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Asteroid dust found within the dinosaur-killing crater

An international team of researchers, including four scientists from the Natural History Museum Vienna and the University of Vienna, report on the discovery of meteorite dust in drill core samples from the Chicxulub impact crater (Mexico).
This finding is the final piece of the puzzle following the discovery of a meteoritic component in rocks from the Cretaceous-Paleogene boundary about 40 years ago, which led to the conclusion that the mass extinction was caused by an asteroid impact.

Sixty-six million years ago, a catastrophic mass extinction entirely reshaped life on Earth. More than two thirds of all the species living at that time became extinct, among them the dinosaurs, or the ammonites. The mammals survived the mass extinction and the disappearance of the dinosaurs left a number of ecological niches empty. There were many hypotheses to explain this mass extinction at the end of the Cretaceous.

The first concrete evidence for an explanation was found in the late 1970s in sediment layers near Gubbio in Italy and Caravaca in Spain, where a very thin clay layer represents the boundary between the Cretaceous and the Paleogene Periods.
About 40 years ago, unusually high concentrations of iridium and other so-called Platinum Group Metals were found in these "clay layers" – rare metals that occur in relatively high concentrations in meteorites but in very low concentrations on the surface of the Earth. This clay layer was explained as having formed from dust that was produced by the impact and vaporization of an asteroid, about 12 km in size. This finding was later strengthened in the early 1990s by the discovery of the about 200 km sized Chicxulub impact crater, buried underneath the Yucatán Peninsula in Mexico.

Now, more than 40 years later, scientists have uncovered the final piece of evidence that ties the global mass extinction to the asteroid impact. An international team of researchers led by a scientist from the Vrije Universiteit Brussel (Belgium), in collaboration with researchers from Vienna, have traced back the global asteroid dust layer to within the Chicxulub impact crater. “The circle is now finally complete”, comments Steven Goderis, a geochemistry professor at the Vrije Universiteit Brussel and lead author of the study.

In May 2016, a discontinuous ring of hills that surrounds the center of the Chicxulub impact structure in Mexico, called a peak ring, was drilled by a science team from the International Ocean Discovery Program (IODP) and the International Continental Scientific Drilling Program (ICDP) Expedition 364. Dr. Ludovic Ferrière, curator of the meteorite and impactite collections at the Natural History Museum Vienna was part of the team of scientists who drilled and described the recovered core samples.

Approximately 835 meters of rock were brought to the surface, which have provided a tremendous amount of new information on the processes that occurred in the crater region before, during, and right after the asteroid impact event. The great detail of the time interval when the crater transitioned from a dynamic environment with returning ocean water and tsunami waves to much quieter conditions is nicely recorded in the drill core. Based on an extensive geochemical analysis of this part of the drill core, the highest concentrations of iridium were found in a clay-rich interval in sediments that cover the crater peak ring, just below limestone from the earliest Paleogene.

“The finding of the iridium anomaly at the “crime scene”, the Chicxulub impact crater in Mexico, may seem anecdotic and far away – in distance and time – for most Austrians, however, the thin clay layer marking this global mass extinction also occur in Austria, namely in the region of Gams (Styria). Back then, shocked, melted and condensed material ejected from the crater was deposited in what is now Austria.” explains Ludovic Ferrière.

Since iridium is an element that is quite difficult to measure in this context due to its low concentrations, the new study combined results from four independent laboratories from around the world. Geochemists from the University of Vienna were involved, with, in addition to Christian Köberl, Dr. Toni Schulz and PhD student Jean-Guillaume Feignon. Not only the concentration of the rare element iridium, but also the contents of the other Platinum Group Metals, as well as the isotope ratios of the even rarer metal osmium, which are characteristic of meteoritic contamination, were investigated in Vienna.

"Our measurements clearly show that a layer containing iridium and other Platinum Group Metals is preserved within the crater," explains Christian Köberl. "This meteoritic dust persisted in the atmosphere for many years after the impact, and only fell back into the crater several decades after the impact event." Therefore, the atmospheric settling of this asteroid dust places important time constraints on the deposition of the crater rocks just below this iridium layer.

The preservation of the iridium layer within the crater constitutes the indisputable evidence that the impact and the extinction are closely linked. The detection of such well-defined iridium anomaly within the Chicxulub crater will undoubtedly also revitalize research on the Cretaceous-Paleogene mass extinction.

The following Universities and institutes have been involved in the study: Vrije Universiteit Brussel, University of Padova, Japan Agency for Marine-Earth Science and Technology, Natural History Museum Vienna, Lund University, University of Notre Dame, Université Libre de Bruxelles, Katholieke Universiteit Leuven, Arizona State University, University of Vienna, Universität zu Köln, Ghent University, Utrecht University, Tokyo Institute of Technology, Florida State University, HNU Neu-Ulm University of Applied Sciences, Lunar and Planetary Institute, Durham University, Pennsylvania State University, University of Texas at Austin, Imperial College London, Vrije Universiteit Amsterdam, and University of Alaska Fairbanks.

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