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

Bastien Soens

to obtain the degree of Doctor of Sciences

Joint PhD with Université Libre de Bruxelles

Title of the PhD thesis:

Petrographic and geochemical characterization of the micrometeorite collection from the Sør Rondane Mountains, Antarctica: Nature and origin of the extraterrestrial flux to Earth

Promotors:
Prof. dr. Steven Goderis (VUB)
Prof. dr. Vinciane Debaille (ULB)
Co-promotor:
Prof. dr. Philippe Claeys (VUB)

The defense will take place on

Friday, September 17, 2021 at 16h00

in **Auditorium QA** at the Campus Humanities, Sciences and Engineering of the Vrije Universiteit Brussel, Pleinlaan 2 - 1050 Elsene. Due to current regulations, only 50 people will be able to attend. Please contact Bastien (bastien.soens@vub.be) to confirm your presence. The defense can also be followed through livestream (link).

Members of the jury

Prof. dr. Yue Gao (VUB, chair)
Prof. dr. Nadine Mattielli (ULB, secretary)
Prof. dr. Luigi Folco (Università di Pisa, Italy)
Prof. dr. Birger Schmitz (Astrogeobiology Laboratory, Sweden)

Curriculum vitae

Bastien Soens (°1991) obtained a Master of Science in Geology at Ghent University in 2015. He subsequently embarked as a PhD student at the AMGC research group to study extraterrestrial dust particles from Antarctica.
During the course of this research, a total of 8 scientific articles were published in international peer reviewed journals. Three additional articles have already been prepared for publication. Bastien also supervised 5 Master students during their thesis research. His research was funded by the Research Foundation – Flanders.

Abstract of the PhD research

The Antarctic continent has traditionally been a successful searching ground for meteoritic material due to its cold and dry climate. Recently, a large collection of micrometeorites was discovered in sedimentary traps and from the Transantarctic Mountains, where extraterrestrial dust particles have accumulated for a prolonged time span (ca. 3–4 Ma). Micrometeorites (or 'cosmic dust') display unique chemical and isotopic signatures, which originate from a large and diverse amount of asteroidal and cometary bodies within the Solar System. They also document major events such as the origin and evolution of the Solar System. These sedimentary deposits consequently represent a valuable archive that documents the flux of extraterrestrial material to Earth and ancient meteoritic events over Antarctica.

Yet, much of this information is lost during the atmospheric entry stage, where cosmic dust is subjected to frictional heating and is molten down. This may significantly alter the original physicochemical and isotopic properties of extraterrestrial dust particles. A thorough understanding of these processes is thus required to reconstruct the atmospheric entry of cosmic dust and interpret their chemical and isotopic data. During the course of this PhD research, multiple sedimentary deposits from the Sør Rondane Mountains (SRM, East Antarctica) were petrographically examined and chemically-isotopically characterized using state-of-the-art instruments. Furthermore, various experiments and numerical models were constructed to replicate the atmospheric entry stage of meteoritic material.

This study has demonstrated that the SRM sedimentary deposits contain a rich and pristine variety of extraterrestrial materials, including micrometeorites, microtektites and meteoritic condensation spherules. Statistical analysis suggests that the SRM micrometeorite collection is representative of the contemporary flux of cosmic dust to Earth. Extraterrestrial material is subjected to a complex interplay of redox and volatilization processes during atmospheric entry heating, which allow to explain the chemical trends observed in micrometeorites. Isotopic studies also suggest that the micrometeorite population samples new, unknown types of asteroidal and/or cometary bodies. Microtektites and meteoritic condensation spherules have been linked to major meteoritic events on Earth ca. 790 ka and 430 ka ago, respectively, and underline the importance of the Earth's atmosphere during their formation. The results of this PhD research emphasize the scientific value of Antarctic sedimentary deposits and provide more insight into the processes taking place during the atmospheric entry of extraterrestrial material.