The Mozambique Belt, eastern Africa: tectonic history in a regional setting

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The Mozambique Belt is part of the East African Orogen (EAO) which extends from the Arabian Nubian Shield in the north to as far south as Antarctica. An exhumation gradient is observed from Kenya to Tanzania, with supracrustal rocks in the north, and deep crustal levels in the south, exposed by erosion following continent-continent collision.

Data from the Mozambique Belt has been archived in a database which has been used to formulate tectonic models for the collision leading to the formation of Gondwana. The database structure has been a test case and could be applied to more extensive regions with much larger datasets. The 'East Africa Database' (Cutten, 2004) utilizes ArcView and Microsoft Access and contains data on: rock lithology, structure, metamorphic grade, igneous, metamorphic and detrital geochronology, geochemistry, P-T conditions and P-T-t paths.

Two principal domains are observed in the Mozambique Belt. The Western Mozambique Belt (WMB), comprises upper amphibolite-grade gneisses of the tectonized Tanzania Craton, with emplacement ages of 2970 to 2648 Ma (Johnson et al., 2003), and also includes reworked Usagaran Belt rocks with ages as young as 1837 Ma. The Eastern Granulites (EG) are high-grade, arc-derived lithologies, with emplacement ages of 841 Ma to 632 Ma. Both terranes include intercalated Neoproterozoic metasedimentary rocks of the West and East Mozambique Basin respectively. Nd isotopic data of WMB show Archean model ages and $\varepsilon_{Nd(t)}$ similar to the Tanzania Craton. The EG show model ages generally ranging from 1300 Ma to 950 Ma and $\varepsilon_{Nd(t)}$ from –3.1 to 6.7 indicating mixing of juvenile arc material with some older crustal melts. Peak metamorphism in both WMB and EG centre on two age clusters of ~640 Ma and ~550 Ma. A clockwise P-T-t path was reported in WMB by Sommer et al. (2003), with peak metamorphic conditions of ~12-13 kbar and 750-800 $^{\circ}$C, dated at ~640 Ma, and attributed to continent-continent collision. However, an anti-clockwise P-T-t path was reported for the Eastern Granulites by Appel et al. (1998) with peak metamorphic conditions of 9.5-11 kbar and 810 ± 40 $^{\circ}$C also at ~640 Ma. In the case of the EG, the observed P-T path was attributed to magmatic underplating and upper crustal magma loading in these arc-derived rocks, preceding continent-continent collision. We suggest that both P-T-t paths are not irreconcilable, but that the early section of the anti-clockwise P-T-t path of Appel et al. (1998) reflects heating at the base of the arc and that peak metamorphism at ~640 Ma in both WMB and EG records their juxtaposition by continent-continent collision.

The contact between WMB and EG is here considered to be a low angle east dipping thrust. The EG can be further subdivided into three thrust sheets based on predominant lithotypes: the Anorthosite thrust sheet, and Typical Eastern Granulite thrust sheet, each representing different levels of a Neoproterozoic continental arc, and the Accretionary Wedge thrust sheet, representing continental shelf depositions outboard of the arc. The EG have previously been identified as a continental arc forming above a west-dipping subducting oceanic plate on the flank of the Tanzania Craton. We suggest that available data is more consistent with an east-dipping subducting oceanic plate on the flank of an outboard continental block (likely central Madagascar). The arc was subsequently thrusted over the Tanzania Craton through closure of the Western Mozambique Ocean and continental collision. The later ~550 Ma peak metamorphic event recorded throughout the Mozambique Belt may reflect subsequent collisions of the remaining continental blocks including East-Antarctica and Australia, to ultimately form Gondwana.

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