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A new geological framework for south-central Madagascar, and its relevance to the "out-of-Africa" hypothesis

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ABSTRACT

The Precambrian shield of south-central Madagascar, excluding the Vohibory region, consists of three geologic domains, from north to south: Antananarivo, Ikalamavony-Itremo, and Anosyen–Androyen. The northern Antananarivo domain represents the Neoarchean sector of the Greater Dharwar Craton amalgamated at 2.52–2.48 Ga. The Greater Dharwar Craton is overlain by several groups of Meso- to Neoproterozoic supracrustal rocks (Ambatolampy, Manampotsy, Ampasary, Sahantaha, and Maha Groups) each with a common and diagnostic signature of Paleoproterozoic detrital zircons (2.2–1.8 Ga). The central domain (Ikalamavony-Itremo) consists of two distinct parts. The Itremo Sub-domain, in the east, is a structurally intercalated sequence of Neoarchean gneiss and shallow marine metasedimentary rocks of Paleo-Mesoproterozoic age (Itremo Group), the latter with Paleoproterozoic detrital zircons ranging in age between 2.2 and 1.8 Ga. The Ikalamavony Sub-domain, to the west, contains abundant volcano-clastic metasediments and lesser quartzite (Ikalamavony Group), formed between 1.03 Ga and 0.98 Ga, and intruded by igneous rocks (Dabolava Suite) of Stenian–Tonian age. Structurally intercalated with these are sheets of Neoarchean gneiss (~2.5 Ga) and Neoproterozoic metaclastic rocks (Molo Group). Like the Itremo Group, quartzite of the Ikalamavony Group has detrital zircons of Paleoproterozoic age (2.1–1.8 Ga). The southern domain of Anosyen–Androyen consists of a newly recognized suite of Paleoproterozoic igneous rocks (2.0–1.8 Ga), and stratified supracrustal rocks also having Paleoproterozoic detrital zircons (2.3–1.8 Ga). The contact between the Anosyen–Androyen and Ikalamavony-Itremo domains, formerly known as the Ranotsara–Bongolava shear zone, is a tightly folded and highly flattened boundary that was ductilely deformed in Ediacaran time. It is roughly equivalent to the Palghat–Cauvery shear zone in south India, and it defines approximately the boundary between the Archean Greater Dharwar Craton (to the north) and the Paleoproterozoic terrane of Anosyen–Androyen (to the south).

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1. Introduction

The Neoproterozoic East African Orogen records the closure of several ocean basins and the final assembly of Gondwanaland. A widely cited, yet contentious, boundary within the orogen is the Betsimisaraka Suture of east Madagascar (Collins et al., 2000a; Kröner et al., 2000), purportedly a convergent Neoproterozoic margin that sutures the continental fragments of "Azania" (of African origin) and the Dharwar Craton, India (of East Gondwana, Collins and Pisarevsky, 2005; BGS et al., 2008; De Waele et al., 2009; Key et al., in press; Fig. 1).

The Betsimisaraka Suture is premised on several lines of evidence, all of them recently questioned by Tucker et al. (in press). One of these is a low-grade medial Proterozoic sedimentary sequence in central Madagascar (Itremo Group, Moine, 1967, 1968, 1974), containing a subset of detrital zircons (2.2–1.8 Ga), purportedly sourced from the Tanzania Craton-Bangweulu Block (Cox et al., 1998, 2004; Fitzsimons and Hulscher, 2005). The presence of the enigmatic detrital zircons led to the hypothesis that Azania, composed of the Itremo Group and its Archean basement, rifted "out-of-Africa" and accreted with the Dharwar Craton before final amalgamation of Gondwana in Ediacaran–Cambrian time (Cox et al., 2004; Fitzsimons and Hulscher, 2005; Collins, 2006). Similar

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