Exploding stars may have caused mass extinction on Earth, study shows
18 August 2020, by Lois Yoksoulian

The team concentrated on the Devonian-Carboniferous boundary because those rocks contain hundreds of thousands of generations of plant spores that appear to be sunburnt by ultraviolet light—evidence of a long-lasting ozone-depletion event.

"Earth-based catastrophes such as large-scale volcanism and global warming can destroy the ozone layer, too, but evidence for those is inconclusive for the time interval in question," Fields said. "Instead, we propose that one or more supernova explosions, about 65 light-years away from Earth, could have been responsible for the protracted loss of ozone."

"To put this into perspective, one of the closest supernova threats today is from the star Betelgeuse, which is over 600 light-years away and well outside of the kill distance of 25 light-years," said graduate student and study co-author Adrienne Ertel.

The team explored other astrophysical causes for ozone depletion, such as meteorite impacts, solar eruptions and gamma-ray bursts. "But these events end quickly and are unlikely to cause the long-lasting ozone depletion that happened at the end of the Devonian period," said graduate student and study co-author Jesse Miller.

A supernova, on the other hand, delivers a one-two punch, the researchers said. The explosion immediately bathes Earth with damaging UV, X-rays and gamma rays. Later, the blast of supernova debris slams into the solar system, subjecting the planet to long-lived irradiation from cosmic rays accelerated by the supernova. The damage to Earth and its ozone layer can last for up to 100,000 years.

However, fossil evidence indicates a 300,000-year...
decline in biodiversity leading up to the Devonian-
Carboniferous mass extinction, suggesting the
possibility of multiple catastrophes, maybe even
multiple supernovae explosions. "This is entirely
possible," Miller said. "Massive stars usually occur
in clusters with other massive stars, and other
supernovae are likely to occur soon after the first
explosion."

The team said the key to proving that a supernova
occurred would be to find the radioactive isotopes
plutonium-244 and samarium-146 in the rocks and
fossils deposited at the time of extinction. "Neither
of these isotopes occurs naturally on Earth today,
and the only way they can get here is via cosmic
explosions," said undergraduate student and co-
author Zhenghai Liu.

The radioactive species born in the supernova are
like green bananas, Fields said. "When you see
green bananas in Illinois, you know they are fresh,
and you know they did not grow here. Like
bananas, Pu-244 and Sm-146 decay over time. So
if we find these radioisotopes on Earth today, we
know they are fresh and not from here—the green
bananas of the isotope world—and thus the smoking
guns of a nearby supernova."

Researchers have yet to search for Pu-244 or
Sm-146 in rocks from the Devonian-Carboniferous
boundary. Fields' team said its study aims to define
the patterns of evidence in the geological record
that would point to supernova explosions.

"The overarching message of our study is that life
on Earth does not exist in isolation," Fields said.
"We are citizens of a larger cosmos, and the
cosmos intervenes in our lives—often imperceptibly,
but sometimes ferociously."

More information: Supernova triggers for End-
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