SCIENCES & BIOENGINEERING SCIENCES

The Research Group
Archaeology,Environmental Changes & Geo-Chemistry

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

Flore Van Maldeghem

to obtain the degree of Doctor of Sciences

Title of the PhD thesis:

Unraveling the Solar System: Tracing the cosmic dust flux to Earth using Polar Sediments

Promotors:
Prof. dr. Steven Goderis (VUB)
Prof. dr. Philippe Claeys (VUB)

The defence will take place on

Monday, February 26, 2024 at 16h in Auditorium I.002
The defence can also be followed through a live stream: http://tinyurl.com/znxs2v39

Members of the jury

Prof. dr. Marc Elskens (VUB, chair)
Prof. dr. Harry Zekollari (VUB, secretary)
Prof. dr. Martine Leermakers (VUB)
Prof. dr. Cécile Engrand (Université Paris-Saclay, France)
Prof. dr. Jérôme Gattacceca (Centre Européen de Recherche et d'Enseignement des Géosciences de l'Environnement, France)
Prof. dr. Philipp Heck (Field Museum of Natural History, USA)

Curriculum vitae

Flore Van Maldeghem obtained her BSc and MSc in Geology at Ghent University. In 2018, she started as a PhD researcher at the Vrije Universiteit Brussel to study micrometeorites from polar sediments using various analytical techniques. She has (co-)authored 9 international peer-reviewed articles of which 2 as first author (one is accepted with revisions) and has presented her work at multiple international conferences. During her PhD, Flore Van Maldeghem participated in one research expedition in Greenland and engaged in science communication for the public.

Abstract of the PhD research

Micrometeorites, tiny particles from space (10 – 2000 µm), constantly reach Earth and carry crucial information about the composition and origin of the Solar System. This PhD project mainly focused on micrometeorites found in sedimentary deposits in the Sør Rondane Mountains of Antarctica, applying state-of-the-art petrographic, chemical, and isotopic techniques. The resulting collection contains a wide variety of extraterrestrial materials, including cosmic spherules, scoriaceous and unmelted micrometeorites, microtektites, and meteoritic condensation spherules, the latter two providing important constraints on large- scale meteoritic events taking place at 790 and 430 ka ago. Based on a comparison with other well-characterized collections, the particles extracted from the Sør Rondane Mountains traps enhance our understanding of the flux of cosmic dust to the Earth.

Isotopic studies of oxygen and iron reveal that micrometeorites sample all meteorite parent bodies, but also represent unknown types of asteroidal (and possibly cometary) bodies. During three key stages, a range of processes modifies the primary nature of micrometeorites: on the parent body, during atmospheric entry, and during their terrestrial residence time. This PhD project documents the effects of these processes on the final petrographic and chemical characteristics of the recovered particles.

This PhD project also addresses the evolution of the extraterrestrial flux through time, with the aim of tracing dust-producing events in the Solar System. This is a challenging task, as most material that reaches the planet's surface weathers away quickly and is not preserved with time, demonstrating the need for resistant mineral proxies or chemical signatures that can be used to reconstruct the extraterrestrial flux through time. Chrome-spinel minerals are robust mineral proxies that withstand chemical and physical weathering. Characterizing chrome-spinel minerals in modern micrometeorites thus contributes to building a comprehensive database, which permits to confirm the value of this proxy to reconstruct the extraterrestrial flux through time.

In the final phase of the project, focus is placed on sedimentary traps from Greenland, initiating a novel method of collecting micrometeorites from the Arctic. Following a sampling methodology similar to that previously applied in Antarctica, these Greenlandic micrometeorites complement current micrometeorite collections and document the physicochemical parameters of these Arctic traps.

Overall, the results of this PhD project emphasize the value of micrometeorites to document both the present and past extraterrestrial flux to the Earth. The reported research enhances our knowledge on the dynamics of the Solar System and offers valuable contributions to the broader field of (micro)meteoritics.