Geology of the Neoproterozoic Lamil Group

by

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The Malu Formation in the Neoproterozoic Lamil Group has detrital zircon age populations and palaeocurrent directions that preclude the Archaean Pilbara Craton as a source. This has major implications for the tectonic evolution of the Paterson Orogen, which is a north-westerly trending belt of deformed and variably metamorphosed Palaeoproterozoic to Neoproterozoic rocks with a common tectonic history that extends from east of the Archaean Pilbara Craton to the Musgrave Complex of central Australia. The orogen is marked by the Warri Gravity High, which is a gravity feature that probably formed during the c. 550 Ma Paterson Orogeny (Fig. 1).

The northwesternmost part of the Paterson Orogen can be subdivided into the Palaeoproterozoic Rudall Complex, and the Neoproterozoic Lamil, Throssell, and Tarcunyah Groups (Fig. 1). The regional stratigraphic relationship between the Lamil and Throssell Groups has not been resolved, but their contact has been recognized using aeromagnetic images as a major northwesterly trending fault zone. The contact between the Tarcunyah and Throssell Groups is a fault over the entire length of about 300 km (Fig. 1). The Tarcunyah Group forms the base of the Officer Basin (Bagas et al., 1995), and is part of Supersequence 1 of the Centralian Superbasin (Walter et al., 1995).

The deposition of the Lamil Group, the age of which is broadly confined between c. 1070 (Fig. 2) and 650 Ma (age of post-orogenic granites), commenced with transpressional faulting during the onset of the Miles Orogeny in a continental setting that may have been a pull-apart basin in a dextral strike-slip system (Bagas, 2000).

In an attempt to determine the provenance of the Lamil Group, 36 detrital zircons from a sample of sandstone in the lower part of the Malu Formation were analysed by sensitive high-resolution ion microprobe (SHRIMP; Nelson, 2000) and compared (Fig. 2) with inherited zircon populations from the Musgrave Complex, Paterson Orogen, and Arunta Orogen regions. Figure 2 shows that the Malu Formation has a group of detrital zircons with U–Pb dates clustering at c. 1070 Ma. Zircons of this age link the source of the sediments to the Mesoproterozoic Musgrave Complex, exposed 400 km to the southeast, because it is the only known exposure of granites (or zircon-bearing rocks) with this age in Australia. The figure also shows that ages of a small proportion of zircons in the Malu Formation overlap with ages of zircons from Palaeoproterozoic rocks in the Rudall Complex and the Arunta Orogen. This is consistent with the provenance of the Lamil Group being the Musgrave Complex, with some detrital zircons coming from either the Rudall Complex of the Paterson Orogen or the Arunta Orogen.

The northeasterly trending palaeocurrents indicated from 130 sites suggest that the provenance of the Malu Formation was the Archaean Pilbara Craton to the southwest. However, the lack of any detrital zircons with Archaean ages suggests that the Pilbara Craton was not the source. Alternatively, the Pilbara Craton was not exposed during the deposition of the Lamil Group, or the sample population is too small to adequately identify the provenance.

This apparent discrepancy between the palaeocurrent data and the detrital zircon signature from the Malu Formation could be explained if the northwestern part of the Paterson Orogen is regarded as allochthonous. This area could have originated closer to the Musgrave Complex and Arunta Orogen, and been displaced 400 km sinistrally following the deposition of the Lamil Group. Such large-scale movement might have occurred during the c. 550 Ma Paterson Orogeny. Alternatively, the provenance for the Lamil Group could be a previously unknown area of Mesoproterozoic basement beneath the Officer Basin. Until more data are collected these results have to be interpreted with caution.

This preliminary work shows that provenance studies combining palaeocurrent data and detrital zircon analyses can be a powerful tool in understanding the geological history of complex structural terranes.

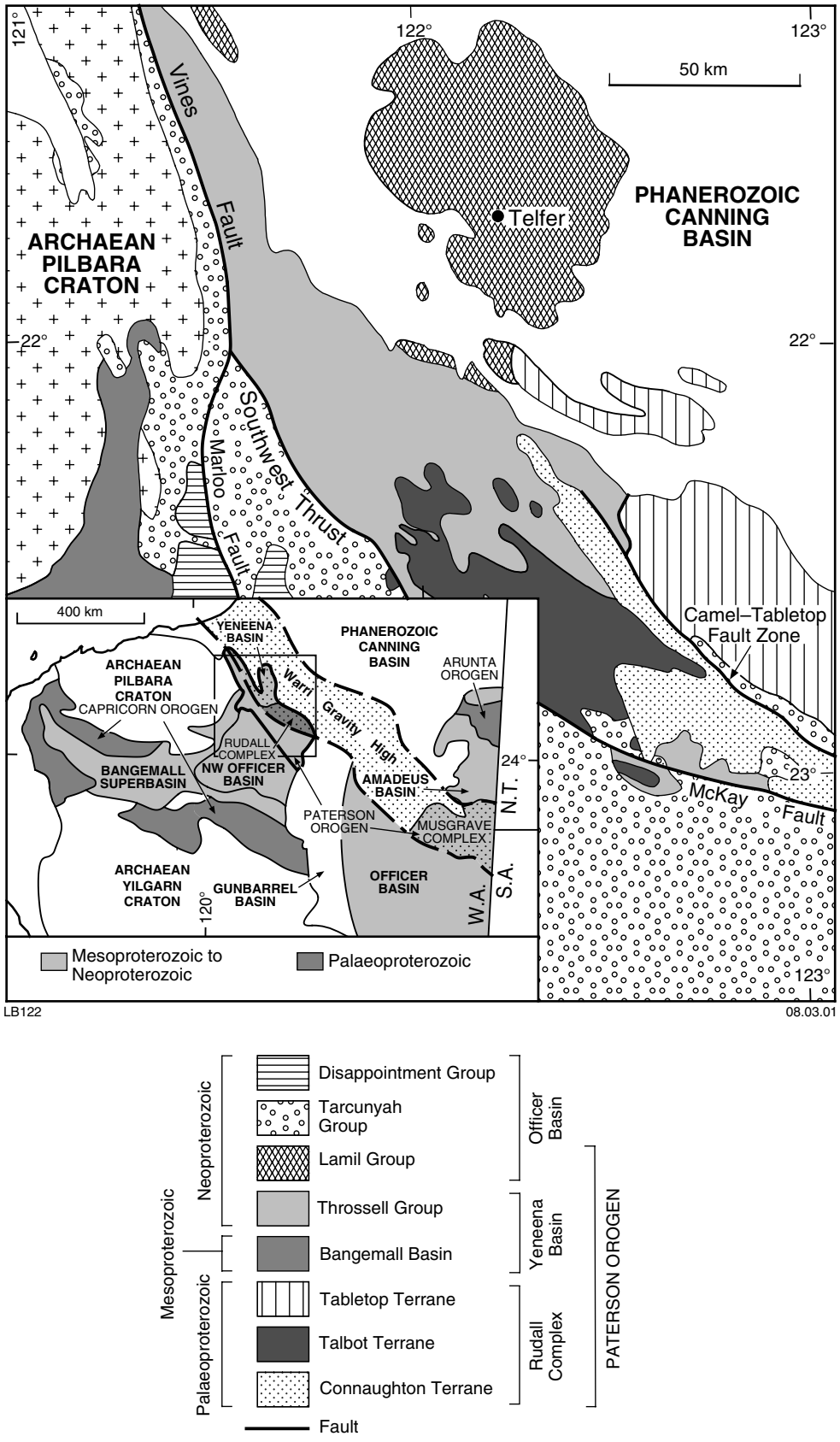

Figure 1. Regional geological setting of the northwestern Paterson Orogen

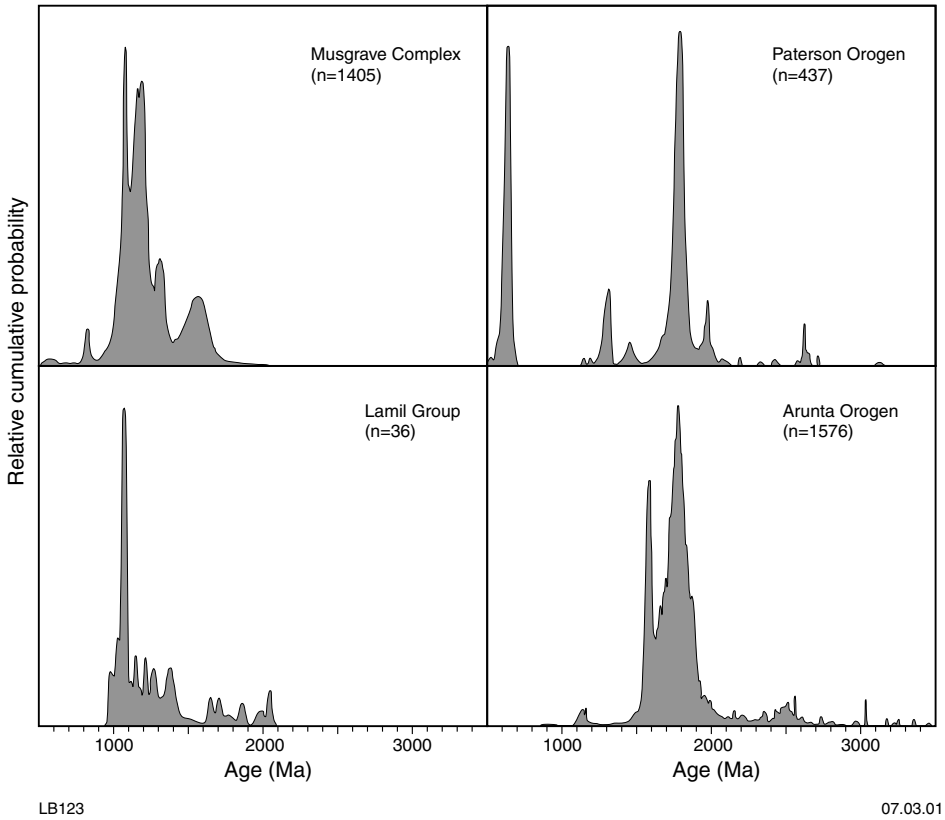

Figure 2. Comparison between relative cumulative probability distributions of detrital zircon components in the Lamil Group, and the inherited–detrital zircon components of the undifferentiated Paterson Orogen, Musgrave Complex, and Arunta Orogen. The graphs for the Musgrave Complex and Arunta Orogen were constructed by A. Camacho (2001, written comm.)

References

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