The Formation Of Ferruginous Pisoliths And The Mobility Of Gold And Pathfinder Elements In The Yilgarn Craton, Western Australia

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Ferruginous pisoliths are spherical bodies in regolith. They are abundant and widespread in the deeply weathered landscape of the Yilgarn Craton of Western Australia and they have been used successfully as a geochemical sampling medium for Au exploration. In places, ore-grade pisolith deposits have been mined. Pisoliths are developed in a variety of residual and transported materials including Tertairy sediments. There are a number of studies on the geochemical dispersion in pisoliths from the underlying primary mineralisation but very few on the origin and location of their contained metals. Without knowledge of the origin and mineral hosts of ore-derived trace metals in the regolith, understanding of anomalous concentrations, and selection of the best sample media is very empirical. This paper presents new information on (a) the nature and origin of pisoliths and (b) on the occurrence and concentration of specific trace elements and gold in a variety of minerals and mineralogical assemblages from the Moolart Well, Rose Dam and Mt Gibson gold deposits. Pisoliths are investigated by a variety of techniques, including bulk chemical composition, XRD, SEM, electron microprobe and laser ablation ICP-MS.

There are four main types of pisoliths: (i) angular to subangular yellowish brown, (ii) massive black, (iii) red earthy and (iv) yellow concentrically structured. Angular nodules are unconformably overlain by black to dark reddish brown and red, earthy pisoliths. Concentric pisoliths commonly occur in the lower clayey part of Tertiary sediments. The most diagnostic morphology of residual, goethite-hematite-rich angular nodules is the preservation of monomictic distinctive bedrock fabrics. Black detrital pisoliths are massive and hematite-maghemite-rich; authigenic red pisoliths are hematite-goethite-kaolinite-rich; authigenic concentrically structured pisoliths have multiple cutans and are goethite-rich. Red, earthy and black grains both have thin (<1mm) red or yellow cutans. Hematite has commonly altered to goethite by rehydration, resulting in goethite pisoliths.

Microanalysis of pisoliths of different origins and mineralogies suggest multi-stage hydromorphic and biogenic dispersion of Au, Cu, As and Pb in goethite and hematite. The dispersion processes are linked with the relative ages of materials and groundwater regimes.