The Meteoritical Society

Meteoritics & Planetary Science 1–2 (2023)
doi: 10.1111/maps.14037

Award

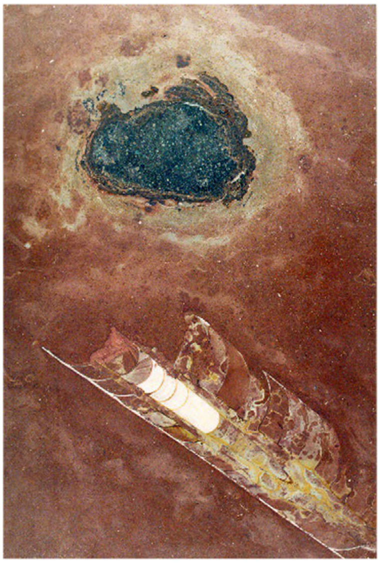
2023 Barringer Medal for Birger Schmitz

Birger Schmitz has changed the way we think about how collisions in the asteroid belt can affect our planet. Unlike "classical" terrestrial impact research, which mostly studies direct effects of large impacts on Earth, Birger's main focus is on small to tiny samples in terrestrial sediments deriving from large collisions in the asteroid belt, and inferring their consequences for Earth. He aptly describes his philosophy as "to link the history of the Earth and its life to the astronomical realm". By establishing his unique Astrogeobiology Laboratory at Lund University, he created the field of paleometeoritics, allowing him to systematically study material that arrived on Earth much earlier than the oldest known meteorite falls recovered from Antarctic ice or old desert surfaces. It is mainly extraterrestrial spinels, dispersed in tiny amounts in sediments or preserved as relics in otherwise highly altered fossil meteorites, that tell this fascinating story.

Birger became inspired during his postdoctoral stage in the group of Luis Alvarez at Lawrence Berkeley National Laboratory, while his later scientific life was largely shaped by the unique treasure trove of by now more than 130 fossil meteorites recovered from a quarry in Sweden, followed by the discovery of abundant fossilized micrometeorites in several coeval Ordovician sediment layers around the world. These samples were classified as L chondritic and provided the unequivocal link between a major asteroid collision—the break-up of an L chondrite parent body—and a well-known resetting of the Ar-Ar clock in many L chondrites, precisely dated by the Heidelberg group at 470 million years ago, coinciding with the ages of the sediments in the quarry. To realize the full scientific potential of the fossil meteorites—and to convince the community that they are far more than just a nice but rather exotic research object—required enormous efforts. This included the separation of the rare extraterrestrial chromite grains out of sometimes hundreds of kg sediment, first by dissolving the latter in strong acids, followed by painstaking searches under a binocular microscope. The latter kept Birger busy during many late evening sessions, accompanied by his favorite opera recordings. Equally important, Birger's charisma and dedication have enabled him to forge a multitude of close collaborations with colleagues and friends around the world, of which the three of us are proud to be a part.

While the fossil meteorites provided a clear link to the break-up of the L chondrite parent body, it was the abundant micrometeoritic chromites and chrome-spinels found in coeval sediments in Sweden, Russia, and China that provided the ultimate evidence that this collision in the asteroid belt resulted in a global rain of extraterrestrial matter on Earth, exceeding the current flux by perhaps two orders of magnitude, while still accounting for a significant fraction of present-day meteorite falls. Surprisingly, the cosmic-ray exposure ages of the chromites from the fossil meteorites are very low for meteorite standards, providing direct confirmation of celestial mechanics simulations predicting that the orbits of bodies in the asteroid belt in resonance with the orbits of Jupiter or Saturn can become chaotic and Earth-crossing on a sub-million-year scale.

How could the break-up of the L chondrite parent body, and possibly other large extraterrestrial impacts, have affected the climate and life on Earth? This is one of the central questions in Birger Schmitz's current research agenda. He and his collaborators have shown that the onset of the Great Ordovician Biodiversification Event (GOBE), the most intense ~20 Ma phase of species radiation during the Paleozoic, coincided with the L chondrite parent break-up and also with a known increase in the formation rate of terrestrial impact craters in the mid-to-late Ordovician. This led to the suggestion that the frequent impacts of kilometer-sized asteroids accelerated the biodiversification process. In his latest work, however, Birger and colleagues suggest that the GOBE may have been triggered not by the large impacts themselves, but by the greatly increased amounts of fine dust in the inner solar system and the stratosphere caused by the L chondrite parent break-up and secondary collisions. This dust would have been the cause of the Ordovician Ice Age, which has been well studied for example in Baltoscandia. Schmitz and coworkers show that the break-up coincides with a major eustatic sea-level fall, also previously attributed to the Ordovician Ice Age, and suggest that the sea-level fall, ultimately caused by the high dust concentration in the inner solar system, is the direct trigger for the increase in biodiversity. Birger emphasizes that further scrutiny is required to test this hypothesis, calling, for example, for detailed climate



A fossilized meteorite (6 × 4 cm) next to a nautiloid shell. This is one of more than 100 fossil meteorites recovered from the Thorsberg quarry in southern Sweden, testifying of the L chondrite parent body break-up some 470 Ma ago.

Birger Schmitz at a regional outcrop of the Swedish micrometeorite-bearing mid-Ordovician marine limestone beds in the vicinity of the Thorsberg quarry. He is pointing to the gray (brighter) limestone bed that was deposited in shallower water than the red (darker) limestone. The visible layers represent a time window of more than one million years.

modeling and careful stratigraphic studies. Regardless of the details, however, the coincidence of the great collision in the asteroid belt, reflected in the terrestrial fossil meteorite, micrometeorite, and cosmic dust record with the onset of increased biodiversification in the mid-Ordovician is well worth further investigation. But Birger's interests do not stop at the Ordovician: as of the time of this writing, he has found and classified extraterrestrial chrome-spinels in sedimentary rocks from 15 time window throughout the Phanerozoic. A major finding was that ordinary chondrites always dominated in the large size fraction from coarse micrometeorites to asteroids, except for one time window. He uses a comprehensive approach to studying how the delivery of extraterrestrial material to Earth has changed over time and whether this may have influenced Earth's climate and biodiversity, considering cosmic dust, micrometeorites, meteorites, and even asteroids. There is no question that Birger Schmitz will continue on this path, also by studying other climatically relevant epochs, such as the late Eocene and the Permian–Triassic boundary.

Anyone who knows Birger and has the good fortune to work with him will agree that his enthusiasm, his breath and depth of knowledge, and his combination of vigorously defending his ideas while willingly accepting different views are what continually drive his ambitious and unique research program. He is more than happy to share the credit for his groundbreaking contributions with his colleagues, including the late self-taught geologist Mario Tassinari, who received an honorary doctorate degree from Lund University. It is certainly also notable that—thanks to Birger, Mario, and the Thor family operating the quarry—the fossil meteorites generously were made available to science. It is our great pleasure to congratulate Birger Schmitz on winning the Meteoritical Society's Barringer Medal and Award.

Rainer Wieler[1]* , Philipp R. Heck[2,3], and Matthias M. M. Meier[4]
[1]Earth Sciences, ETH Zürich, Zürich, Switzerland,
[2]Robert A. Pritzker Center for Meteoritics and Polar Studies, Negaunee Integrative Research Center, Field Museum of Natural History, Chicago, Illinois, USA,
[3]Department of the Geophysical Sciences, University of Chicago, Chicago, Illinois, USA, [4]Naturmuseum St. Gallen, St. Gallen, Switzerland
*Email: wieler@erdw.ethz.ch