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Tectonic setting, evolution and orogenic gold potential of the late Mesoarchaean Mosquito Creek Basin, North Pilbara Craton, Western Australia

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Abstract

The geology, evolution, and metallogenic potential of the Mesoarchaean Mosquito Creek Basin remains poorly understood, despite the presence of several orogenic gold deposits. The basin is dominated by medium- to coarse-grained, poorly sorted and chemically immature sandstone and conglomerates, characterised by very high Cr/Th, high Th/Sc, and low Zr/Sc relative to average continental crust. These features are consistent with the presence of significant mafic rocks in the source terrain(s), a limited role for sediment recycling, and deposition in an increasingly distal passive margin setting on the southeastern edge of the Palaeo- to Mesoarchaean East Pilbara Terrane.

New U–Pb SHRIMP data on 358 detrital zircons indicate a conservative maximum depositional age of 2972 + 14/−37 Ma (robust median; 96.1% confidence). Zircon provenance spectra from conglomeratic rocks near the base of the unit are consistent with substantial derivation from the East Pilbara Terrane, but finer-grained sandstones higher in the stratigraphy appear to have been sourced elsewhere, as their zircon age spectra are not well matched by any of the exposed Pilbara terranes.

The Mosquito Creek Basin was deformed before and during collision with the northern edge of the Mesoarchaean Kurrana Terrane, which resulted in the development of macroscopic north-verging folds, thrust faulting, and widespread sub-greenschist to greenschist facies metamorphism. This collisional event probably took place at ca. 2900 Ma, based on two identical Pb–Pb model ages of 2905 ± 9 Ma from epigenetic galena associated with vein-hosted gold–antimony mineralization. The metallogenic potential of the Mosquito Creek Basin remains largely unevaluated; however, the possibility of a passive margin setting and continental basement points to relatively limited potential for the formation of major orogenic gold deposits.

Keywords: North Pilbara Craton; Archaean; Mosquito Creek Formation; Detrital zircon geochronology; Geochemistry; Orogenic gold

1. Introduction

Turbidite-hosted orogenic gold deposits are well documented throughout the world. Examples are Palaeoproterozoic deposits in the Granites–Tanami Orogen of Northern Australia (Bagas et al., 2007), and Palaeozoic deposits of southeastern Australia (e.g. Bierlein et al., 2001, 2004), New Zealand (e.g. Christie and Brathwaite, 2003), and North America (Goldfarb et al., 1997, 1998; Böhlke, 1999; Bierlein et al., 2004). However, very little has been published on Mesoarchaean deposits. Examples are the epizonal deposits in the Mosquito Creek Basin (MCB) of the Archaean North Pilbara Craton that have produced over 8 t of gold (Ferguson and Ruddock, 2001).

Alluvial gold was discovered in the MCB near Nullagine township in 1886 and gave impetus for further exploration for gold and other precious metals in the region (Fig. 1), which continues to this day (Noldart and Wyatt, 1962).

Since the 1980s, various research groups have proposed that the structural history of the area involved either horizontal compressional tectonics, or invoked a range of diapiric models for the emplacement of Archaean granitic complexes (Van Kranendonk et al., 2002; Blewett et al., 2002, and references

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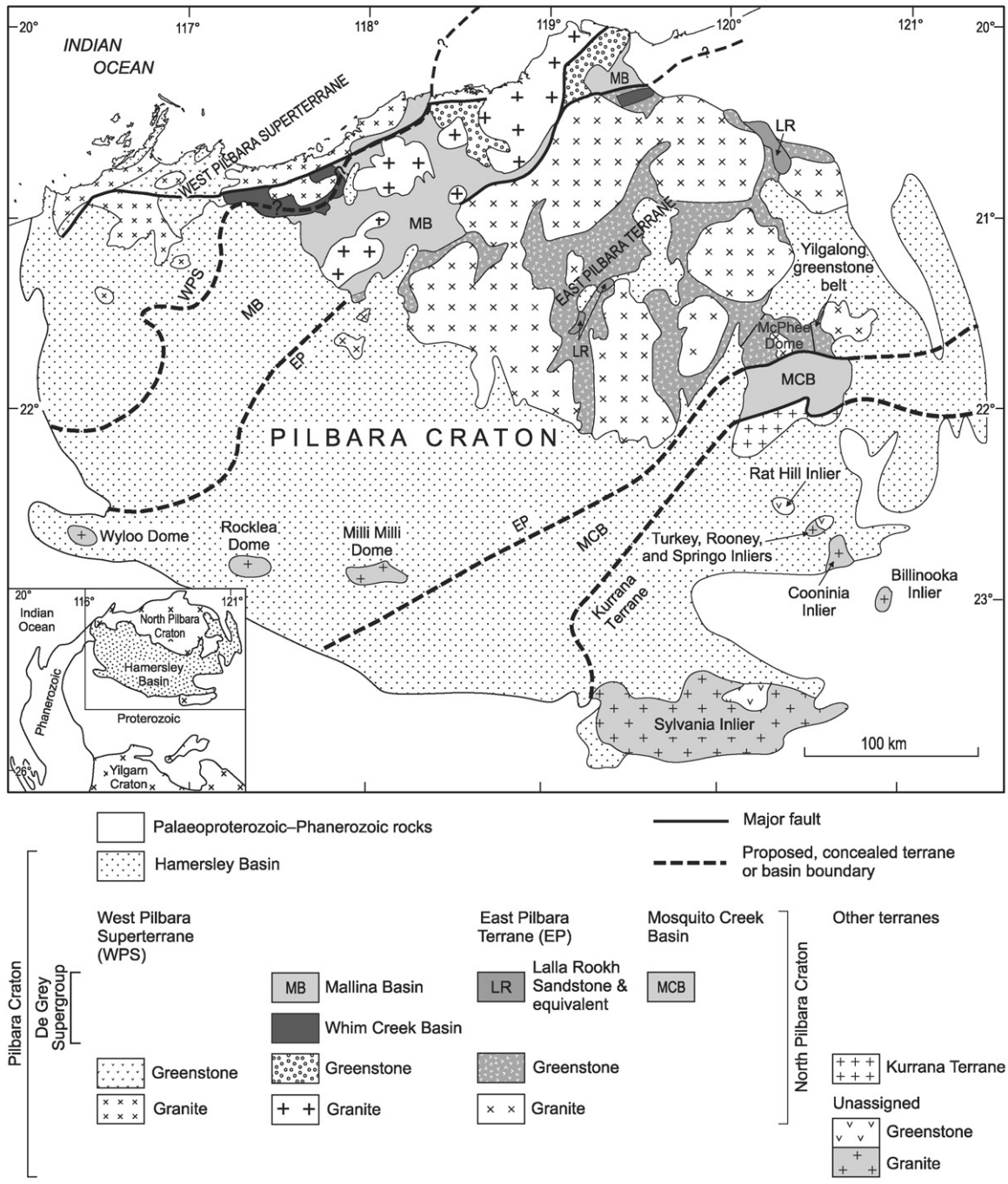

Fig. 1. Regional geological setting of the North Pilbara Craton.

therein). Hickman (1984) interpreted the MCB to have formed through subsidence during the later stages of granitic diapirism in the East Pilbara Terrane (EP), whereas Eriksson et al. (1994) interpreted it as a forearc basin and accretionary complex situated to the north of a subduction complex. Tyler et al. (1992) interpreted the Kurrana Shear Zone as a suture between two distinct terranes (Fig. 2), which amalgamated between 3000 and 2760 Ma. Krapez and Eisenlohr (1998) suggested that the MCB was equivalent in age to the ca. 3240 Ma Gorge Creek Group in the EP. By contrast, Witt et al. (1998) interpreted the MCB (Maitland, 1908; Noldart and Wyatt, 1962; Hickman, 1983, 2001) to be contemporaneous with the Mesoarchaean De Grey Supergroup (Van Kranendonk et al., 2004, 2007; Fig. 1).

This study presents new constraints on the age and provenance of the Mosquito Creek Formation based on SHRIMP U–Pb dating of detrital zircons, which was documented as a preliminary report including limited geochronological data by Bagas et al. (2004). Zircons are durable and can survive the processes of weathering and erosion, are largely unaffected by metamorphism below amphibolite facies, and can survive transport over distances of many hundreds or even thousands