EOCENE CHEMICAL WEATHERING IN SOUTHEAST YILGARN BLOCK

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The southeast margin of the Yilgarn Craton, in southwestern Australia, was inundated by marine transgressions during the Middle and Late Eocene. These transgressions resulted in the deposition of marine sediments in the shallow Eucla Basin and its marginal palaeovalleys, commonly for distances of several hundred kilometres from the palaeo-shoreline.

The Eocene palaeo-shoreline, at the onlap of the Eucla Basin with the Yilgarn Craton, was deeply embayed during this period. Organic and pyrite-rich, fine-grained, non-marine sediments, including locally thick peat accumulations, were deposited in the incised palaeovalleys and coastal plains during the early stages of the Middle Eocene transgression. Continued transgression drowned the palaeovalleys, forming estuaries that supported the extensive development of fringing mangrove communities and temperate rainforest. Terrigenous sediments accumulated in most estuaries and embayments during the Middle Eocene. The exception was in the Cowan Palaeovalley where reduced terrigenous influx allowed the deposition of shallow-marine, cool-water carbonates

When the sea regressed during the Middle Eocene and sea levels fell by at least 80 metres the estuarine sediments were drained, resulting in oxidation of the pyrite rich profile; generating sulphuric acid and precipitating haematite. The development of acid sulphate soils in reclaimed coastal wetlands is a contemporary analogue for this process. We speculate that acidification of the saline groundwater draining from the estuarine sediments would have resulted in dramatic leaching of the surrounding country rock, generating deep weathering profiles. Silica would have flooded the near-shore marine environment as a consequence of this deep weathering “event”, providing key nutrients for the extraordinary proliferation of marine sponges that formed the extensive coastal spiculites and spongolites of the Late Eocene transgression. Onshore, metal ions would have been released by weathering of the country rock and may have been fixed with precipitating haematitic iron.

If these speculated changes in the nature of the regolith in environments marginal to the unconformity of the Eucla Basin and the Yilgarn Craton during the mid Tertiary can be substantiated then geochemical exploration models in the Kalgoorlie region will need to be reviewed. Our hypothesis presents new and very different possibilities regarding the timing of deep weathering associated with acid leaching, and the age, style and distribution of metal traps within the regolith. Traps which may be the source of anomalies and secondary deposits.

Although this hypothetical model pertains to the southeastern Yilgarn Craton, it is also applicable to other margins of the Eucla Basin. It is especially applicable to the eastern margin, where similar Eocene sediments filled the same type of palaeo-landscape of coastal embayments and drowned estuaries of the Gawler Craton. Thus, we expect similar implications for the development and modification of geochemical signatures of ore bodies, and their supergene expression, in the Gawler Craton.