Reconstructing variations in atmospheric O_2 during the Paleozoic and Mesozoic

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The concentration of atmospheric oxygen during the Paleozoic and Mesozoic Eras may have played a pivotal role in the evolution of animals, and later mammals. But due to the lack of direct geochemical proxies for O_2 levels, reconstructing ancient variations in oxygen concentration relies heavily on modelling approaches. These models take account of the long term cycling of carbon and sulphur between the atmosphere, oceans and sediments in order to estimate the rate of burial of reduced carbon and sulphur species – which are the predominant oxygen sources over geological timescales.

Here we evaluate a key modelling technique called Isotope Mass Balance, which is used to estimate the global oxygen source from sedimentary records of $\delta^{13}C$ and $\delta^{34}S$, and forms the backbone of the well-known GEOCARBSULF model [1]. We update the technique using modern computational methods and recent isotope data [2], and an improved representation of the role of the inorganic carbon cycle in setting carbonate $\delta^{13}C$ [3].

Our results show a significantly different history of atmospheric oxygen than that proposed by the original GEOCARBSULF model, which raises questions about the role of early land plants, and the oxygen-imposed limits on animal evolution.

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