Giant Crater Linked to Mass Extinction

Earth scientists have moved within one step of gaining a conviction in nature's grandest murder case: the mass extinction that closed the age of the dinosaurs 65 million years ago. Researchers have determined that a large crater-like structure in Mexico dates from this exact time, all but sealing the case that a mammoth meteorite or comet slammed into Earth and wreaked havoc at the boundary between Earth's Cretaceous (K) and Tertiary (T) periods.

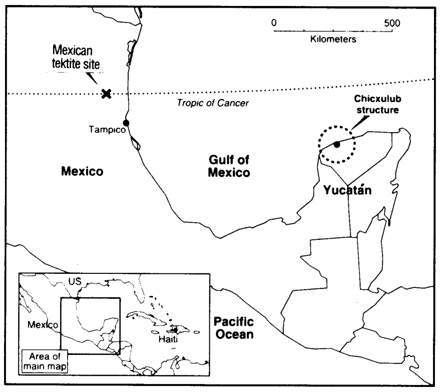
"This lets us go on to a new phase in the whole program of research," says Walter Alvarez, a geologist at the University of California, Berkeley, who participated in the new study and was part of the team that originally proposed the idea of an impact at the K-T boundary. "It should allow us to stop arguing about whether there was or was not an impact at precisely the time of the extinctions. This essentially ties that down."

Since the late 1970s, geologists have found numerous signs of an extraterrestrial impact at the K-T boundary, but until recently they had failed to locate the most important clue: a large crater of the right age. In the last two years, investigators have focused on a buried circular feature in northern Yucatán, under the town of Chicxulub (SN: 1/25/92, p.56). With a diameter of 180 kilometers, the proposed crater is the largest known on Earth. But questionable sedimentary evidence suggested that the structure was too old.

In the Aug. 14 SCIENCE, geochronologist Carl C. Swisher III of the Institute of Human Origins in Berkeley, Calif., and his colleagues report that rocks from inside the Chicxulub circle formed exactly 65 million years ago and are the same age as impact debris found around the Caribbean/Gulf of Mexico region. To date the rocks, Swisher's group used a radiometric technique that relies on the radioactive decay of potassium-40 to argon-40 over millions of years.

Swisher and his co-workers dated rock samples collected in the 1950s when PEMEX, the Mexican national oil company, drilled into the Chicxulub structure, which lies beneath a kilometer of sedimentary rock. Because a warehouse fire years ago destroyed much of the rock collected from that drilling project, most U.S. researchers thought it would be impossible to find a sample suitable for radiometric dating. But several Mexican scientists had saved pieces of the core.

Like a central piece in a puzzle, the date for Chicxulub pulls together many disparate clues in the K-T mystery. Geologists have found several signs that the K-T crash occurred in the Caribbean/Gulf of Mexico region. In particular, researchers



in that area recently found glassy tektite rocks, formed when melted rock is sprayed into the air and then quenched as it falls. When Swisher dated tektites from Haiti and the Mexican mainland, he discovered that their age was identical to that of rocks from the Chicxulub structure. Along with previous work that shows similarities in chemical composition, the new dating study strongly supports the idea that an impact at Chicxulub created the Mexican and Haitian tektites, Swisher and his colleagues say.

Before they truly claim a conviction, researchers must resolve why sedimentary records collected by PEMEX indicate the Chicxulub structure is older than K-T age, says Gerta Keller, a paleontologist at Princeton (N.J.) University. They must also confirm the widespread suspicion that the buried circle is indeed a crater. A drilling project can answer both of those questions.

Geoscientists can then start examining how the Chicxulub crash affected life around the globe. While impact supporters believe that cataclysm can explain the entire extinction story, others believe the impact was only one of many disasters that befell life at the time, wiping out many species in addition to the last remaining dinosaurs (SN: 2/1/92, p.72). The list of remaining suspects includes climate change, a drop in global sea levels, massive volcanic eruptions, and other impacts. Geoscientists are currently drilling into a small impact crater in Iowa to determine whether it also formed precisely at the K-T boundary. Other candidate craters exist in Alaska and Siberia. *—R. Monastersky*

Electric antimatter: Checking the charge

The skeptical, inquiring physicist takes nothing for granted. Consider, for example, the fundamental notion that electrical charge comes in packages of only a certain size and the complementary idea that the electron and proton have equal but opposite charges.

These notions date back to the beginning of the century. However, according to a suggestion made by Albert Einstein in 1924, a slight difference in the charges carried by the electron and proton could account for the existence of the magnetic fields of the sun and Earth. Other theorists have suggested that even a difference as small as one part in 10^{20} could account for the expansion of the universe.

Such considerations led to a number of experimental tests, which established to very high precision that the electron and proton charges are equal. Physicists have long assumed that the same equality holds between the electron and positron (the electron's positively charged, antimatter counterpart) and between the proton and antiproton.

In the July 27 PHYSICAL REVIEW LETTERS, two researchers provide the first indication based on experimental data that this assumption is justified.

"We realized that there had never been any experiments to test that the quantum of charge on either the positron or antiproton is the same as the quantum of charge carried by the electron or proton. Nobody had questioned this at all," says Richard J. Hughes of the Los Alamos (N.M.) National Laboratory, who coauthored the new report with B.I. Deutch of the University of Aarhus in Denmark.

To rectify this long-standing oversight, Hughes and Deutch studied existing experimental data and found a way to combine the results from two different types of experiments to provide a direct, independent measure of the ratios of the electron-positron and proton-antiproton charges.

"Our results . . . represent the first tests of charge quantization for the positron and antiproton, which, with the available experimental results, are at a much lower precision than the tests for electrons, protons, and neutrons," the researchers write.

Efforts to improve the precision hinge on planned experiments involving antihydrogen, which consists of a positron and an antiproton. "Although antihydrogen has not yet been produced in the laboratory, plans to do so and to perform precision spectroscopic measurements on it exist," Hughes and Deutch note.

"This is the kind of consistency check we need to do to answer how it is that we know certain things, such as conservation of charge in reactions," Hughes says. *—I. Peterson*