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Sedimentary zinc in the Palaeoproterozoic: implications for the chemical conditions of early eukaryote habitats

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Sedimentary enrichments of redox-sensitive metals can provide key constraints on the redox evolution of Earth's surface environments. Massive zinc sulphide deposits hosted by Palaeoproterozoic shales have been cited as evidence for the development of sulphidic marine conditions [e.g., 1] following the oxidation of the atmosphere, leading to the sequestration and burial of zinc sulphide from seawater. These deposits broadly coincide with the first appearance of eukaryotes in the fossil record, and have major implications for eukaryote ecology as sulphidic conditions can deplete bioessential trace elements. However, more recent models [2,3] for the genesis of many shale-hosted zinc sulphide deposits posit that the mineralisation significantly post-dates the deposition of the host rocks, in which case these deposits cannot inform our understanding of environmental conditions. Here, we present a high-resolution stratigraphic, petrographic and geochemical study of drill cores from the Teena and Here's Your Chance zinc sulphide deposits which are hosted by shales of the ca. 1640 Ma Barney Creek Formation (McArthur Basin, Northern Territory, Australia). We compare these insights to other Palaeoproterozoic deposits globally to test hypotheses about the implications of synsedimentary zinc sulphide mineralisation, and discuss implications for the environmental and chemical conditions of early eukaryote evolution.

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