Clock in the rock: Scientists measure Earth's history

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The mass extinction of dinosaurs occurred about 66 million years ago, at the end of the Cretaceous Period (K) and the beginning of the Tertiary Period, known as the K-T boundary. A massive asteroid slammed into what is now the Gulf of Mexico about that time.

"About" is the key word here. The correlation is close, but not close enough for Samuel A. Bowring, a professor of geology in MIT's Department of Earth, Atmospheric and Planetary Sciences.

"With the K-T boundary and the death of the dinosaurs, everyone is happy with it being caused by an impact. To me, that's a reason not to be happy," said Bowring.

Bowring thinks there is a correlation between the two events. But he firmly believes that it may be possible to more precisely date the sequence of events before, during and after the extinction.

"There are questions that need to be addressed that are preserved in the rock record -- questions about rates of evolution, and sudden climate change in the past." The challenge, he said, is in making accurate time scales.

In 2003 Bowring launched the Earthtime initiative to bring together scientists from all over the world to work together to calibrate and sequence Earth history through the integration of high-precision geochronology and quantitative chronostratigraphy.

Now, Earthtime (www.earth-time.org) has more than 200 members, hailing from a variety of disciplines. "It's creating a lot of new interactions that weren't there before, paleontologists talking to geochronologists," Bowring said. "It brings together evolutionary biology, developmental biology, paleontology, oceanography."

Earthtime's official goal is to bring dating accuracy to better than 0.1 percent. That means in dating a 250-million-year-old fossil, results would be plus or minus 250,000 years. Bowring thinks it is possible to improve precision to 0.05 percent.

Earthtime utilizes two main dating techniques, which are applied to the volcanic ash layers that contain rock fossil records. One technique measures the clocklike decay of uranium to lead inside zircon crystals, which are frequently found in volcanic ash beds. Another measures the amount of argon gas produced in minerals like feldspar by the decay of potassium. The two methods produce slightly different results, but with correct correlation and using data from fossil record from all over the world, they are helping to generate a more accurate time scale.

"We are working on the age of the K-T boundary right now using zircon and we think we can constrain it to within about 50,000 years," Bowring said.

Other issues that a more precise Earth time scale could address include the mystery behind a massive extinction about 252 million years ago at the end of the Permian period, in which 90 percent of all sea life became extinct. The cause might be a gigantic outpouring of lava from volcanoes in Siberia, the so-called Siberian Traps, which occurred about 251 to 252 million years ago. But what if the eruption occurred after the extinction began? "We have the time of the extinction very well constrained but we don't have the time of the Siberian Traps very well constrained," Bowring said.

Another mystery is what caused the Cambrian explosion, a huge proliferation of life about 530 million years ago; every order and class of animals we see today appears in the fossil record in a relatively short time.

Was this a "record of sudden appearance or a record of sudden preservation, because it is also when animals developed hard parts?" Bowring asked.

Indeed, in a conversation with Bowring, the earth seems to be a giant yo-yo, with climate, temperatures and geography changing drastically over the eons. Such fluctuations have significant implications for the current rise in planetary temperature, he noted.

"If you can move past the last million years and start looking deeper in time -- looking at these huge fluctuations in climate, what caused them and how we came out of them -- that will certainly be very beneficial for understanding what is happening to us now," he said.

Dealing with mind-boggling units of time has made Bowring regard humanity's period on our planet as little more than a blip.

"I do think a lot about how inconsequential humans are in the big scheme of things," he said. "We have not yet even proved we're a viable species compared to dinosaurs, for example. Dinosaurs were around from 230 million years ago to 66 million years ago. That's a long time. They were very successful. Humans have been around for maybe a million years. It doesn't look like we're going to have that long of a legacy but we'll see."

Source: MIT