Geophysical Research Abstracts, Vol. 8, 02019, 2006
SRef-ID: 1607-7962/gra/EGU06-A-02019

Reappraisal of the geology and structural evolution of the Precambrian basement in north and east-central Madagascar

P. Pitfield (1), W. Bauer (1), D. Schofield (1), T. Kusky (2,3) and T. Randriamananjara (4)

1. British Geological Survey, Nottingham, UK
2. Saint Louis University, Missouri, USA
3. United States Geological Survey, Reston, Virginia, USA
4. Projet de Gouvernance des Ressources Minerales, MEM, Antananarivo, Madagascar

(pejp@bgs.ac.uk / Fax: +44-115-9363520 / Phone: +44-115-9363122)

The Precambrian basement of Madagascar is currently the focus of a major, World Bank-supported, Mineral Resources Management Project. The 3-year programme, which commenced in 2005, combines 1:100,000-scale geological mapping with aero-geophysical and geochemical surveys in specific areas of enhanced mineral potential. Targeted petrological, structural and ore deposit studies are being undertaken in the intervening areas. The northern and east-central parts of the Madagascar (Zones A, B and D north) are being surveyed by a BGS-USGS consortium and some preliminary results are presented herein.

Although previously published maps are quite sound in terms of lithological and mineralogical information, some contacts are misplaced and units poorly defined or absent. Furthermore, a lithostratigraphic approach has been erroneously applied, in part based on migmatite texture. Structural data is deficient and has led to a number of structural projects in recent years by a series of university-based groups [3,17,15,5,10]. This project will introduce a modern terminology, a revised tectonostratigraphic subdivision and incorporate new structural and geochronological data.

The polydeformed Precambrian basement of north-central Madagascar is composed of two juxtaposed N-S-trending Archaean domains with different tectonic and pa-

leogeographic affinities. In the northernmost part of the island, these are overthrust by the E-W-trending Bemarivo belt [3,6] which is dominated by Neoproterozoic rocks metamorphosed up to granulite facies conditions during the Cambrian [19,2].

The Antongil block [12,13] exposed along the east coast is a tectonic fragment correlated with the western Dharwar craton of southern India [17,7,5]. It comprises a complex of foliated and unfoliated granites, tonalitic orthogneisses (protolith age 3190Ma) [17] and variably migmatitic gneisses with 100's metre-scale lenses of kyanite-grade metasedimentary rocks and sparse bodies of low-grade ultramafic-intermediate rocks (greenstones). The undeformed granites yield ages in the range 2540-2510Ma [17,4]. BGS/USGS studies show that the metasediments were affected by at least three superposed folding episodes. Sahantaha shelf sediments of Neoproterozoic age with a Dharwar craton provenance[6] were deposited on the NW passive margin of the Antongil basement. The unconformity[12] is tectonically reworked [20]. The dating programme should elucidate whether the Antongil block underwent Pan-African deformation.

The Antananarivo block of central Madagascar consists of variably migmatitic paragneiss and granitoid orthogneiss with 2.75-2.5Ga protoliths [19,14], intruded by voluminous magmatic rocks formed in an active continental margin setting [11]. This basement is unconformably overlain in the west by metasediments of the Itremo Group that have yielded detrital zircon populations consistent with an African provenance [8]. Both units were intruded by 820-720 Ma calc-alkaline granitoids and metamorphosed under granulite and upper amphibolite facies conditions during the late Neoproterozoic [19,14,5]. The Antananarivo Block is structurally overlain by Archaean basic orthogneisses, paragneisses and amphibolites, intruded by c.800Ma layered mafic-ultramafic bodies and post-tectonic c.530Ma granite plutons. They form four main outcrops that, from west to east, are known as the Maevatanana, Andriamena, Beforona and Mandritsara belts and collectively comprise the Tsaratanana thrust sheet [14,7]. Their interpretation as greenstone belts [1,18] has been reassessed. The basal contact with the Antananarivo block has been reported to be a mylonite zone with top-to-east kinematics [7,10]. Some meta-supracrustal belts previously shown as part of the Antananarivo Block are reassigned to the Tsaratanana thrust sheet. Widespread polyphase granitic sheets were intruded into shear zones at 634-528 Ma [16,3]. The N-S oriented, 30km wide, continental-scale, subvertical Angavo shear zone records two main tectonothermal events dated at 590-530Ma and 530-500Ma [15]. It records dominantly coaxial strain [5] resulting from E-W shortening rather than significant strike-slip [17].

The Betsimisaraka suture (BS) zone, a 10's of km wide high strain belt, comprises amphibolite-granulite facies metasediments associated with km-scale lensoid masses

of mafic-ultramafic rocks. It marks the line of closure of the Palaeo-Mozambique ocean separating Central Madagascar from the Antongil Block as a result of westward subduction during the Neoproterozoic [7,6]. The metasedimentary protoliths were sourced from the Dharwar craton and have depositional ages of 800-550Ma [6]. Eastward thrusting onto the shelf-craton took place between 630 and 515Ma [5] and gave rise to an inverted metamorphic sequence, and generation of S-type granites. One of the main challenges of the revision mapping is the subdivision and delineation of this imbricated boundary.

In summary four NS-trending belts are recognised that from E. to W. are: the Archaean Antongil craton, the Sahantaha shelf, the BS zone, and the Antananarivo Andean-type magmatic arc, a sequence typical of many collisional orogenic belts[20]. Correlation of structures with published geochronological data suggests two main E-W contractional events: 640-560Ma and 530-510Ma. [5,9,10]

References

1 Ashwal et al., 1997. Gondwana Res. Group, Misc. Publ. 6, 53pp

2 Buchwaldt et al., 2003. Am. Mineralogist, 88, 1753-1768

3 Collins et al,, 2000. Gondwana Res., 3, 549-552.

4 Collins et al., 2001. Gondwana Res., 4, 152-153.

5 Collins et al., 2003a. Precambrian Res., 123, 111-133.

6 Collins et al., 2003b. Tectonophysics, 375, 77-99.

7 Collins and Windley, 2002. J. Geol., 110, 325-339.

1. Cox et al., 2004. J. Geol., 112, 379-399.
2. Fitzsimons et al., 2004. *In* Chetty & Bhasker (eds) Int Field Workshop,

Nat. Geophys Res. Inst, Hyderabad, India, 13-15.

10 Goncalves et al., 2003. Precamb. Res., 123, 135-157

11 Handke et al., 1999. Geology, 27, 351-354.

12 Hottin, 1969. Ducumentation du Bureau Géol., 178, 1-192, 193-381

13 Hottin, 1976. Bull. Bur. Rech. Géol. Mineral, II. Sect. 4, 117-153.

14 Kröner et al., 2000. Am. J. Sci., 300, 251-288.

15 Martelat et al., 2000. Precamb. Res., 102, 1-20.

16 Nédélec et al., 1995. J. Petrol., 36, 1367-1391.

1. Nédélec et al., 2000. Tectonics, 19, 997-1020.
2. Peters et al., 2003. USGS Rep., 159pp.

19 Tucker et al., 1999. J. Geol., 107, 135-153.

20 Windley, 2005. BGS Int Rep., 23pp.