

'Cascade of events' caused sudden explosion of animal life

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The explosion of animal life on Earth around 520 million years ago was the result of a combination of interlinked factors rather than a single underlying cause, according to a new study.

Dozens of individual theories have been put forward over the past few decades for this rapid diversification of animal species in the early Cambrian period of [geological time](#).

But a paper by Professor Paul Smith of Oxford University and Professor David Harper of Durham University suggests a more holistic approach is required to discover the reasons behind what has become known as the Cambrian Explosion.

Theories for the Cambrian Explosion fall into three main categories – geological, geochemical and biological – and most have been claimed as standalone processes that were the main cause of the explosion.

Whatever the cause, this major evolutionary event led to a wide range of biological innovation, including the origin of modern ecosystems, a rapid increase in [animal diversity](#), the origin of skeletons and the first appearance of specialist modes of life such as burrowing and swimming.

Among the weird and wonderful creatures to emerge in the early Cambrian was *Anomalocaris*, the free-swimming, metre-long top predator of the time with a mouth composed of 32 overlapping plates that could constrict to crush prey. It is distantly related to modern

[arthropods](#), including crabs and lobsters.

Vertebrate animals also made their first appearance in the Cambrian Explosion, the distant ancestors of modern fish, reptiles, birds and mammals.

Professor Smith, Professor Harper and a team of scientists have spent four years working on data from a site in northernmost Greenland, facing the Arctic Ocean.

The site, at Siriuspasset, is located at 83°N, just 500 miles from the North Pole in a remote part of north Greenland. Although logistically very difficult to reach, Siriuspasset attracted the team because of the high quality of its fossil material and the insights it provides.

Professor Smith and Professor Harper's findings are published in the latest edition of the journal *Science*.

Professor Smith, lead author of the report and Director of the Oxford University Museum of Natural History, said: 'This is a period of time that has attracted a lot of attention because it is when animals appear very abruptly in the fossil record, and in great diversity. Out of this event came nearly all of the major groups of animals that we recognise today.

'Because it is such a major biological event, it has attracted much opinion and speculation about its cause.'

Described by the researchers as a 'cascade of events', the interacting causes behind the explosion in animal life are likely to have begun with an early Cambrian sea level rise. This generated a large increase in the area of habitable seafloor, which in turn drove an increase in animal diversity. These early events then translate into the complex interaction of biological, geochemical and geological processes described in

individual hypotheses.

Professor Harper, Professor of Palaeontology in the Department of Earth Sciences at Durham University, said: 'The Cambrian Explosion is one of the most important events in the history of life on our planet, establishing animals as the most visible part of the planet's marine ecosystems.'

'It would be naïve to think that any one cause ignited this phenomenal explosion of [animal life](#). Rather, a chain reaction involving a number of biological and geological drivers kicked into gear, escalating the planet's diversity during a relatively short interval of deep time.'

'The Cambrian Explosion set the scene for much of the subsequent marine life that built on cascading and nested feedback loops, linking the organisms and their environment, that first developed some 520 million years ago.'

Professor Smith said: 'Work at the Siriuspasset site in north Greenland has cemented our thinking that it wasn't a matter of saying one hypothesis is right and one is wrong. Rather than focusing on one single cause, we should be looking at the interaction of a number of different mechanisms.'

'Most of the hypotheses have at least a kernel of truth, but each is insufficient to have been the single cause of the Cambrian explosion. What we need to do now is focus on the sequence of interconnected events and the way they related to each other – the initial geological triggers that led to the geochemical effects, followed by a range of biological processes.'

More information: The paper 'Causes of the Cambrian Explosion' by M. Paul Smith and David A. T. Harper is published in *Science*, Vol. 341,

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1126/science.1239450](http://www.sciencemag.org/lookup/doi/10.1126/science.1239450)

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