Integrated redox and nutrient cycling in the fossiliferous terminal Ediacaran Nama Group, Namibia

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There is a pronounced increase in the diversity of motile organisms in the late Ediacaran Period (560-540 million years ago, Ma). It is well recognised that oxygen is a prerequisite to metabolically active ecologies, however relative changes in the spatial extent of oxic waters and habitation by terminal Ediacaran forms remain largely unconstrained. Even more uncertain are the impacts of variable palaeomarine redox conditions on regional nutrient cycling and associated productivity at this time. We integrate a new palaeoredox and nutrient cycling dataset of Fe and P speciation with a full biotic inventory of one of the most important terminal Ediacaran fossiliferous sedimentary successions, the Nama Group of Namibia (~550-540 Ma).

In the Nama basin, complex soft-bodied benthic macrobiota and ichnotaxa inhabited wave-dominated shoreface clastic environments that were well oxygenated through frequent mixing. Communities of skeletal biota (e.g. *Cloudina*, *Namacalathus* and *Namapoikia*) inhabited shallow shelf to mid-ramp carbonate facies above, or intermittently within, the zone of manganese reduction where regular ferruginous anoxic incursions during marine transgressions likely proved detrimental.

The most dramatic feature of the combined Fe-speciation data is a gradual transition from unstable and dominantly ferruginous conditions during deposition of the Kuibis Subgroup at ~550 Ma, to stable oxic conditions immediately prior to the Ediacaran-Cambrian boundary unconformity at ~540 Ma. P-speciation data suggest that the mechanism driving the long term redox transition in the Nama Group may have been associated with the initial drawdown and sedimentary retention of P in association with Fe minerals under ferruginous water column conditions. Limited sedimentary P recycling during deposition of the Kuibis Subgroup led to a reduction in P bioavailability and primary production in the local marine environment, thereby weakening the regional oxygen minimum zone. This study provides the first fully integrated, quantitative dataset of palaeoredox and nutrient cycling in the Ediacaran, with implications for the environmental requirements of some enigmatic terminal Ediacaran organisms.