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Provenance history of the Bangemall Supergroup and implications for the Mesoproterozoic paleogeography of the West Australian Craton

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ABSTRACT

The 4–10 km-thick Bangemall Supergroup, comprising the Edmund and Collier Groups, was deposited between 1620 and 1070 Ma in response to intracratonic extensional reactivation of the Paleoproterozoic compressional Capricorn Orogen. The supergroup can be further divided into six depositional packages bounded by unconformities or major marine flooding surfaces. U–Pb dating of over 1200 detrital zircon grains from 19 samples representative of each of the major sandstone units within these packages has failed to identify any zircon populations attributable to syndepositional magmatism. However, this extensive dataset provides a provenance history of the Bangemall Supergroup, which is here integrated with paleocurrent data which indicates that all source areas were located within the Mesoproterozoic West Australian Craton, with the main source area for the northern Bangemall Supergroup being the Gascoyne Complex and southern Pilbara Craton. All samples have prominent age modes in the 1850–1600 Ma range, indicating significant contribution from the northern Gascoyne Complex and coeval sedimentary basins. Some samples also display prominent modes in the 2780–2450 Ma range, consistent with derivation from the Fortescue and Hamersley Groups of the southern Pilbara Craton. The Edmund Group has age-spectra in which the dominant modes become older upwards, recording unroofing of the underlying basement from the Gascoyne Complex to the Archean granites and greenstones of the Pilbara Craton. In contrast, the Collier Group records unroofing of the underlying Edmund Group, with possible additional contribution from the Pilbara Craton and Paterson Orogen, and is characterized by age-spectra in which the dominant modes become younger upwards. These data imply that the West Australian Craton remained intact throughout the Mesoproterozoic assembly of Rodinia, and was the only source of detritus for the Bangemall Supergroup.

1. Introduction

The Bangemall Supergroup is a Mesoproterozoic succession consisting of ~4–10 km of mostly fine-grained siliciclastic and carbonate sedimentary rocks that unconformably overlie Paleoproterozoic igneous and metamorphic rocks of the Gascoyne Complex, and Paleoproterozoic sedimentary rocks on the margins of the Archean Yilgarn and Pilbara cratons (Fig. 1). The succession is subdivided into a lower Edmund Group and an upper, unconformably overlying Collier Group (Martin and Thorne, 2004). Deposition of the Bangemall Supergroup occurred in response to intracontinental extensional reactivation of structures formed during the Paleoproterzoic Capricorn and Mangaroon Orogenies (Cawood and Tyler, 2004; Sheppard et al., 2005). The Bangemall Supergroup was subsequently deformed during the Neoproterozoic Edmundian Orogeny (Martin and Thorne, 2004), and is overlain by Neoproterozoic to Phanerozoic strata of the Officer Basin to the east (Perincek, 1996; Williams, 1992), and by the Phanerozoic Carnarvon Basin to the west (Fig. 1).

The age of the Bangemall Supergroup is poorly constrained, although deposition must postdate the intrusion of *c.*1620 Ma granites into the unconformably underlying Gascoyne Complex (Martin and Thorne, 2004). The most reliable age constraints are provided by a suite of *c.*1465 Ma dolerite sills intruded exclusively into the Edmund Group, and a suite of *c.*1070 Ma dolerite sills that were intruded mainly into the Collier Group (Wingate, 2002). Both dolerite suites show localized evidence of magma interaction with

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wet or partially lithified sediments, including soft-sediment deformation, fluidization, and quench fragmentation (Martin, 2003; Muhling and Brakel, 1985). The depositional age of the Edmund Group must therefore be slightly older than 1465 Ma, and the Collier Group slightly older than 1070 Ma.

During the course of recent regional geological mapping of the Bangemall Supergroup, 19 samples of sandstone have been collected from the major sandstone-dominated units for SHRIMP U–Pb detrital zircon analysis (Figs. 2 and 3). The initial objective of this sampling strategy was to constrain the depositional age of the Bangemall Supergroup more precisely by attempting to identify penecontemporaneous magmatic zircon populations younger than the underlying basement that may have been introduced by syndepositional volcanic activity. Since all zircon populations identified can be attributed to basement derivation, the detrital zircon age data were integrated with extensive paleocurrent data with a view to determining the provenance history of the Bangemall Supergroup and the Mesoproterozoic paleogeography of the West Australian Craton. These results have important implications for understanding Rodinia reconstructions by identifying the ages and relative positions of source areas that contributed detrital zircons to the Bangemall Supergroup during the assembly of Rodinia.

2. Geological setting

2.1. Regional geology

The study area is situated in the northwestern Capricorn Orogen (Fig. 1), where the Bangemall Supergroup unconformably overlies Paleoproterozoic igneous and low- to high-grade

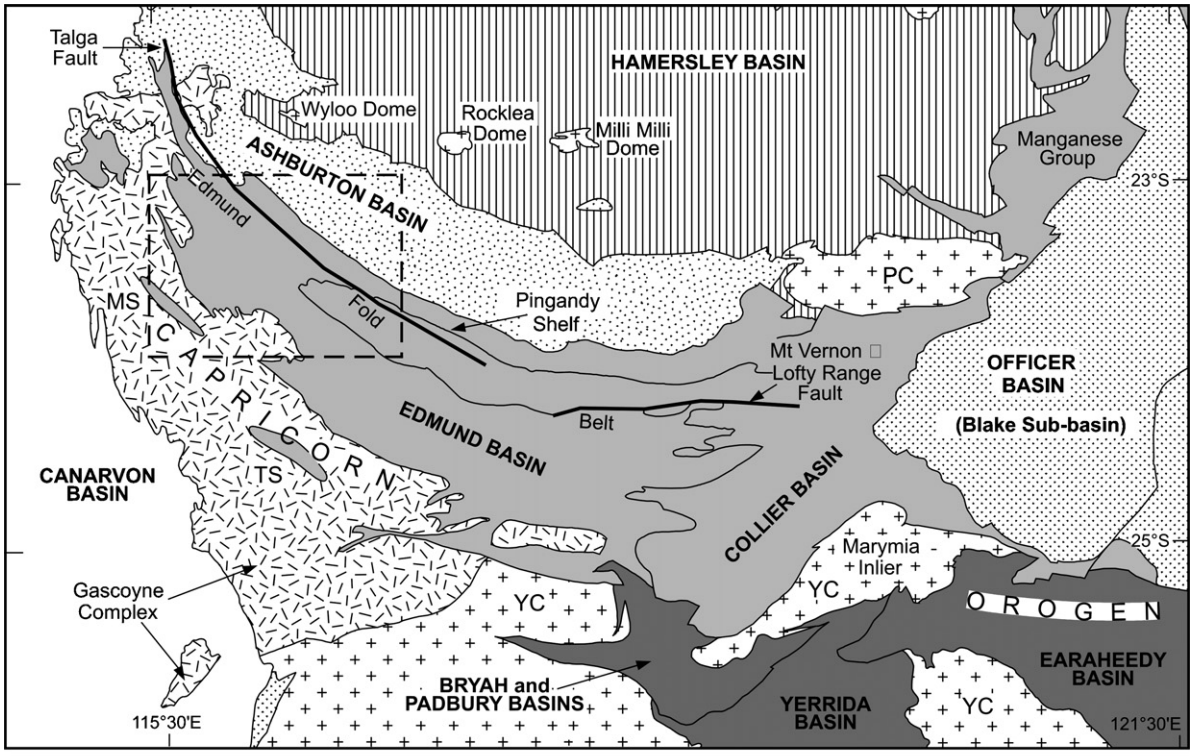

Fig. 1. Regional geological setting of the Bangemall Supergroup within the Capricorn Orogen, showing the distribution of the Edmund and Collier basins. Details of the study area, indicated by a dashed outline, are presented in Fig. 2. PC = Pilbara Craton, YC = Yilgarn Craton, MS = Mangaroon Syncline, TS = Ti Tree Syncline.