

**Global biogeochemical models for
deep time: what have we learned and
where are the biggest problems? *R.*
*Berner Lecture***

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Since the establishment of geological carbon cycle models like Berner's GEOCARB, the following decades have seen the field and the numerical tools it relies on increase in size and complexity. Some of the key questions that drove the invention of these early models have been adequately answered, while some have not, and many new questions have appeared. In this talk I will give a brief introduction to global biogeochemical models for deep time, and will summarise recent work we have done to explore the drivers of long-term CO₂ and temperature change, the history of atmospheric oxygen, and how the evolution of the biosphere has been coupled to that of the global environment. I will also demonstrate how these models have been used to test hypotheses about biosphere stability and resilience. But I also want to use this opportunity to communicate the key uncertainties and problems with our existing models, to show how these impact some of our most fundamental theories, and to outline what the wider geochemistry community can do to help us to move forward together.