

## **A sedimentary fingerprint of oscillating redox through the Cambrian Period**

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Geochemical and mineralogical signatures recovered from sedimentary rocks underpin our current view of ocean/atmosphere redox through time. Sediments deposited under stable oxic or anoxic end members of the redox spectrum retain the most distinctive geochemical signatures. Most proxies, however, do not readily identify subtle redox fluctuations occurring over the time-integrated history of a sediment package. Here, merging chemical, crystallographic and sedimentological data, we propose a new crystallization mechanism for the Fe<sup>2+</sup>-Fe<sup>3+</sup>-silicate mineral glauconite. We show that the rate at which pore waters oscillate between oxic and anoxic states directly controls the glauconite crystallization rate, providing key environmental context for glauconite distribution in time and space. In addition, our model sheds new light on the widespread, facies-independent peak in glauconite production within the Cambrian Period, which we argue was a result of the elevated susceptibility of Cambrian marine water masses to frequent redox oscillation. This apex in glauconite production was perhaps the first time, but not the last, that the oceans crossed an oxygen threshold triggering redox oscillations that resonated through multiple biogeochemical cycles. Identifying a sedimentary fingerprint for fluctuations in dissolved oxygen content adds a critical new dimension to our view of redox evolution, helping to disentangle evolutionary pattern from environmental change.