Spatiotemporal coevolution of oxygen levels and early animals

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The Ediacaran (635–541 Ma) and early Cambrian (541–509 Ma) were key periods in Earth's history, marked by early diversification of animals and a rise in atmospheric and oceanic oxygen levels[1]. The coevolution hypothesis argues that a great oceanic oxygenation triggered the rise of early animals [2-3], whereas other researchers deemphasize the importance of changing oxygen levels based on assumed low oxygen requirements for early animals [4-5]. However, both hypotheses are challenged by seemingly contradictory evidence for both significant [2-3] and limited [6] oceanic oxygenation. Recent studies of marine redox—with a particular focus on the fossiliferous sections in South China—demonstrate high spatial heterogeneity of oceanic oxygen (redox) conditions and temporally dynamic marine shelf oxygenation in a dominantly anoxic ocean during the Ediacaran and early Cambrian. This spatiotemporal pattern is associated with a general coupling to early animal evolution. We attribute varying shelf oxygenation to a complex interplay among the evolving atmosphere, continents, oceans, and biosphere during a critical period in Earth history [7]. Based on these findings, we propose a model which describes the spatiotemporal coevolution of oxygen levels and early animals. In this model, dynamic spatiotemporal oxygenations of marine shelves played a key role in the rise of early animals [7].

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