

## **Extreme redox oscillations due to coupling of the marine sulphur and carbon cycles during the Cambrian explosion**

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Extreme carbon isotope fluctuations have long been known to characterise the Cambrian radiations, but it is commonly assumed that any excess oxidant generated by organic carbon burial (higher  $\delta^{13}\text{C}$ ) will be balanced by reduced pyrite burial (lower  $\delta^{34}\text{S}$ ), and vice-versa. On the other hand, some recent studies suggest that organic carbon and pyrite sulphur burial may be positively correlated during the late Cambrian SPICE event, leading to a singular pulse in oxygenation. Using a new, high-fidelity analytical approach, we demonstrate a convincing positive correlation between carbonate  $\delta^{13}\text{C}$  and carbonate-associated sulphate  $\delta^{34}\text{S}$  at the Siberian Aldan-Lena Rivers sections, through five isotope cycles during the canonical explosive phase of the Cambrian radiations from ~523 to ~516 Myr ago. This isotopic coupling reflects periodic oscillations in ocean redox that shed light on the episodic radiations of major animal phyla with which they coincide. Conversely, the Botomian-Toyonian extinction events on the Siberian Platform coincide with decoupled isotope records that evidence a localised shrinking marine sulphate reservoir through this later interval. These new data demonstrate a tight relationship between environmental and biological evolution during one of the most fundamental transitions towards the modern biosphere.