Multiple geochemical proxies reveal a Late Cambrian ocean anoxic event

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Recent geochemical studies of the Ediacaran and Cambrian are revealing that the transition between the dominantly reducing Proterozoic ocean to a generally well-oxygenated Phanerozoic ocean was less straightforward then previously considered. We present geochemical data from the SPICE (Steptoean Positive Carbon Isotope Excursion) that delineate a Late Cambrian ocean anoxic event. Carbonate-C, sulfate-S and pyrite-S isotope records from globally distributed sections through the SPICE show parallel, positive shifts that suggest enhanced burial of organic C and pyrite S consistent with widespread anoxic deposition. This suggestion is confirmed by geochemical box modeling of the event, which predicts that increased organic carbon and pyrite burial occurred under euxinic conditions.

Molybdenum concentration and isotope data from the euxinic Alum Shale of Sweden also point to expanded anoxic deposition during the SPICE. Mo isotope data show a negative excursion at the peak of the SPICE, which drops from 1.4‰ to 0.8‰, a value similar to that of the modern riverine flux. Mo concentrations show a crash in enrichment coincident with Mo isotope excursion. The indication from both the Mo isotope and concentration datasets is a depletion of the seawater Mo inventory caused by Mo sequestration over a large area of the ocean.

The sum of our geochemical data and modeling point to the SPICE as an interval of increased oceanic anoxia and imply that redox transition from a reducing to more oxygenated ocean may have extended well into the Phanerozoic. This delay in ventilation of the ocean maybe responsible for the apparent plateau in marine faunal diversity observed between the Cambrian Explosion and Ordovician Radiation.

Creating new continental crust Fiji-Tonga

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Forty years after Ross Taylor assigned Gill this topic for a PhD, we have a new report. New continental-type crust started to form east of Australia at about the same time as in IBM, caused by changes in Pacific Plate motion. The first magmas for about 20 m.y. were varieties of the Island Arc Tholeiitic Series after all – 'Pacific' in their Pb-Hf-Nd isotopes, less depleted than N-MORB isotopically but more depleted in HFSE and REE. Subsequent formation of the South Fiji (backarc) Basin caused further elemental and isotopic depletion of the mantle wedge and crust derived from it. Calcalkaline andesites similar in composition to old continental crust are rare and mostly in the rear arc. Shoshonitic magmas are ever rarer and related to the termination of subduction. Tonalitic plutons (middle crust) formed episodically with variable igneous protolith residence times. No pre-Cenozoic zircon cores have been found. The plutons inherited the full range of preceding mantle and crustal history, are 'juvenile' despite having old Hf model ages (TDM), and are depleted in the incompatible elements that are enriched in old continental crust. Although continental crust continues to be created in the Cenozoic, the new crust dilutes the old and "oceanizes" continents unless it recycles them, perhaps during continental collision and preservation.