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New Clues to a Mass Extinction: Colby Geologist Robert Gastaldo and Student Researchers unearth Evidence that contradicts prevailing Models about ancient Die-offs

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NEW CLUES TO A MASS EXTINCTION

Colby geologist Robert Gastaldo and student researchers unearth evidence that contradicts prevailing models about ancient die-offs

By Stephen Collins '74

Photography by Professor Robert Gastaldo

Colby geologists are rewriting deep time history, altering the script of how scientists understand the mother of all mass extinctions—the End-Permian event that occurred approximately 252 million years ago. Or to suggest that they don't, in fact, understand it.

An article in the October *GEOLOGY* magazine concludes that we need to reconsider the global collapse model long used to explain how ecosystems responded during those mass extinctions. Whipple-Coddington Professor of Geology Robert Gastaldo is the lead author, with scientists from South Africa, Canada, and the United States as coauthors.

Their latest evidence suggests that the End-Permian event that killed most terrestrial reptiles and amphibians probably occurred 1.6 million years before the widespread die-offs of marine species. The two events were long believed simultaneous.

"It's not to say the marine ecosystems didn't undergo cataclysmic demise," Gastaldo said in his office the week of the publication. "They did. There was catastrophic biodiversity loss. But our data now indicate that whatever happened to the animals didn't happen because the plants died out. It's probably one of these turnovers that are in response to some other event that isn't directly related to what happened at the End Permian."

Since 2003, 25 Colby students have worked on research in South Africa's Karoo Basin building the case for this challenge to long-held theories. Most of those students were either coauthors

Above: Field party in June 2015 on the Bethel Farm, Free State, South Africa. Oriana Battifarano '17; Johann Neveling of the Council for Geoscience, Pretoria; Robert Gastaldo, Whipple-Coddington Professor of Geology; and Alyson Churchill '17 (left to right).

Top image: Alyson Churchill '17 and Oriana Battifarano '17 sit on rock that once was described as the vertebrate-defined Permian Triassic boundary. The grayish-brown rock beneath them once was interpreted to represent a change in climate conditions to an arid landscape. Right: the Karoo Basin is shown, north of Cape Town, South Africa.

> “It doesn’t solve all the mysteries, but it gives us better insight into what we weren’t able to see before.”
>
> —Whipple-Coddington Professor of Geology Robert Gastaldo

on peer-reviewed journal articles or presented research at professional geology conferences. Eleven students were listed as coauthors of various articles thus far, and more than 30 national conference presentations have been made by students, Gastaldo said. All five Colby students who worked in South Africa in 2015 presented research at the Geological Society of America’s annual meeting, Nov. 1-4 in Baltimore.

Besides taking samples and analyzing strata in the layers of rock exposed at several sites in the Karoo, Colby recently added aerial drone reconnaissance to the research effort. In January 2015 Takuto Sasajima ’16 piloted a quadcopter drone to make video recordings of sandstone beds high on cliff faces—formations that scientists can’t see in detail from the valley floor and can’t see in sufficient breadth if they climb the steep terrain, Gastaldo said.

Those videos, combined with photographs, are rendered into three-dimensional computer models that can be studied back in the lab. “All the images and movies are combined into a big photomosaic that shows the entire mountainside,” Sasajima said. Using software called PhotoScan, the team created “a quite awesome video 3D model, more precise than we imagined it would be,” he said.

Tak Sasajima ’16 readies the research team’s DJI quadcopter for a flight along the mountain’s edge to record images of resistant sandstone features. Images from the quadcopter are used to generate three-dimensional models, allowing the team to reconstruct the original river system.

The recently assembled multidisciplinary data set also includes the discovery of zircon crystals that helped establish high-precision dates for various strata and events.

The evidence raises more questions about when and how life on Earth changed more than 250 million years ago, when nearly 90 percent of marine animals and perhaps 80 percent of land vertebrates are thought to have gone extinct. Why are newly discovered fossil plants and vertebrates found in Permian-age rocks that are thought to be part of the post-extinction landscape? Why is the fossilized skull of a herbivore found at the base of a river channel 15 meters higher and the head of a predator 120 meters higher than when these animals are believed to have died off from lack to food? Why is there a big chunk of petrified wood, complete with healthy growth rings, in a layer that was supposed to reflect a time of desert conditions? And what of the volcanic deposits discovered where others claimed to have found no evidence of volcanic activity?

Gastaldo said the research in South Africa has provided unique field and research experiences for Colby undergraduates over the last 12 years. It was Sasajima’s second research project as a geology major; he helped compile a post-glacial history of an island off the coast of Maine with Professor Bob Nelson earlier. Sasajima said he’s learned research techniques and presentation skills in the process, but learning “what it takes to look for an answer that’s not in a textbook, [and] discover something that no one else has ever discovered, is very exciting. Especially as an undergraduate. I’m grateful for the very rare opportunities Colby has provided to do real science and to learn what it takes to be a scientist,” he said.