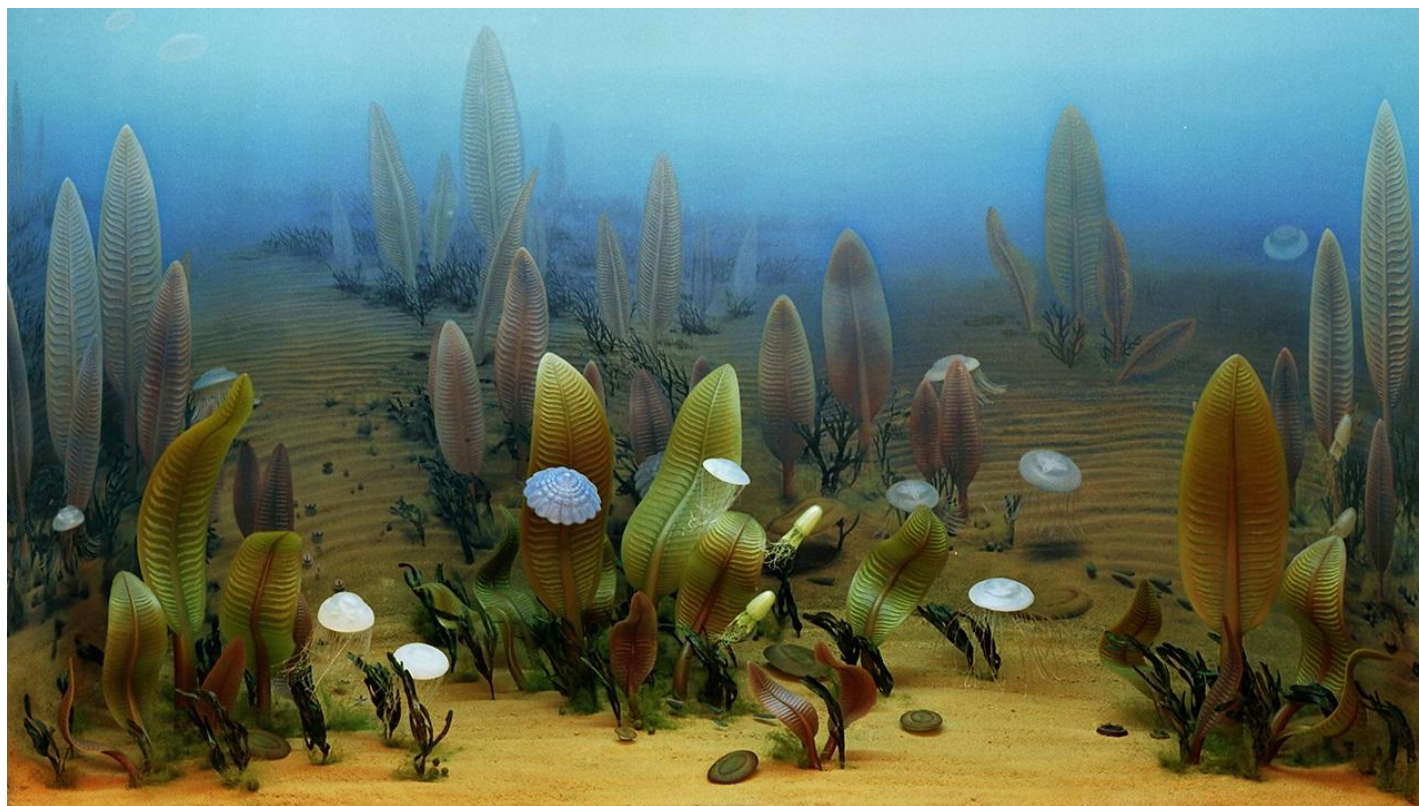


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Death by UV? Did an increase in UV radiation kill off the soft-bodied creatures of the Ediacaran—pictured—paving the way for the Cambrian explosion? CHASE STUDIO/SCIENCE SOURCE

Hyperactive magnetic field may have led to one of Earth's major extinctions

By [Ian Randall](#) | Feb. 16, 2016 , 10:45 AM

Rapid reversals of Earth's magnetic field 550 million years ago destroyed a large part of the ozone layer and let in a flood of ultraviolet radiation, devastating the unusual creatures of the so-called Ediacaran Period and triggering an evolutionary flight from light that led to the Cambrian explosion of animal groups. That's the conclusion of a new study, which proposes a connection between hyperactive field reversals and this crucial moment in the evolution of life.

The Kotlinian Crisis, as it is known, saw widespread extinction and put an end to the Ediacaran Period. During this time, large (up to meter-sized) soft-bodied organisms, often shaped like discs or fronds, had lived on or in shallow horizontal burrows beneath thick mats of bacteria which, unlike today, coated the sea floor. The slimy mats acted as a barrier between the water above and the

sediments below, preventing oxygen from reaching under the sea floor and making it largely uninhabitable.

The Ediacaran gave way to the Cambrian explosion, 542 million years ago: the rapid emergence of new species with complex body plans, hard parts for defense, and sophisticated eyes. Burrowing also became more common and varied, which broke down the once-widespread bacterial mats, allowing oxygen into the sea floor to form a newly hospitable space for living.

Scientists have long argued over what caused the Cambrian explosion in the first place. Potential explanations have included rising levels of atmospheric oxygen because of photosynthesis, allowing for the development of more complex animals; the rise in carnivorous species and new predatory tactics, such as the flat and segmented, armor-crushing creatures known as anomalocaridids; and the breakup of the supercontinent Rodinia, which may have created new ecological niches and isolated populations as the continents drifted apart.

In their new study, however, geologist Joseph Meert of the University of Florida in Gainesville and his colleagues propose a different hypothesis: that these evolutionary changes might have been connected to rapid reversals in the direction of Earth's magnetic field. During a reversal, magnetic north and south trade places—an event which, in geologically recent times, occurs about once every million years.

Yet in the Ediacaran, such reversals were a lot more common, the team proposes. Certain minerals in rocks can preserve a record of the direction of Earth's magnetic field when the rock formed. While studying these magnetic records in 550-million-year-old, Ediacaran-aged sedimentary rocks in the Ural Mountains in western Russia, the team discovered evidence to suggest the reversal rate then was 20 times faster than it is today. "Earth's magnetic field underwent a period of hyperactive reversals," Meert says.

Previous research has suggested that Earth's protective magnetic field would be weaker across such periods of frequent reversal, compromising its ability to shield life from harmful solar radiation and cosmic rays. On top of this, the duration of each individual reversal episode—thought to take an average of 7000–10,000 years—would likely see the field temporarily weakened even more before growing back in the opposite direction.

This weakened shielding would have allowed more energetic particles into the upper atmosphere, which would have begun to break down the ozone layer that protects Earth from harmful UV radiation, Meert says. **Twenty to 40% of ozone coverage might have been lost**—in turn, doubling the amount of UV radiation that reached Earth's surface, the team reports in a paper in press in *Gondwana Research*. "Organisms with the ability to escape UV radiation would be favored in such an environment."

This flight from dangerous levels of UV light, therefore, might explain many of the evolutionary changes that occurred during the Late Ediacaran and Early Cambrian, Meert says. Creatures with

complex eyes to sense the light and the ability to seek shelter from the radiation—for example, by migrating into deeper waters during the daytime—would have been more successful. The growth of hard coatings and shells would afford additional UV protection, as would the capacity to burrow deeper into the sea floor.

In turn, these changes may have opened up new environments. The development of shells, for example, helps creatures colonize intertidal areas, protected not only from UV rays but also stronger waves and the risk of drying out. Similarly, the breakdown of the bacterial mats by early burrowing would have opened up the upper sea floor further for life.

Looking forward, the researchers are now hoping to examine other Ediacaran sediments from around the globe to verify the rapid reversals' signal, along with hunting for biological or chemical evidence for high doses of UV radiation in the fossil record.

There are many factors that may explain why the Cambrian explosion occurred, but the researchers' "escape from light" idea adds a novel possibility to the debate, says David Harper, a paleontologist at Durham University in the United Kingdom who was not involved in the study. "The authors have opened up yet another exciting and imaginative area of research within which to frame and test new hypotheses for the origin and early evolution of animal-based communities."

Geobiologist Joseph Kirschvink of the California Institute of Technology in Pasadena, is skeptical, however. Although the idea that UV radiation increases without Earth's magnetic field is long-established, its effect on the evolution of life at this time should be limited, he says, as the radiation would not be able to reach and damage the germ line, the cells of the body used in sexual reproduction to pass genetic information to offspring. The radiation "would affect the outer skin ... but the germ cells are usually internal and protected." As such, he argues, the idea that increased levels of UV radiation significantly affected the evolution of life in the Ediacaran is problematic.

Posted in: [Earth, Evolution](#)

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Ian Randall

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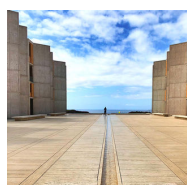
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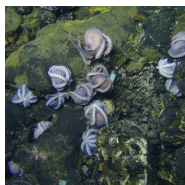
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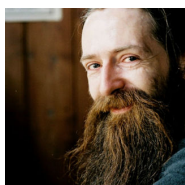
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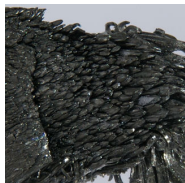
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