What can fossil shellfish tell us about our environmental future? Plenty.

September 25 2018, by Joseph Mcclain

Paleontologist Rowan Lockwood examines the fossilized remains of shellfish to understand present and future environmental implications. She has used fossil oysters to make recommendations on policy for the Chesapeake Bay and is a co-author on a paper that examines the fate of shellfish during a long-past episode of global warming known as the PETM. Credit: Stephen Salpukas

The Earth's climate is changing, and it's changed before. The world's oceans are warming, and they've warmed before.

Past episodes of oceanic warming—and their effects—are recorded in the fossil record and scientists can unlock the predictive power frozen in geologic time to get insight into our own environmental future.

William & Mary paleontologist Rowan Lockwood is a member of a team of scientists that examined fossil record of shellfish that lived during a global warming event that occurred more than 50 million years ago. Their report, "Little lasting impact of the Paleocene-Eocene Thermal Maximum on shallow marine molluscan faunas," was published in the journal *Science Advances*.

The Paleocene-Eocene Thermal Maximum, or PETM, occurred about 56 million years ago. Lockwood explained that the PETM was triggered by the release of 10,000 gigatons of carbon into the atmosphere from the seafloor or volcanic eruptions.

The result of all that carbon, she said, was a massive rise in global sea temperatures and increased ocean acidification. The natural global warming of the PETM makes it the best-available comparison to our anthropogenic-heated environment, but the paper states, dolefully, "The PETM likely underestimates the expected impact of ongoing combustion of fossil fuels."

Lockwood explained that there are natural contributors of carbon-laden greenhouse gases at work today—volcanism is one. And the carbon extractors such as the ocean and trees are still at work.

"Trees and plant material have been absorbing greenhouse gases for millions of years," she said. "When plants and other living organisms die and are buried into the ground for millions of years, they become coal and oil—natural carbon sinks."

Lockwood, a professor in the university's Department of Geology, explained that the greenhouse-gas carbon stays locked away underground until released into the atmosphere. There are natural releases such as volcanic events or weathering—but human extraction and combustion of coal and oil short-circuit the process, taking only a few years to unlock millions of years of sequestered carbon.

"Today's rates of global warming are significantly faster than anything we've seen in Earth's history," Lockwood said. It's the same for ocean acidification and related carbon-driven changes to the environment. "The PETM is the closest that we have in the past, but modern warming is still far outstripping those rates."

Lockwood's co-authors on the Science Advances paper are Linda C. Ivany of Syracuse University, Carlie Pietsch of San Jose State University, John C. Handley of the University of Rochester, Warren D. Allmon of Cornell University and Jocelyn A. Sessa of Drexel University. The work was funded by grants from the National Science Foundation.

The collaborators chose to focus on well-known fossil outcrops on the coastal plain of Alabama and Mississippi, covered by a shallow ocean during the PETM. Other studies have looked at the effects of the PETM in deep-sea and terrestrial environments, but there has been little examination of how shallow-sea life weathered the warming, acidification and oxygen stress that were the facts of life during the PETM interval.

"These are some of the best-preserved shallow marine localities in the world," Lockwood said. "I focused on the largest and best-preserved species in the fossil record."

The scientists looked at a number of factors in fossils from before and after the PETM: diversity, body size, abundance, persistence. And they found that the shellfish weathered the thousands of years of environmental stress pretty well. Lockwood said she and her collaborators were surprised.

"The PETM is interesting because we know that it's associated with the mass extinction of microscopic organisms living in the ocean," she said. "Since these microscopic organisms are the base of the marine food chain, we hypothesized we would see extinction in the mollusks as well."

Lockwood cautioned that the story is incomplete. Even the rich fossil beds of the Gulf coastal plain have some blank spots in their fossil record, she said, and therefore the collaborators can't explain why or how the shellfish were so successful.

"So, it's possible that the mollusks have responded, but we don't have a finely tuned enough record to observe that," she explained. "But if they did respond, they bounced back surprisingly quickly on a geologic time scale."

More information: Linda C. Ivany et al. Little lasting impact of the Paleocene-Eocene Thermal Maximum on shallow marine molluscan faunas, *Science Advances* (2018). DOI: 10.1126/sciadv.aat5528

Provided by The College of William & Mary