Journal of the Geological Society, *London*, Vol. **162**, 2005, pp. 433–450. Printed in Great Britain.

A review of the Mesoproterozoic to early Palaeozoic magmatic and tectonothermal history of south–central Africa: implications for Rodinia and Gondwana

SIMON P. JOHNSON[1], TOBY RIVERS[2] & BERT DE WAELE[3]

[1]*Institute for Research on Earth Evolution (IFREE), Japan Agency for Marine–Earth Science and Technology, 2–15 Natsushima-cho, Yokosuka-shi Kanagawa-ken 237-0061, Japan (e-mail: sjohnson@jamstec.go.jp)*

[2]*Department of Earth Sciences, Memorial University, St John's, Newfoundland, Canada, A1B 3X5*

[3]*Tectonics Special Research Centre, School of Earth and Geographical Sciences, University of Western Australia, 35 Stirling Highway, Crawley, W.A. 6009, Australia*

Abstract: This paper provides a review of the tectonic evolution of central–southern Africa from Mesoproterozoic to earliest Palaeozoic times, using available geological information and a robust U–Pb zircon database. During the late Mesoproterozoic, the southern margin of the Congo–Tanzania–Bangweulu Craton was characterized by suprasubduction-zone magmatism and the accretion of arc and microcontinental fragments. Magmatism within the adjacent Irumide Belt formed by recycling of older continental crust. Ophiolite blocks, possibly part of an olistostromal mélange, are present in a Neoproterozoic sequence overlying the Irumide Belt, and the occurrence of high-pressure/low-temperature subduction-zone metamorphism and protracted Neoproterozoic suprasubduction-zone magmatism demonstrates that there was an ocean to the south (present-day coordinates) of the Congo–Tanzania–Bangweulu Craton until the amalgamation of Gondwana at 550–520 Ma, indicating that the Congo–Tanzania–Bangweulu Craton was not part of Rodinia. On the basis of their different ages and styles of magmatism, the Mesoproterozoic Kibaran Belt, Choma–Kalomo Block and Irumide Belt are not components of the same orogen, therefore precluding a sub-Saharan-wide, linked 'Kibaran' (*sensu lato*) orogenic event. Evidence is presented to illustrate that the Congo–Tanzania–Bangweulu and Kalahari Cratons developed independently until their final collision during the Pan-African Orogeny along the Damara–Lufilian–Zambezi Orogen at *c*. 550–520 Ma.

Keywords: Gondwana, Rodinia, Pan-African Orogeny, south–central Africa, tectonic evolution.

Like other continental regions, Africa comprises several Archaean cratonic nuclei that are 'stitched' together by younger orogenic belts. These belts record the history of break-up, accretion and collisional orogenesis that eventually resulted in the present configuration of the African continent. In this paper, we are concerned with the sub-Saharan region, which is known to consist of Archaean nuclei sutured by orogenic belts of Palaeoproterozoic, Mesoproterozoic and Neoproterozoic to earliest Palaeozoic age (Fig. 1, inset). It has been suggested that the Palaeo- and Mesoproterozoic belts may record the participation of these Archaean nuclei in the supercontinents Columbia (Rogers & Santosh 2002) and Rodinia (e.g. McMenamin & Schulte-McMenamin 1990; Hoffman 1991; Moores 1991; Dalziel 1992) respectively, and that the Neoproterozoic to earliest Palaeozoic belts record the formation and assembly of Gondwana (Shackleton 1996). However, details of several of these connections, especially those in pre-Gondwanan times, remain poorly constrained and locally disputed. The key to understanding the amalgamation history of this region lies in unravelling the complex tectonic history of the various orogenic belts, some of which have undergone penetrative structural and thermal reworking following their initial post-orogenic stabilization, rendering their interpretation especially cryptic. To improve understanding of these belts, the following first-order goals must be achieved.

(1) Discrimination between basement and juvenile material, such as sediments deposited in continental or oceanic basins, ophiolite suites, island arcs or continental-margin arcs.

(2) The robust dating of juvenile material (e.g. ophiolite formation and obduction, arc formation and accretion), and constraints on the timing of sedimentation.

(3) Defining the nature (collisional, accretionary, extensional) and precise timing of magmatism and peak orogenesis and the delineation of the late orogenic thermotectonic history (e.g. extensional collapse).

(4) The evaluation and backstripping of variably penetrative overprinting deformation and/or metamorphism.

Until recently, the understanding of most of the Mesoproterozoic and Neoproterozoic belts of southern Africa was at a rudimentary level. However, a flurry of recent publications, especially those presenting new, high-precision geochronology, *P–T* determinations and petrogenetic studies, have shed new light on various aspects of their tectonic evolution, prompting us to attempt a synthesis of the available data in the light of our own recent and continuing research.

Published geochronology

From the 1960s to the 1980s, the majority of published geochronological data for the African subcontinent was based on the Rb/Sr isotopic system (e.g. Cahen *et al*. 1984). Recent high-precision U–Pb dating by sensitive high-resolution ion microprobe (SHRIMP) and single-zircon isotope dilution-thermal ionization mass spectrometry (ID-TIMS) indicates that many of these Rb/Sr dates have been reset and are thus not amenable to straightforward interpretation. Therefore, this discussion is limited to U/Pb zircon or monazite ages, principally those determined by SHRIMP or ID-TIMS methods