New evidence for big die-off

Offshore Australian site could be result of asteroid impact, scientists say

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It's been called the worst day ever on Earth: Around 250 million years ago, in a geologic blink of an eye, more than half of all species on land and 90 percent of species in the sea perished.

For such a great dying — a time when life itself nearly went extinct — you'd think scientists might know what did it. But you'd be wrong. There are plenty of suspects for what caused the extinction, but so far no convictions.

This month, scientists reported circumstantial evidence that pushed one possible culprit to the front of the lineup: an impact from outer space.

A geologic structure buried off the northwestern coast of Australia, the researchers say, is the scar left by a giant space rock that slammed into the Earth. The impact would have kicked up dust that encircled the globe, causing worldwide climate changes and killing off most animals.

If confirmed, the Australian crater would be a much-older counterpart to a crater named Chicxulub, which lies underwater off the Mexican coast. Chicxulub, most scientists think, marks the spot where an asteroid hit 65 million years ago, killing off the dinosaurs in another great "mass extinction."

But many scientists — even some who helped link Chicxulub with the dinosaur die-off — are skeptical of the proposed Australian crater. And the report, published online in the journal Science, has inflamed a long-simmering debate over how to recognize impact craters and whether to link them with mass extinctions.

By any measure, the die-off that defined the end of the Permian period and the beginning of the Triassic — dated to 251 million years ago — was a watershed moment in the history of life. Only about 10 percent of species overall squeezed through.

Life forms that had dominated the Permian — creatures like crinoids, bryozoans and brachiopods — had nearly vanished by the Triassic. The transformation was so extreme that at least one early paleontologist thought that life had arisen independently, for a second time, at the beginning of the Triassic period, says paleobiologist Douglas Erwin of the National Museum of Natural History.

And the extinction happened quickly, at least on geologic time scales — in less than 160,000 years, according to research by Dr. Erwin and others. Scientists have been hard-pressed to find a cause for such a rapid event.

In the past, researchers have suggested a host of causes for the extinction, including massive volcanic eruptions in Siberia and widespread changes in the oceans' chemistry. Impacts have been considered before; the Woodleigh crater in Australia was a contender until geologic dating proved it far too old.

But no hypothesis has been a strong front-runner — until, perhaps, now.

"I don't think I would say that this is yet a slam-dunk for impact," says Dr. Erwin, "but it certainly makes it a more plausible contender."

The new work comes from Luann Becker, a geologist at the University of California, Santa Barbara, who has been looking for an extraterrestrial link to the extinction for years.

In 2001, she reported finding extraterrestrial gases trapped inside cage-shaped molecules in 251-million-year-old rocks — evidence, she argued, for an impact at that time. But other researchers haven't confirmed the finding.

Last fall, Dr. Becker reported finding meteorite fragments from rocks of the same age in Antarctica. These, she said, may have been pieces of the actual space rock that hit.

Now, she and her colleagues say they have located ground zero for the impact — an underwater feature called Bedout (pronounced "buh-DOO").

Imagine a map of the world as it was 251 million years ago, when the continents were still arranged in the supercontinent Pangaea. Then plot on the map the locations of impact-related debris — for instance, mineral grains fractured or melted into glass by the force of an impact.

Bedout happens to lie in the center of that debris and could therefore be the source, says Dr. Becker.

In 1996, an Australian geologist had suggested that Bedout

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could have been punched out by an impact. But nobody had ever followed up with detailed studies.

Then Dr. Becker located two core samples that oil explorers had drilled from Bedout decades earlier. So she and a New York colleague, Robert Porada of the University of Rochester, hopped a plane to Australia to study the cores.

Geologists had initially thought the cores contained a volcanic rock called breccia, made of chunks jumbled together by the force of an eruption. Dr. Becker and colleagues argue instead that the rocks are a breccia formed by the immense power of an extraterrestrial impact.

"It looks exactly like what you would expect an impact core to look like," she says.

Also, some of the mineral grains inside the core had been remelted into glass, which her team interprets as another sign of an impact.

Other studies, using gravity and seismic data, also suggest that Bedout is an old, but typical, impact crater, says Dr. Becker. It appears to be about 120 miles across — roughly the size of the Chicxulub crater off the coast of Mexico, left by the 6-mile-wide asteroid that killed the dinosaurs.

Finally, one mineral grain taken from Bedout dates to 250.1 million years, plus or minus 4.5 million years. That puts it right in the time frame of the Permo-Triassic mass extinction, the team says.

The date also places the impact at roughly the same time as huge volcanic eruptions in Siberia — one of the previous possible culprits for the extinction. The impact may have even somehow triggered eruptions halfway around the world, Dr. Becker’s team says.

"Links between extraterrestrial impacts and volcanism have been proposed before, but geologists have yet to come up with a plausible way to explain how the two could be connected.

Scientists who specialize in studying impacts aren’t ready to accept Bedout into the crater fold.

"I don’t find their evidence very convincing," said Philippe Cleyes, of Vrije Universiteit Brussel, in an e-mail interview. "In my view they failed to demonstrate that this structure is a crater."

Evidence cited by Dr. Becker’s team could be interpreted several ways, he says. He thinks the Bedout core shows more like volcanic rocks than rocks formed by an impact. And he says they don’t really consider the core taken from Chicxulub, a crater he has studied extensively.

Dr. Becker, a geologist at the University of Arizona who helped identify Chicxulub as an impact crater, agrees.

"There is a small chance," he says, "that the ...[Permo-Triassic] boundary is related to an impact event. There’s even a tiny chance that this Bedout structure is an impact crater. But the evidence being presented is so weak and unclear that it really in some sense muddies the waters."

To resolve the controversy, scientists will do what they always do — gather more evidence and see what it says.

Dr. Becker’s team, for one, hopes to return to Bedout and do more detailed studies of the structure. Ship and airplane surveys could reveal more about its size and shape, which in turn could strengthen or refute its identity as an impact crater.

With Chicxulub, it took just two years to go from identifying the crater to pinning down its identity as the dinosaur killer. But a Permain extinction, which was greater, may take much longer if it is to be accepted.