SCIENCE NEWS of the week

Rare Amino Acids Support Impact Theory

For a decade, geologists and paleontologists have debated whether comet or meteorite impacts 65 million years ago wiped out a large fraction of existing species, including the last surviving dinosaurs. A rival theory holds that terrestrial processes such as volcanic eruptions caused the mass extinctions of that time, known as the Cretaceous-Tertiary (K-T) boundary. This week, scientists reported a startling new piece of impact evidence from the boundary — extraterrestrial amino acids.

"The fact that we detect these amino acids, I think, makes the impact hypothesis really solid," says chemist Jeffrey L. Bada of the Scripps Institution of Oceanography in La Jolla, Calif.

Amino acids are best known because they link together in chains to form proteins in living cells. But these molecules also appear in certain kinds of meteorites. Bada examined a section of the K-T boundary from Denmark in an effort to identify two of the most common meteoritic amino acids, isovaline and alpha-aminoisobutyric acid. These forms are extremely rare on Earth.

With high-performance liquid chromatography and gas chromatography/mass spectrometry, Bada and student Meixun Zhao found that the Denmark section contained significant amounts of the two amino acids. Trying to detect the equivalent of a single gram of amino acid in more than a ton of rock, the researchers spent five years performing and rechecking the analysis, which they describe in the June 8 NATURE.

While the rarity of these amino acids indicates an extraterrestrial origin, another finding provides even stronger evidence, says Stanley L. Miller of the University of California, San Diego. Bada and Zhao found equal amounts of two isovaline configurations in the Denmark section. The rare terrestrial fungus that produces isovaline only makes one configuration, Miller says.

Other researchers call these results convincing, noting the careful analytical techniques used. "There seems little room for doubt that Zhao and Bada have correctly identified these amino acids," says chemist John R. Cronin of Arizona State University in Tempe.

Yet Cronin says the findings raise several significant questions. He and others wonder how the amino acids survived so well through the heat of the impact and their exposure to the atmosphere after settling to the ground. "That is very surprising," he notes.

The location of the amino acids in the section also perplexes Zhao and Bada. They found the molecules tens of centimeters above and below the clay layer that marks the K-T boundary in Denmark. But virtually none appeared within the clay itself.

The K-T clay contains enriched levels of elements such as iridium that are extremely rare in Earth's crust but are much more abundant in meteorites and comets. Scientists think the layer contains fine particles lofted into the air from an impact or volcanic eruptions. Theoretically, if an impact occurred, extraterrestrial amino acids should also appear in that layer. To explain the absence of these molecules, Bada suggests they originally sat in the layer but later migrated into the surrounding carbonate rocks. He is now analyzing other K-T boundary sections from different locales.

Bada cautions that the amino acids say little about how the impact affected life on Earth. Many paleontologists admit that an impact occurred but maintain that more gradual processes, such as climate change, caused the extinctions, some of which seem to be spread out over millions of years.

"What the amino acids tell us," says Bada, "is we don't know as much as we think we do about that event as far as what object hit and what processes occurred during impact." — *R. Monastersky*

Sperm capture genes to create new life

A new kind of biological fusion has taken place in an Italian research lab. Scientists there have discovered that sperm cells can take up foreign DNA molecules, and they report using these sperm to create genetically altered mice. If confirmed, the finding may give researchers a more rapid technique for creating "transgenic" animals that carry foreign genes, says embryologist Jan W. Abramczuk of the National Institute of Dental Research in Bethesda, Md. The research also suggests that the evolutionary process may capitalize on this property of sperm to allow the transfer of genes between species, say the Italian scientists in the June 2 CELL.

"If [the new work] can be reproduced, this will be a very important technique," comments W. French Anderson of the National Heart, Lung, and Blood Institute in Bethesda. At present, the primary method used to create transgenic animals — which are used in disease research and to improve livestock — involves microinjecting DNA into embryos. This requires great skill, expensive equipment and a lot of time, Anderson notes.

The finding that sperm cells take up DNA surprised scientists because DNA uptake in other body cells requires harsher chemical conditions than those used in the Italian study. And sperm cells would seem even more impenetrable than other cells in light of their tightly packed genome and the additional membrane the foreign DNA must cross to reach the nucleus, says Jon W. Gordon of Mount Sinai School of Medicine in New York City.

The researchers, led by Corrado Spadafora of the Institute of Biomedical Technology in Rome, incubated mouse sperm with DNA carrying a gene for a bacterial enzyme called chloramphenicol acetyl transferase (CAT). After half an hour, they counted up to 4,000 DNA particles associated with each sperm cell. It is not clear how far the DNA penetrated each sperm or whether it was incorporated into the sperm's genome.

Spadafora and his colleagues then fertilized mouse eggs with DNA-incubated sperm and transferred the eggs to mice serving as surrogate mothers. Screening 250 progeny, the researchers found that about 30 percent carried the foreign DNA — a success rate slightly above the maximum attained with the microinjection method, they say. They also discovered that mice in the next generation inherited the gene in the expected Mendelian fashion and that certain cells of a sample of transgenic mice contained working CAT enzymes.

Sperm's ability to take up DNA is not unique to mice; the researchers report similar findings using frog and sea urchin sperm. But "the evolutionary importance of this process will remain elusive as long as there is no clear-cut example of a transferred gene that confers a selective advantage to the recipient organism," write Max L. Birnstiel and Meinrad Busslinger of Austria's Research Institute of Molecular Pathology in an accompanying editorial.

Abramczuk says he initially read the Italians' findings with disbelief, noting in particular that the incubation medium contained DNA-degrading enzymes, which should have prevented DNA uptake. He then reproduced the conditions in his own lab and found that the sperm somehow deactivated the enzymes. "As incredible as it may seem, I cannot reject the [Italian researchers'] claim," he says. — *I. Wickelgren*