Cretaceous extinctions: The strikes add up

Ever since geologists identified a huge crater buried beneath the Yucatán Peninsula two years ago, growing numbers of researchers have accepted the idea that a huge asteroid crashed there 65 million years ago, killing off a large fraction of Earth's existing life, including the last surviving dinosaurs. New evidence indicates a second object splashed into the Pacific Ocean at nearly the same time, magnifying the catastrophe that marks the boundary between Earth's Cretaceous (K) and Tertiary (T) periods.

As if two strikes were not enough, a separate research report suggests that the impacts sparked planet-wide blazes that burned perhaps a quarter of all vegetation on the continents.

Eric Robin and his colleagues from the Centre des Faibles Radioactivités in Gif-sur-Yvette, France, concluded that an asteroid hit the Pacific after they analyzed tiny particles found in seafloor sediments collected in the northwestern part of that ocean. Dating from the time of the K-T boundary, the millimeter-wide grains sorted into two types: rounded "spherules" similar to those found elsewhere around the world, and unusual irregularly shaped fragments.

Robin thinks both types came from the same source, but the irregular grains are particularly important because they appear to be ancient versions of the mini-meteorites that continually rain down on Earth's surface. The spherules and irregular fragments also contain high concentrations of iridium, an element rare in Earth's crust but concentrated within meteorites and comets, Robin and his colleagues report in the June 17 NATURE.

Because the K-T boundary sediments in the Pacific contain vast numbers of these particles, the researchers say the deposit could not have formed from the normally slow buildup of micrometeorites. They suggest the ancient grains must have formed when a large object hit Earth at the K-T time, breaking up into a spray of molten and partly molten drops that cooled as they fell into the ocean.

The particles could not have come from the Yucatán impact, however, because the irregular fragments have a delicate structure that could not have survived the force required to loft them from the Gulf of Mexico to the far Pacific, says Robin. He suggests the fragments and spherules came from a closer crash in deep water, which would have allowed meteorite material to survive the impact. A strike in the Pacific would also explain why K-T spherules found in that ocean have a distinctive composition.

"In the Pacific, in the Caribbean, and in Europe there are [particles] with very different compositions. So you have to explain all these particles. With a single impact, it's rather difficult. With multiple objects, it's easy," Robin says.

Judging from the distribution of spherules in the Pacific, he and his colleagues estimate the impacting body had a diameter of 2 kilometers. Researchers have estimated that the body responsible for the main K-T impact must have measured at least 10 kilometers across, which is large enough to have carved out the 180-kilometer-wide Yucatán structure, named the Chicxulub crater.

A 35-kilometer-wide crater in Iowa also dates from the time of the K-T boundary, suggesting an extraterrestrial object hit there as well. Earlier this year, researchers proposed that a series of comets could have caused the multiple impacts (SN: 4/3/93, p.212).

Jan Smit of the Free University of Amsterdam, who has studied spherules from the K-T time, says Robin's group "has something good by the tail, but it's too early to say whether they are right or wrong." Contrary to Robin's assertions, it may be that such particles formed during the Chicxulub crash could have survived the trip to the Pacific, Smit says.

Researchers have theorized that a large impact would have spawned a range of catastrophic consequences, including prolonged darkness, global warming, and extremely acidic rainfall. Some evidence collected in recent years suggests global wildfires also followed the impact. In the June GEOLOGY, Linda C. Ivany and Ross J. Salawitch of Harvard University report finding hints of such massive conflagrations recorded in seafloor sediments from around the world.

The two researchers investigated the shells of one-celled organisms that contain information about the relative abundance of two carbon isotopes – one light and one heavy – in the ocean. Scientists have long known that the balance of the two isotopes shifted dramatically at the K-T boundary time, indicating that nearly all plankton died out in the top layer of the ocean. But Ivany and Salawitch say that event can account for only part of the isotope shift. To explain the rest, they propose that wildfires burned 25 percent of the vegetation on land, filling the air with isotopically light carbon that dissolved into the ocean. *– R. Monastersky*

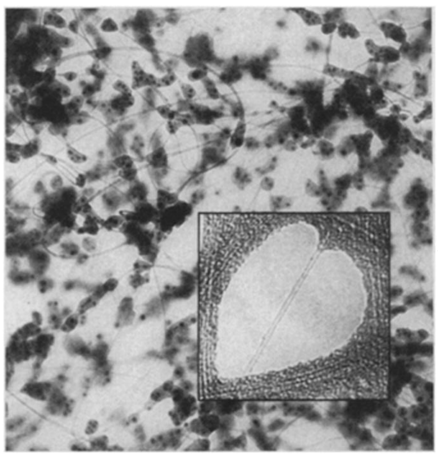
Getting down to the basics with buckytubes

Ever since chemists discovered buckytubes (SN: 11/16/91, p. 310), they've speculated that these hollow, nanometer-size carbon cylinders – related to the spherical buckyball – could prove the strongest fibers known and may also make good wires for molecular-scale electrical devices.

Scientists should soon have the materials to test those predictions. Two research groups report in the June 17 NATURE that they can make uniform batches of single-layer buckytubes. The ability to make this most basic of buckytubes will help chemists better understand the material's mechanical and electronic properties.

Previously, large-scale synthesis methods produced different sizes of buckytubes, often with several nested inside one another like Russian dolls (SN: 7/18/92, p.36). Such variability made it difficult for chemists to study these molecules. Researchers have explored the chemistry of single-shell buckytubes using computer simulations (SN: 11/14/92, p.327).

Now, a team of scientists at IBM's Almaden Research Center in San Jose, Calif., has made the real thing – although they were attempting to make metal-stuffed buckyballs. The group used the standard carbon arc technique for synthesizing buckminsterfullerenes, but added various powdered metals to one of the graphite electrodes. When they added cobalt, an unusual spider-web-like material grew all over the chamber, says IBM's Donald S. Bethune. A transmission electron microscope revealed that the rubbery material consisted largely of interwoven buckytubes, all about 1.2 nanometers in diameter and with walls a single atomic layer thick.



Robert Beyers, IBM Research/NATURE

Electron micrograph of web-like material shows bundles of tubes and cobalt clusters (dark spots) embedded in soot containing fullerenes and amorphous carbon. Inset: A single-layer buckytube passes through a heart-shaped space.

"There may be a magic-sized cobalt cluster that specifically triggers the growth of these tubes," Bethune posits.

Sumio Iijima and Toshinari Ichihashi of NEC Corp. in Tsukuba, Japan, also grew single-layer buckytubes in a carbon arc reactor, but iron served as the catalyst. They added methane and argon gases to the chamber, which proved essential to their synthesis, they report in NATURE.
– K. F. Schmidt