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Authigenic ferruginous pisoliths in aeolian sands: A new sampling medium for exploring the Yamarna Terrane, Western Australia

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Areas of thick transported cover, particularly those covered by sand dunes are extensive in the eastern parts of Western Australia, particularly in the Yamarna Terrane, NE Albany Fraser Orogen and Paterson Province. These areas represent a great challenge for mineral exploration. The most north-eastern Yamarna Terrane of the Yilgarn Craton in Western Australia is underexplored due to the scarcity of outcrops, deep weathering, and a lack of historical mineral discoveries.

Geochemical exploration approaches developed for the weathered terranes of the Yilgarn Craton can't be directly applied to the Yamarna Belt that is covered by weathered Permian (glacial) and Quaternary sand dunes on weathered Archaean basement. This different transported cover setting and regolith-landscape influences the effectiveness of metal migration mechanisms in and through cover, and hence a selection of the best sample media for exploration. However, the development of authigenic ferruginous pisoliths near-surface in the aeolian sands identifies proximal Au and As anomalies over Au mineralisation. Gold and As migrated through the Permian and aeolian sand cover by different dispersion processes. Gold was extracted mainly from pisoliths by K-iodide and K-cyanide suggesting Au was dispersed in particulate and soluble forms, whereas small amounts were extracted by 0.1M hydroxylamine hydrochloride and 0.1M tetra-sodium pyrophosphates suggesting a part of Au was associated with Mn oxides and organic compounds. Arsenic was extracted by 0.1M tetra-sodium pyrophosphate and Eucalyptus foliages shows As anomaly over the mineralisation. This suggest the role of organics in the dispersion of As. The internal structure of the pisoliths examined by SEM showed the abundance of mineralised (Fe-rich) fungal hyphae and (Mn-rich) spores which may indicate an active biogenic role in Au fixation.

The geochemical composition of the pisoliths is not only accurately delineating the location of the Au mineralisation, but also its mineralogy and chemical signature. Pisoliths are anomalous in Au and As over mineralisation where Au is associated with arsenopyrite. Conversely, when Au mineralisation is associated with pyrrhotite, these pisoliths are only anomalous in Au. Therefore, these pisoliths represent a new sampling medium that has not been used before in similarly challenging areas covered by sand dunes.