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Research highlight

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Three pulses of breaths toward three evolutionary shifts

Oxygen levels in the ocean increased three times between the early Ediacaran and the early Cambrian, in synchrony with major developments in animal evolution.

Credit: Image from PicScout. http://picscout.springernature.com/fotoweb/archives/5000-All-Files/2022/09/05/AdobeStock_330584892.jpeg.info#c=%2Ffotoweb%2Farchives%2F5000-All-Files%2F%3Fq%3Dbubble%2520water

If we could travel 2000 million years back in time, we would have to breathe from an atmosphere with no more than 1% of today's oxygen levels. Reaching the atmospheric and oceanic oxygen concentrations that we enjoy today took billions of years. One of the most important steps on this path is known as the Neoproterozoic Oxygenation Event, which is thought to have taken place in the Ediacaran Period approximately 600 million years ago. Yet, the details of this oxygenation and the way it affected the evolution of complex animals remains a subject of active research, as the oxygen-sensitive geological evidence is ambiguous and sometimes contradictory[1,2].

Kaiho et al.[3] studied the oceanic oxygen levels recorded in various marine sedimentary rock sequences located in Australia, Oman, and China. Their analyses reveal five oxygen-rich (oxic) and five oxygen-deficient (anoxic) phases, that occurred between the end of the Ediacaran and the beginning of the Cambrian Period. Moreover, oxygen levels of Earth's surface waters during the oxic phases increased in three progressive steps between the early Ediacaran (640–600 million years ago) and the early Cambrian (530–520 million years ago). Each step-increase in oxygen level is broadly synchronized with a period of important developments in animal evolution, including the appearance of hard calcified shells, and the appearance of specific biota such as the Arthropoda group that includes the famously extinct trilobites. The appearance of Arthropoda along with the appearance of other animal biota mark the beginning of the Cambrian explosion 520 million of years ago, one of the most important animal diversification periods in geologic history.

The broad synchroneity between the three stages of oxygen increase, recorded in these sites, and the step changes in animal evolution, supports the idea that progressive oxygenation may have had a role in shaping the diversification of animal life at the end of the Ediacaran and the beginning of the Cambrian, a view that has been debated[1,2,4]. It will take analyses of not only oxygen conditions but also other potential primary controls that may have influenced evolution, such as nutrient availability and the role of other geological processes, to better understand what set the perfect conditions for these important evolutionary shifts.

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Competing interests

The author declares no competing interests.