of these changes.

Matthias supervised several students, published his work as (co-)author in multiple international peer-reviewed journals and book chapters, and has frequently presented his work at international conferences. His work was funded by a fellowship from the Research Foundation - Flanders (FWO).

Abstract of the PhD research

The state of the Earth's climate has changed in the past. These changes in climate often occurred on long time scales – thousands to even many millions of years. This is in contract with the current-day fast global warming which is caused by the human-induced increase of certain gases in the atmosphere (CO_2 or methane) which reinforce the greenhouse effect. Therefore, documenting the climate of the past is crucial to understand future climate changes and to better calibrate climate models.

We chose to study the Ordovician period (~485-444 million years ago) as it is particularly intriguing and contains crucial information on the processes behind rapid and brutal climate variability. The Ordovician period was characterized by CO_2 concentrations several times higher than today and the virtual lack of vegetation on the continents. The largest fraction of developed life was still living in the oceans. Most of the land masses were located south of the equator and a gigantic ocean occupied the Northern Hemisphere. Another fascinating feature of the Ordovician is the evolution of warm conditions towards an intense period of glaciations.

We focused on the role of astronomical cycles as a climate forcing during the Ordovician. The orbit and orientation of the Earth relative to the Sun vary continuously in a very regular way. This variation changes climate as it controls the distribution of solar energy on the Earth's surface through space and time. We used, and developed, different techniques to identify such cycles in the rock record. Because we studied very old rocks, we had to pay special care to how we approached this challenge. As a result, large parts of this thesis focus on methodological questions. How can we measure these astronomical cycles and test if they were really there?

This thesis explores ways of measuring the geochemical composition of rocks, how we can analyze those measured signals and what the reproducibility of these approaches is. We demonstrate that astronomically driven variations in solar irradiation are indeed traceable in Ordovician rocks. These findings result in a better insight into the causes, timing and duration of the Ordovician climatic events. Moreover, because of the very regular nature of theses cycles, we can construct very precise geological time scales which are unique so far back in time.