The paleoenvironmental implications of pre-GOE Fe and Mn deposition in the Mesoarchean Pongola Supergroup, South Africa

A. J.B. SMITH[1]*, E. RAMMILA[1] AND N. J. BEUKES[1]

[1]PPM, Department of Geology, University of Johannesburg, Johannesburg, South Africa
(*correspondence: bertuss@uj.ac.za)

The Mesoarchean (~2.96-2.92 Ga) Mozaan Group of the Pongola Supergroup of southern Africa is one of the oldest, well preserved supracratonic successions in the world. A manganiferous iron formation (IF) occurs in the Ijzermijn Member in the middle of the basal quartzite-dominated Sinqeni Formation of the Mozaan Group [1]. Two deep level drill cores intersecting the Ijzermijn Member, drilled approximately 20 km apart, provide valuable insight into the lateral facies distribution of this IF and paleoenviromental conditions in which it was deposited.

Both drill cores contain stratigraphically correlatable, thinly laminated, ^{13}C-depleted carbonate facies IF that overlie shale with a sharp transgressive contact and is, in turn, overlain with a sharp erosional contact by quartzite. However, the IF in one drill core contains Mn-rich horizons (up to ~20 weight % MnO) where the Mn is hosted by ^{13}C-depleted Fe-rich rhodochrosite. The Fe-rich rhodochrosite occurs either as fine-grained and laminated or concretionary carbonate. These textures, along with the ^{13}C-depletion, indicate a diagenetic origin where precipitated Fe^{3+}, Mn^{3+} and Mn^{4+} were reduced by organic carbon in the sediment to form carbonate.

The IF in both drill cores were deposited during a transgressive event below storm wave base and therefore most likely below the photic zone. A regional reconstruction of the basin indicates that the Mn-rich IF was deposted more proximal to the paleo-coastline [1]. REY data suggest precipitation from a hydrothermal plume in marine setting. Restriction of iron and manganese to deep water sedimentary facies rules out oxidative precipitation by photoautotrophs. Much more likely is that preciptation was mediated by iron and manganese oxidizing chemolithoautotrophs that implies the presence of micro-oxic conditions in relatively deep water of the Mozaan basin at the time; an interpretation supported by Cr isotope data [2].

[1] Beukes and Cairncross (1991) *S. Afr. J. Geol.*, **94**, 44-69.
[2] Crowe *et al* (2013) *Nature*, **501**, 535-538.