BAMM!

Belgian Antarctic Meteorites and Micrometeorites to document solar system formation and evolution

Since 2009, joint Belgian-Japanese missions in Antarctica have recovered more than 1200 highly pristine meteorites and >2500 micrometeorites from the blue ice fields surrounding the Sør Rondane Mountains. This Antarctic project aimed at extending the Belgian meteorite patrimony and stimulating meteorite curation and research at federal institutes and universities in Belgium, initially supported by the former BELAM (2012-2016) and AMUNDSEN (2016-2022) BELSPO projects. It built on and expanded the assembled expertise, and centered on a number of highly promising, but previously unexplored research opportunities provided by this valuable set of newly recovered extraterrestrial samples.

Meteorites constitute the most primitive objects in the solar system and represent the building blocks of the terrestrial planets. Their petrographic, chemical and isotopic study sheds light on the evolution of planetary materials in the early solar system and documents planetary differentiation processes. However, as (micro)meteorites represent highly fragile material, optimal preservation conditions are needed to provide a reliable understanding of their formational history. Antarctic (micro)meteorites constitute an enormous volume of extraterrestrial material that was preserved under excellent conditions thanks to a dry and cold climate, but may be lost in the future following the current climate change.

The objectives of the BAMM! project were to further constrain our understanding of the formation and evolution of solar system materials, investigating the meteorites and micrometeorites recently collected in the Sør Rondane Mountains of Antarctica, through two complementary approaches that converge by implementing state-of-the-art in situ isotopic analysis:

(1) A detailed study of micrometeorites and their igneous textures has been performed to better document their parent body precursors (possibly not sampled by larger meteorites), quantify the continuum between unmelted and fully molten objects, and further constrain the effects of rapid melting, melt extraction and silicate-metal segregation on the petrological, chemical and isotopic characteristics of the precursor materials. One of the main focuses of this project has been to fully characterize a peculiar group of micrometeorites that, based on oxygen isotopes, does not appear to be represented among macroscopic meteorites.

(2) A precise characterization of the isotope anomalies existing in bulk meteorite samples, and their counterparts in the constituent mineralogical phases measured by in situ mass spectrometry to better understand the presence and destruction of nucleosynthetic anomaly carrier phases during nebular and planetary processes.

Another goal of the BAMM! project has been to further expand the Belgian Antarctic meteorite collection. As such, it encouraged a reliable, long-term protective curation program of Antarctic meteorites at the RBINS, which is now a key Antarctic (micro)meteorite curation center in Europe. Efforts were also made to disseminate the scientific results broadly, also towards a broad – non-scientific – audience.

Overall, the Sør Rondane Mountains deposits studied during the BAMM! project represent a rich, representative micrometeorite collection from East Antarctica that significantly contributed to better understand planetary differentiation processes. The scientific results have been valorized in a series of important manuscripts, including top journals (including *Science Advances, Nature Astronomy, Geoscience Frontiers*).

The position of the RBINS as an internationally recognized meteorite curation center and expert in meteorite classification and studies has been consolidated during the BAMM! project, as testified by meteorite classification, exhibition and the new samples that entered the collection.

The BAMM! project emphasizes the importance of studies led on meteorites and micrometeorites to bring crucial information about planetary evolution. The continuation of the successful Antarctic program for collecting extraterrestrial material is of capital importance for the recovery of new material, the study of which ensuring the continuation of successful (micro)meteorite research at the national and international level.

Keywords

Antarctica, meteorites, micrometeorites, isotope anomalies, curation