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Multiple carbon burial episodes and isotope excursions in the aftermath of the Palaeoproterozoic Great Oxidation Event

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The global sequestration of carbon influences both climate and oxygen levels and one of the greatest accumulations of organic-rich sediment in Earth history occurred c. 2 billion years ago, following the Great Oxidation Event. It has been proposed that this was a single, globally synchronous event. We show, instead, there were several discrete carbon burial episodes (CBEs) during an interval spanning 200 million years. Furthermore, their association with large igneous provinces and characteristic organic carbon isotopic profiles are traits also present in much younger oceanic anoxia events suggesting similar causality.

Positive carbonate-carbon isotope excursions ($\delta^{13}C$ > +5‰ and locally much higher, i.e. the Lomagundi-Jatuli Event) are also hallmark features of Palaeoproterozoic successions. Like CBEs, they are assumed to archive a global event of unique environmental conditions following the Great Oxidation Event [1]. By combining new and published geochronology we also show that timing of the termination of the Lomagundi-Jatuli Event may have differed by up to 90 Ma between localities in northwest Russia, northwest Scotland and globally.

The interpretations above are based, in part, on new high precision U-Pb (zircon and baddeleyite) ID-TIMS data. Given our inferences regarding geological relationships, the Pilgujärvi Sedimentary Formation CBE in the Pechenga Greenstone Belt on the Kola craton was deposited at c. 1.92 Ga whereas the Zaonega Formation CBE in the Onega Basin on the Karelia craton was deposited at c. 1.97 Ga [2]. By comparison with sections in northern Australia and Gabon it can be shown that CBEs on four disparate cratons were temporally discrete depositional episodes occurring between c. 2.1 Ga and 1.85 Ga. Furthermore, the Lomagundi-Jatuli event in the Pechenga Greenstone Belt had terminated by 2.06 Ga [3] but was ongoing in the Onega Basin at 1.97 Ga and in the Loch Maree Group, in Scotland, between 2.0 and 1.9 Ga [4]. This is inconsistent with models that treat these as representing a singular, global event. Our findings show that hallmark events of the Palaeoproterozoic Earth in the aftermath of the Great Oxidation Event have features not dramatically unlike some known for the Phanerozoic Earth. Perhaps the corollary is that once the transformation of Earth from an anoxic to oxic planet occurred, biogeochemical processes began operating that, as in the case of organic-rich rocks, do not necessitate searching for processes requiring explanations unique to the Precambrian.

References:

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