

Stratigraphy, tectonic evolution, and mineral potential of the Earraheedy Basin

by

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The Palaeoproterozoic Earraheedy Basin contains the Earraheedy Group, and lies at the eastern end of the Capricorn Orogen (Tyler et al., 1998). Recent geological mapping has led to a revision of the stratigraphy (Fig. 1), the development of a new model for basin evolution, and a better understanding of the potential for mineralization. Basement to the Earraheedy Basin is the Archaean Yilgarn Craton, and to the west the early Palaeoproterozoic Yerrida Basin. The Earraheedy Basin is interpreted to have been much larger than its present-day exposure, extending farther to the southwest and to the north, where it is masked by the overlying Bangemall and Officer Basins. The preserved exposure of the basin forms an east-plunging open syncline. The northern limb of this syncline is deformed, forming the Stanley Fold Belt. Deformation decreases southward.

Regional stratigraphic relationships indicate that the Earraheedy Basin is younger than the Yerrida Basin (2200 Ma; Woodhead and Hergt, 1997) and older than the Bangemall Basin (1650 Ma; Nelson, 1995), and that it appears to be unaffected by the 1800 Ma Capricorn Orogeny. Poor age constraints hinder more accurate placement of the basin within the regional framework. Isotopic ages for Earraheedy Group sedimentary rocks and mineralization in the basin cluster around 1800–1700 Ma.

The Earraheedy Group (Fig. 1) is a 5 km-thick package of shallow marine clastic and chemical sedimentary rocks that has been divided into two subgroups. The Tooloo Subgroup consists of the Yelma Formation (base), Frere Formation, and Windidda Formation (top). The overlying Miningarra Subgroup consists of the Chiall Formation (base), Wongawol Formation, Kulele Limestone, and Mulgarra Sandstone (top).

The Yelma Formation contains shale, sandstone and carbonate that were deposited in shallow-marine and locally fluvial environments. In the southwest of the basin, Mississippi Valley-type Pb–Zn–Cu mineralization occurs in an approximately 100 m-thick carbonate facies, the Sweetwaters Well Member. The overlying Frere Formation records the onset of the precipitation of Fe oxides within the basin, and consists of granular iron

formation separated by two major shale bands, and minor carbonate. The granular iron formation beds probably formed in the shallow waters of a continental shelf. Ferruginous peloids accreted in wave- and current-agitated iron-rich waters (Beukes and Klein, 1992), and were deposited after some reworking by mechanical processes, with variable terrigenous contamination. The overlying Windidda Formation consists of shale, locally stromatolitic carbonate, minor jasperoidal beds and granular iron formation. The finely laminated shale in the Windidda Formation, in the north and southwest of the Earraheedy Basin, is separated as the Karri Karri Member (Fig. 1). The Windidda Formation is interpreted to represent a carbonate shelf in the southeast, grading northwards to the quiet water deposition of the Karri Karri Member.

The Chiall Formation combines, as members, the former Wandiwarra Formation and Princess Ranges Quartzite. The Chiall Formation consists of shale, siltstone, and mudstone intercalated with thick sandstone beds and intraclastic breccia. The formation is the product of a change from combined chemical and clastic deposition to dominantly clastic deposition. At the base of the formation in the southeast, a breccia of poorly sorted, angular carbonate clasts in a glauconitic sandstone matrix is interpreted as a hardground, which records the rapid drowning and cementation of the carbonate platform of the Windidda Formation with minimal sedimentation. Sedimentary structures and palaeocurrent data indicate a tidal environment in the southeast, deepening northwards to below fair-weather wave base.

The Wongawol Formation consists of shale, siltstone to very fine grained sandstone, intraclastic breccia, and carbonate–glauconite breccia. Deposition was in a very shallow, locally emergent environment, with periods of minimal sedimentation. The Kulele Limestone is a cyclic platform carbonate succession, consisting of carbonate units which are separated by shale and sandstone. Carbonate units are stromatolitic, oolitic, and pisolitic, with individual stromatolites up to 3 m high and 4 m wide. Compared with the Wongawol Formation, the basin deepened slightly and had less terrigenous influx. At the top of the succession, the Mulgarra Sandstone consists of

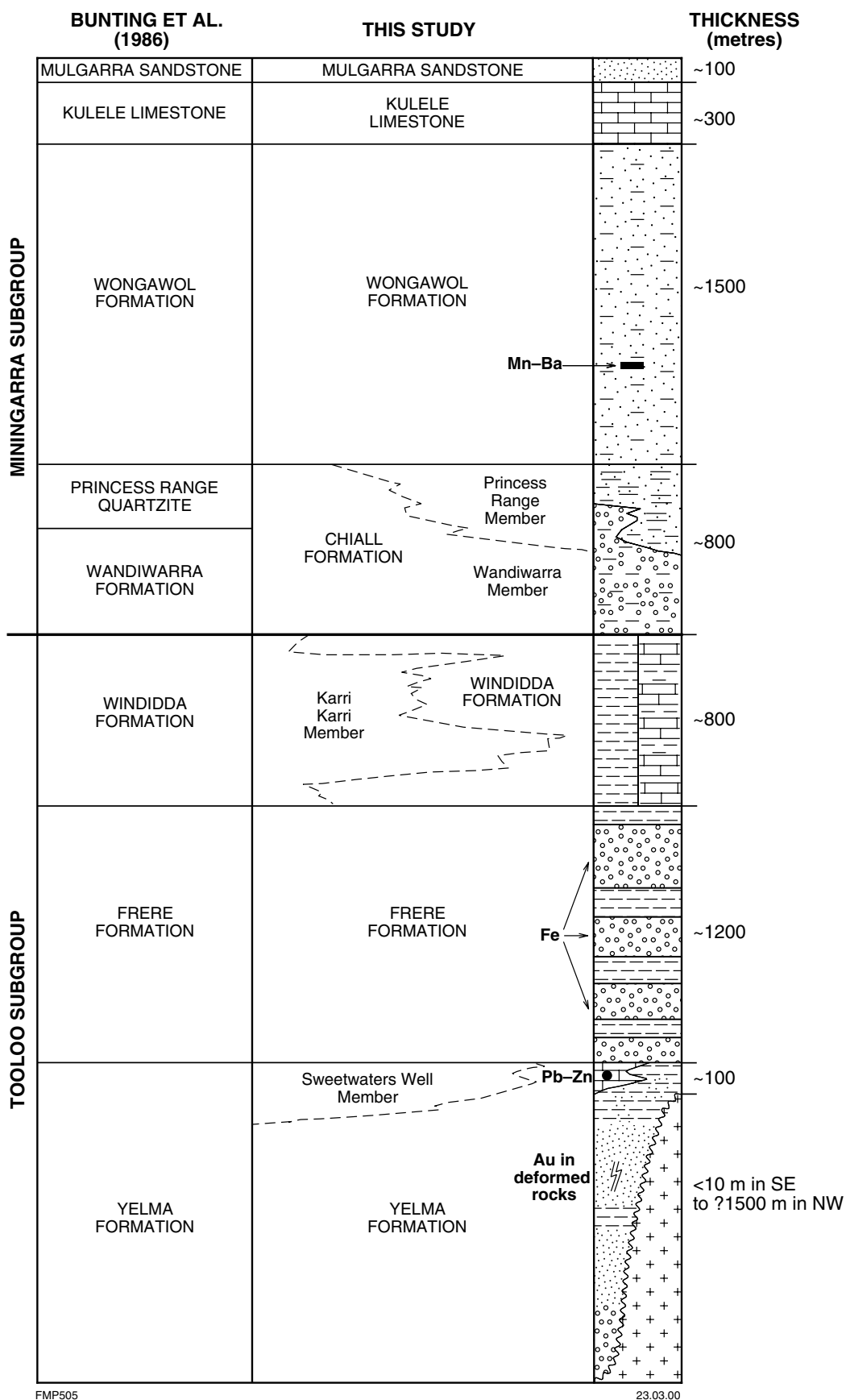


Figure 1. Stratigraphy, broad lithology, and mineralization of the Earaeedy Group

sandstone, shale and minor carbonate, and may reflect a final stage of terrigenous influx and tectonism.

The exposed Earraheedy Group is characterized by a shallow-marine to coastal depositional setting, with a shoreline to the south and southeast, and deepening towards the north. This is consistent with models of granular iron formation being the shallow-water facies equivalent of deeper water banded iron-formation (Beukes and Klein, 1992).

Known mineralization in the Earraheedy Basin consists of MVT Pb–Zn–Cu deposits in the Sweetwaters Well Member, near the Shoemaker Impact Structure. Sphalerite, galena, pyrite, and chalcopyrite occur largely as fracture fill, vug fill, or carbonate replacement. The large (>200 Mt) Magellan Pb deposit is hosted by outliers of the Yelma Formation overlying the Yerrida Group. Minor stratiform Mn and Fe oxides are present within the shale units of the Windidda Formation. These stratiform oxides contain anomalous abundances of Cu, Ba, and Pb, thus enhancing the prospectivity of the Earraheedy Basin for stratabound Cu of the Kupferschiefer type. Gold mineralization is present in the deformed Stanley Fold Belt (the presently exposed northern margin of the Earraheedy Group) where it is associated with mylonite and quartz veins.

Any tectonic model for the inception and evolution of the Earraheedy Basin is hindered by poor age constraints. However, on the basis of current field work we envisage that the basin was part of a rifted continental margin in

the northeast of the Yilgarn Craton. Compressive movements, perhaps associated with the collision with the North Australian plate, formed the Stanley Fold Belt. Only the southern shelf portion of the continental margin is now exposed. A mid-ocean ridge, which was probably located some distance north of the presently exposed margin and east of the Pilbara Craton, provided the source of dissolved iron for Frere Formation deposition.

References

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