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Red Bed-Hosted Oncolitic Manganese Ore of the Paleoproterozoic Soutpansberg Group, Bronkhorstfontein, South Africa

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Abstract

The Bronkhorstfontein manganese deposit near Tolwe, Limpopo province, South Africa, constitutes an exceptionally well preserved and unmetamorphosed shallow-marine manganese deposit of Late Paleoproterozoic age. It is the oldest known deposit that displays characteristics of economically important shallow-marine pisolitic manganese deposits of Mesozoic and Cenozoic age. Manganese mineralization at Bronkhorstfontein occurs as five laterally continuous, up to 2-m-thick, beds that are hosted by an alluvial red bed succession, preserved as part of an erosional outlier of the Wyllies Poort Formation, Soutpansberg Group. Manganiferous beds mark transgressive surfaces and formed in a storm-dominated, shallow-water environment of a deltaic to litoral setting. The massively bedded siliceous ore contains up to 41 wt percent Mn, at Mn/Fe ratios between 6 and 10. The mineralogy of the ore is simple; braunite, hematite, and quartz are the dominant constituents, with minor pyrolusite, cryptomelane, and chalcedony as products of supergene alteration. Rare earth element and trace element geochemical indicators suggest that the manganese mineralization originated as hydrogenetic Mn^{4+} oxyhydroxide precipitates, which were diagenetically transformed into braunite. The most striking feature of the manganese ores of the Bronkhorstfontein deposit is the beautiful preservation of various types of sedimentary particles, including well-rounded detrital quartz grains and hematite-chert pellets, as well as oncoids. The oncoids, in particular, are remarkable, because they are very similar in size, shape, and internal texture to modern biogenic analogues. Their abundance throughout the ore-bearing strata and their absence from the intercalated sediments strongly suggests that oncoid-building micro-organisms mediated manganese precipitation. This observation is used to suggest that microbial mediation may be of greater importance for the origin of shallow-marine manganese deposition than is indicated by currently accepted metallogenetic models for shallow-marine pisolitic manganese deposits.