WE'RE BACK! LIFE MAKES QUICK RETURN AFTER MASS EXTINCTION

Ammonoids seemed to have bounced back quickly after the mass extinction at the end of the Permian 252 million years ago.

Scientists have long puzzled over how species recover after mass extinctions. Now, a study suggests that some animals recover from near extinction far more rapidly than was previously thought possible.

Scientists have long thought that a "survival interval" of low levels of biodiversity — the variety of distinct species on Earth — always follows an extinction crisis. This interval lasts from 5 million to 10 million years, after which there is a "recovery phase" of another 5 million to 20 million years, when biodiversity slowly climbs back to pre-extinction levels.

But one subclass of marine cephalopods — ammonoids — appears to challenge that idea: The spiral-shelled creatures bounced back relatively quickly after the most widespread mass extinction in Earth's history. At the end of the Permian, 252 million years ago, a mass extinction killed 95 percent of marine life and 70 percent of terrestrial vertebrate life. Ammonoids were among the most affected: The crisis reduced ammonoid biodiversity from about 85 genera to just three genera. But within just 1 million years, ammonoids returned to their pre-extinction levels of diversity.

A team led by Armaud Brayard, a paleontologist at the University of Burgundy in Dijon, France, and including Gilles Escarguel, a paleontologist and macroecologist at the University of Lyon in France, and paleozoologist Hugo Bucher of the University of Zurich, Switzerland, spent more than seven years studying ammonoid fossils in rocks spanning from 307 million to 201 million years ago in southern China and southwestern North America.

They found that 1 million years after the crisis, ammonoids were not only just as diverse as before the extinction — but they initially were more diverse, increasing to about 110 genera but eventually settling at around 70. Thus, if there was a survival interval, it was extremely short, the team reported in Science. The recovery phase, on the other hand, began almost immediately and involved a sharp, sudden increase in the number of ammonoid genera. "When we started this work, about seven years ago, we absolutely did not expect to find this result," Escarguel says.

The existing recovery theory is based on the "logistic model of diversification," which assumes a simple linear relationship between lower levels of biodiversity and the origination of new species. The team's results, however, show that "the 'rules' of diversification controlling the dynamics of biodiversity on Earth could well not be the same during a post-crisis diversification when compared to 'normal' times," Escarguel says.

What those rules would be "remains to be established," he says. His idea is that instead of a linear inverse relationship between levels of biodiversity and originations, the relationship is exponential. At low levels of biodiversity, such as after a mass extinction, originations would increase at a much higher rate, relative to the diversity level, than during times of higher biodiversity.

Charles Marshall, a paleobiologist at Harvard University in Cambridge, Mass., who, with evolutionary biologist David Jacobs of the University of California at Los Angeles, wrote an accompanying commentary for Science, says that this report adds new information that bears on the extinction, but that these ammonoids might be special cases.

One theory for why so many marine genera died at the end of the Permian is that the ocean chemistry changed dramatically: For example, the waters may have become extremely high in carbon dioxide and hydrogen sulfide and/or low in oxygen. Evidence from bottom-dwelling creatures, such as gastropods and bivalves, indicates that oceans remained stressed for 3 million to 4 million years after the extinction. However, the rapid recovery of ammonoids, which lived in the water column, may indicate that the water column was a less toxic environment than the sea bottom, Marshall says.

Alternatively, he says, "these particular ammonoids may have been low-oxygen and low-nutrient specialists, and so might indicate that the water column was also stressed during the Early Triassic, like the sea bottom." He and Jacobs note that the geologic record suggests that some ammonoids tended to diversify quickly after a range of environmental crises. In order to find out whether the ammonoid recovery took place in a stressed or unstressed water column, scientists will need to better understand the biology of ammonoids. Because ammonoids are extinct, one way to do this is to study their closest living relatives, such as squid.

Escarguel agrees that there are many questions for further research, including why some species did survive and whether organisms lower on the food chain, such as plankton, experienced similarly explosive growth — probably necessary for ammonoids to have thrived.

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