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A re-evaluation of the Kumta Suture in western peninsular India and its extension into Madagascar

Sheree E. Armistead[a,*], Alan S. Collins[a], Justin L. Payne[b], John D. Foden[a], Bert De Waele[c,d], E. Shaji[e], M. Santosh[a]

[a] Centre for Tectonics, Resources and Exploration (TRaX), Department of Earth Sciences, The University of Adelaide, SA 5005, Australia
[b] Centre for Tectonics, Resources and Exploration (TraX), School of Built and Natural Environments, The University of South Australia, SA 5001, Australia
[c] SRK Consulting, 10 Richardson Street, West Perth, WA 6005, Australia
[d] Department of Applied Geology, Curtin University, WA, Australia
[e] Department of Geology, University of Kerala, Kariavattom, Trivandrum, India

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ABSTRACT

It has long been recognised that Madagascar was contiguous with India until the Late Cretaceous. However, the timing and nature of the amalgamation of these two regions remain highly contentious as is the location of Madagascar against India in Gondwana. Here we address these issues with new U-Pb and Lu-Hf zircon data from five metasedimentary samples from the Karwar Block of India and new Lu-Hf data from eight previously dated igneous rocks from central Madagascar and the Antongil-Masora domains of eastern Madagascar. New U-Pb data from Karwar-region detrital zircon grains yield two dominant age peaks at c. 3100 Ma and c. 2500 Ma. The c. 3100 Ma population has relatively juvenile $\varepsilon_{Hf}(t)$ values that trend toward an evolved signature at c. 2500 Ma. The c. 2500 Ma population shows a wide range of $\varepsilon_{Hf}(t)$ values reflecting mixing of an evolved source with a juvenile source at that time. These data, and the new Lu-Hf data from Madagascar, are compared with our new compilation of over 7000 U-Pb and 1000 Lu-Hf analyses from Madagascar and India. We have used multi-dimensional scaling to assess similarities in these data in a statistically robust way. We propose that the Karwar Block of western peninsular India is an extension of the western Dharwar Craton and not part of the Antananarivo Domain of Madagascar as has been suggested in some models. Based on $\varepsilon_{Hf}(t)$ signatures we also suggest that India (and the Antongil-Masora domains of Madagascar) were palaeogeographically isolated from central Madagascar (the Antananarivo Domain) during the Palaeoproterozoic. This supports a model where central Madagascar and India amalgamated during the Neoproterozoic along the Betsimisaraka Suture.

1. Introduction

The assembly of central Gondwana occurred along the Neoproterozoic–Cambrian East African Orogen, which formed by at least two orogenies—the c. 650 Ma East African Orogeny and the c. 550–530 Ma Malagasy Orogeny. These events involved the amalgamation of several continental blocks along discrete orogenic belts (Collins and Pisarevsky, 2005; Fritz et al., 2013; Johnson et al., 2011; Stern, 1994). Of particular interest, and contention, is whether the amalgamation of Azania (a postulated Neoproterozoic continent that consists of central Madagascar, the Madurai Block of India, a swath of eastern Africa and a part of Yemen (Collins and Pisarevsky, 2005; Collins and Windley, 2002)) and Neoproterozoic India occurred at this time, or whether this had taken place much earlier during the Archaean (e.g. Tucker et al., 2011a, 2011b, 2014). Several models have been proposed to account for similarities in the geology of Madagascar and India, but these models vary significantly in the timing and nature of major tectonic events that led to the amalgamation of these two regions (Boger et al., 2015, 2014; Collins and Pisarevsky, 2005; Collins and Windley, 2002; Ishwar-Kumar et al., 2013; Tucker et al., 2011a, 2011b, 2014).

Several opposing models have emerged in the literature that describe very different hypotheses for the tectonic evolution of Madagascar and India. The recognition that rocks of the Antongil-Masora domains of eastern Madagascar are similar to the Dharwar Craton (Tucker et al., 1999), and distinctly different from central Madagascar, led Collins and Windley (2002) to propose the Betsimisaraka Suture (Fig. 1). This proposed suture zone along present day eastern

* Corresponding author.
E-mail addresses: sheree.armistead@adelaide.edu.au (S.E. Armistead), alan.collins@adelaide.edu.au (A.S. Collins), Justin.Payne@unisa.edu.au (J.L. Payne), john.foden@adelaide.edu.au (J.D. Foden), bdewaele@srk.com.au (B. De Waele), shajigeology@gmail.com (E. Shaji), santosh@cugb.edu.cn (M. Santosh).

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