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Mass extinctions, recovery and resilience

Sedex brine expulsions to the ocean: The underling culprit of catastrophic global change and mass extinctions

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Increasingly, chemostratigraphic studies show dramatic episodes of global climate-oceanic instability that are denoted by isotope disturbances in oceanic C, O, S and Sr and trace element cycles. It is now clear that these reorganizations of global Earth systems form the nodes in the evolutionary trajectory of life. Yet, while our understanding of these phenomena is advancing, the underlying trigger(s) remain poorly understood.

We integrate new palaeontological and chemostratigraphic tools to advance an alternative hypothesis for the trigger of these dramatic events. Specifically, we propose that massive releases of sedimentary brines, analogous to those that form sedimentary-exhalative (sedex) ore deposits, induced runaway fertilization and eutrophication that through a series of positive feedbacks resulted in these perturbations of global ocean-climate systems. Central to this new model are new ore genesis and fluid flow studies that demonstrate these brine discharges supplied quantities of metals, radiogenic Sr and biolimiting nutrients to the oceans surpassing that of the total modern riverine flux to the ocean. Strong temporal correlations between brine releases, combined with mass balance evidence and oceanographic box modelling, suggest that the flux of radiogenic Sr-rich sedex brines was sufficient to cause observed positive excursions (“spikes”) in the global marine Sr-isotope record that correspond with global δ13C and δ18O, global anoxia, metal-rich black shale deposition, climate change, metal-induced teratology of marine organisms, and significant biotic extinctions - suggesting that these massive brine exhalations may be for the ultimate culprit of these catastrophic global events.