A REVIEW OF THE MESOPROTEROZOIC TO EARLY PALAEOZOIC MAGMATIC AND TECTONOTHERMAL HISTORY OF CENTRAL SOUTHERN AFRICA: IMPLICATIONS FOR RODINIA AND GONDWANA RECONSTRUCTIONS. S. P. Johnson[1] and T. Rivers[2], [1]Institute for Frontier Research on Earth Evolution, JAMSTEC, 2-15 Natsushima-cho, Yokosuka, Japan, 237-0061, sjohnson@jamstec.go.jp, [2]Department of Earth Sciences, Memorial University, St John's, Newfoundland, Canada, A1B 3X5, trivers@sparky2.esd.mun.ca.

Introduction: Like other continental regions, sub-Saharan Africa comprises several Archaean cratonic nuclei that are enveloped by younger orogenic belts that record the history of break-up and accretionary and collisional orogenesis that eventually resulted in the present configuration of the African continent. Until recently, the understanding of most of these orogenic belts was at a rudimentary level for a variety of reasons including poor geochronological dating of magmatic/tectonic episodes and the widespread overprinting of the Palaeo- and Mesoproterozoic belts during the Pan-African orogeny. However, recent publications, especially those concerning the precise timing (i.e., high-precision U-Pb zircon dates) and significance of magmatic crystallization events and tectonometamorphic episodes, have begun to shed new light on these old problems. Furthermore, these data provide crucial information on the configuration of Rodinia and the assembly history of Gondwana.

Geochronological Database: Most published geochronological data for the southern African sub-continent is based on the Rb-Sr isotopic system. Recent high-precision U-Pb dating using the SHRIMP (sensitive high-resolution ion microprobe) has confirmed that many of these Rb-Sr ages have been reset and, thus, are not amenable to straightforward interpretation. As a result, this discussion is limited to U-Pb zircon or monazite ages, principally those determined by SHRIMP, TIMS (thermal ionization mass spectrometry) and Pb-Pb evaporation techniques. For the Mesoproterozoic, a total of 109 igneous U-Pb zircon cryststallisation ages is considered (Fig. 1). A total of 31 ages is available to constrain Pan-African metamorphism (Fig. 2).

Mesoproterozoic Evolution: The Mesoproterozoic Kibaran Belt, Irumide Belt (and its reworked extension referred to here as the Southern Irumide Belt), and the Choma-Kalomo Block have traditionally been considered to have developed in a single, long-lived (ca. 400 M.y.) "Kibaran-age" orogenic event, namely the Kibaran Orogeny [1-3]. Since igneous rocks form in a variety of tectonic environments, it is inappropriate to make direct correlations on the basis of age alone, as has been done in other reviews and syntheses of the region. Here the data are subdivided into (1) oceanic/island-arc magmatism; (2) supra-subduction continental-margin-arc magmatism; (3) syntectonic continental collision magmatism; (4) post-tectonic/anorogenic magmatism; and (5) continental/arc rifting magmatism.

A continent-wide Kibaran Orogney? From Fig. 1 it is clear that the sub-regions of the Irumide Belt, *sensu lato*, i.e., the southeastern margin of the CTB (Congo-Tanzania-Bangweulu) craton, all share an important supra-subduction zone magmatic episode [4-7], between ca. 1100 and 970 Ma.

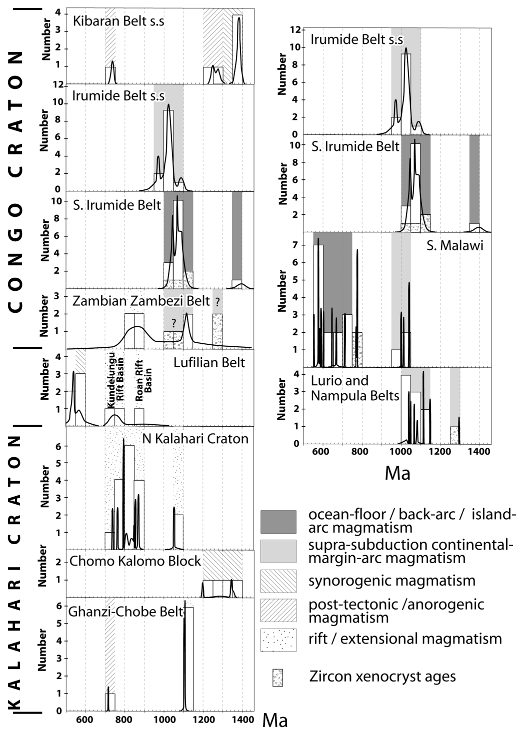

Figure 1. Histogram and probability density curves -"bar codes" - for 109 U-Pb magmatic crystallization ages from central, southern Africa.

The lack of syn-collision-related granitoid magmatism suggests that the Irumide Belt formed in an active, Andean- or Cordilleran-type setting [7] consistent with prolonged accretion of oceanic fragments as far back as 1.4 Ga [4] and the HT-LP metamorphic signature of the belt. Similar-aged active continental margin and island-arc magmatism is also present in southern Malawi and the Mozambique Belt (Fig. 1). Altogether, these data indicate the presence of an oceanic realm to the southeast (present coordinates) of the CTB craton during the Mesoproterozoic (Fig. 2). This signature contrasts strongly with that for the

Kibaran Belt, *sensu.stricto*, in which peak, syn-collisional, magmatism at ca. 1390-1370 Ma was associated with MT-MP metamorphism [8] resulting from continental collison between the Congo and Tanzania-Bangweulu cratons (Fig. 3). The contrasting styles and ages of magmatism and metamorphism in the two belts imply that they developed in different tectonic regimes and do not support the concept that they formed in a linked orogenic system. The “bar codes” of Fig. 1 clearly negate any correlations of the Choma-Kalomo Block, across the Zambezi Belt, with the Irumide Belt *sensu stricto*. It is important to note that no oceanic, collisional or post-tectonic magmatic activity is recorded along the northern margin of the Kalahari craton during this “Kibaran-aged” time frame.

Were the Congo and Kalahari Cratons part of Rodinia? Although there is no consensus on its configuration, it is widely assumed that Rodinia formed during Late Mesoproterozoic (1.1-1.0 Ga) collisional events. Where robust APWP’s are lacking, geological constraints from the craton’s margins are essential for such reconstructions. It is clear that, at the time of Rodinia formation, the southern margin of the CTB craton faced an open oceanic realm. Constraints on the other CTB craton margins, summarized in [9-10], similarly lack evidence for collisional orogenesis at this time. Sparse palaeomagnetic data [10] from the Sáo Francisco craton also suggest that the CTB craton was not an integral part of Rodinia and most likey existed as a separate, distal entity (Fig. 2). On the basis of a well-dated, robust palaeomagnetic pole [11], it is possible that the Kalahari craton may have been situated near to Western Australia (Fig. 2).

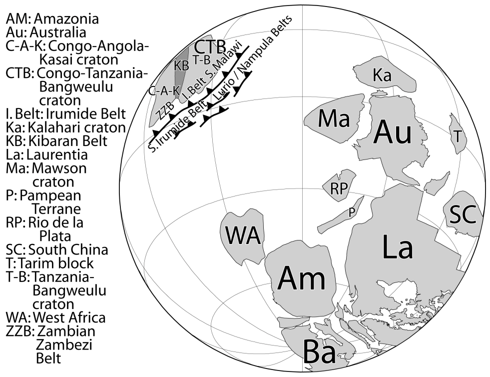

Figure 2. Rodinia reconstruction after [10], illustrating the tectonic environment of the CTB and Kalahari cratons at ca. 1.0 Ga.

Furthermore, magmatic events associated with Rodinia break-up appear to have occurred in a similar time frame to those along the northern margin of the Kalahari craton (Fig. 1) [12].

Neoproterozoic Tectonothermal Evolution: Thousands of isolated mafic and mafic-eclogite blocks within the Roan Group of the Lufilian Belt provide evidence for a Neoproterozic oceanic basin between the CTB and Kalahari cratons. Prolonged supra-subduction magmatism in Southern Malawi, until ca. 550 Ma (Fig. 1), is further evidence for this major oceanic tract. LT-HP eclogite facies metamorphic conditions dated at ca. 590 Ma [13] record the subduction of this oceanic crust. Collision-related MT-MP amphibolite facies metamorphism occurred between 570-520 Ma concurrently with the assembly of Gondwana. The Damara-Lufilian-Zambezi (DLZ) orogeny is the westerly continuation of the Kuunga orogeny [14].

Tectonic History of southern Africa: Figure 3 illustrates the assembly history of southern Africa which is represented by two main branches, one comprising the Congo, Tanzania and Bangweulu cratons and the other the Zimbabwe and Kaapvaal cratons. These branches record successive collisional and accretionary events that finally converge at 570-520 Ma across the DLZ orogen.

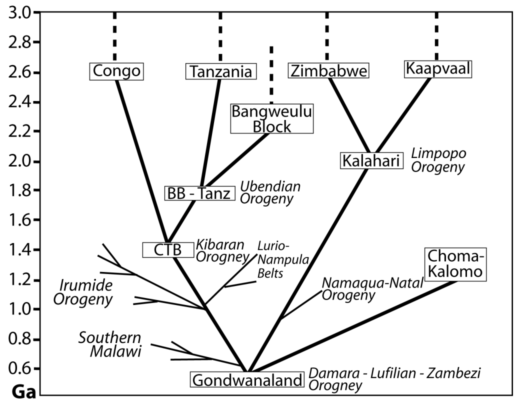

Figure 3. Cladogram showing the tectonic assembly history of southern Africa.

References: [1] Kroner (1977) *Tectonoph 40*, 101-135. [2] Hanson (2003*) GSL Sp Pub 206*, 427-463. [3] Kampunzu et al. (2003) *GSA 03*, Abstract, 124-3. [4] Oliver et al. (1998) *Geol 26*, 571-573. [5] Johnson and Oliver (2000) *Precam Res 103*, 125-146. [6] Johnson and Oliver (2004). *Precam Res 130, 71-97*. [7] Katongo et al. (submitted) *JAES* [8] Kokonyangi et al. (2001) *Gond Res Abstr 663-664.* [9] Kroner and Cordani (2003) *Tectonoph 374, 325-352*. [10] Pisarevsky et al. (2004) *GSL Sp Pub 206.* 35-55. [11] Powell et al. (2001) *Precam Res* 110, 33-46. [12] Li et al. (2003) *Precam Res* 122, 85-109. [13] John et al. (2003) *Geol 31, 243-246.* [14] Meert (2003) *Tectonoph 362,* 1-40.