Lithos 284–285 (2017) 666–690

Contents lists available at ScienceDirect

Lithos

journal homepage: www.elsevier.com/locate/lithos

Neoproterozoic eclogite- to high-pressure granulite-facies metamorphism in the Mozambique belt of east-central Tanzania: A petrological, geochemical and geochronological approach

H. Sommer [a,*], A. Kröner [a], J. Lowry [b]

[a] Institut für Geowissenschaften, Universität Mainz, 55099 Mainz, Germany
[b] School of Geography, Earth Science and Environment, The University of the South Pacific, Laucala Campus, Suva, Fiji

ARTICLE INFO

Article history:
Received 26 November 2016
Accepted 21 May 2017
Available online 31 May 2017

Keywords:
Tanzania
Mozambique belt
P-T loops
Zircon geochronology

ABSTRACT

This study investigated Neoproterozoic (Pan-African) eclogite- and high-pressure-granulite (E-HPG) facies rocks from the Mozambique belt of east-central Tanzania, collected close to the town of Ifakara and the adjacent Furua area from different tectonic settings, the Palaeoproterozoic Usagaran and the Neoproterozoic Mozambique belt. The studied rocks are E-HPG facies granite- and diorite-gneisses and a meta-gabbroic rock, which are retrogressed to amphibolite- and greenschist-facies conditions. Four different clockwise *P-T* paths were constructed. The first *P-T* path for a granodioritic gneiss displays peak metamorphic conditions at ~830 °C and ~13.0 kbar. The second *P-T* path for a quartz dioritic gneiss shows peak metamorphic conditions of ~920 °C and ~14.9 kbar. The third *P-T* path for a mafic granulite shows peak metamorphic conditions of ~820 °C and ~13.2 kbar. A fourth *P-T* path for a monzodioritic gneiss also displays peak metamorphic conditions of up to ~810 °C and ~14.9 kbar. Evidence for all four *P-T* paths is provided by mineral chemical and modal abundance calculations in combination with textural observations in thin sections. Zircon ages indicate that the east-central part of the Mozambique belt in Tanzania consists of granite-, granodiorite- and monzodiorite gneisses with Mesoarchaean (~2915 Ma), Neoarchaean (~2637–2676 Ma) and Palaeoproterozoic (~1873–1926 Ma) protolith ages. Early Neoproterozoic (Tonian) igneous zircons were found in the mafic granulite with an age of ~989 Ma. Late Neoproterozoic (Cyrogenian) igneous zircons were found in a dioritic and monzodiorite gneiss with ages of ~748 Ma and ~718 Ma, respectively. Metamorphic zircons extracted from Qtz-monzodiorite and granodiorite gneisses yielded ages of ~640 Ma and are considered to approximate the peak of regional E-HPG metamorphism. We suggest that this high-grade metamorphic event was caused by the collision of fragments of East and West Gondwana during the Pan-African orogeny, associated with ocean closure and the formation of Andean-type continental arc domains, which ended in the formation of a collisional belt.

1. Introduction

The Neoproterozoic Mozambique belt (MB) of East Africa and Madagascar consists of high-grade granulite- and amphibolite-facies rocks (Holmes, 1951; Jacobs et al., 1998; Sommer and Kröner, 2013; Sommer et al., 2003, 2008). Together with the lower grade assemblages in the Arabian-Nubian Shield of northeast Africa and Arabia, these rock units make up the East African Orogen (EAO) (Fig. 1; Stern, 1994; Johnson et al., 2011). A southern continuation of the EAO into East Antarctica through India has also been suggested (Collins and Pisarevsky, 2005; Collins and Windley, 2002; Fritz et al., 2013; Grantham et al., 2008; Jacobs et al., 1998; Pant et al., 2013).

Emplacement ages of granulite protoliths in the MB of southern, central to northern Tanzania range between ~2900 and ~730 Ma (Fig. 2A–C; Table 1; Collins et al., 2012; De Waele et al., 2006; Fitzsimons, 2016; Fritz et al., 2013; Grantham et al., 2008; Kröner et al., 2003; Maboko, 2000; Maboko and Nakamura, 1996; Möller et al., 2000; Muhongo et al., 2001; Sommer and Kröner, 2013; Sommer et al., 2003, 2005a, 2005b; Spooner et al., 1970; Thomas et al., 2013, 2016). Different ages for Proterozoic orogenic domains in the MB suggest that it is poly-orogenic (Shackleton, 1986). Generally, two geodynamic models exist to explain granulite-facies metamorphism during the Neoproterozoic in Tanzania: *(i)* Collision between two large blocks of East and West Gondwana; and *(ii)* Amalgamation of several microcontinents during the Neoproterozoic (Collins and Pisarevsky, 2005; Fitzsimons, 2016; Sommer and Kröner, 2013; Tucker et al., 2014). Accretion and collision of these microcontinents during the late Neoproterozoic to early Cambrian gave rise to the MB.

* Corresponding author at: School of Geography, Earth Science and Environment, The University of the South Pacific, Laucala Campus, Suva, Fiji.
E-mail address: info@holgersommer.de (H. Sommer).

http://dx.doi.org/10.1016/j.lithos.2017.05.010
0024-4937/

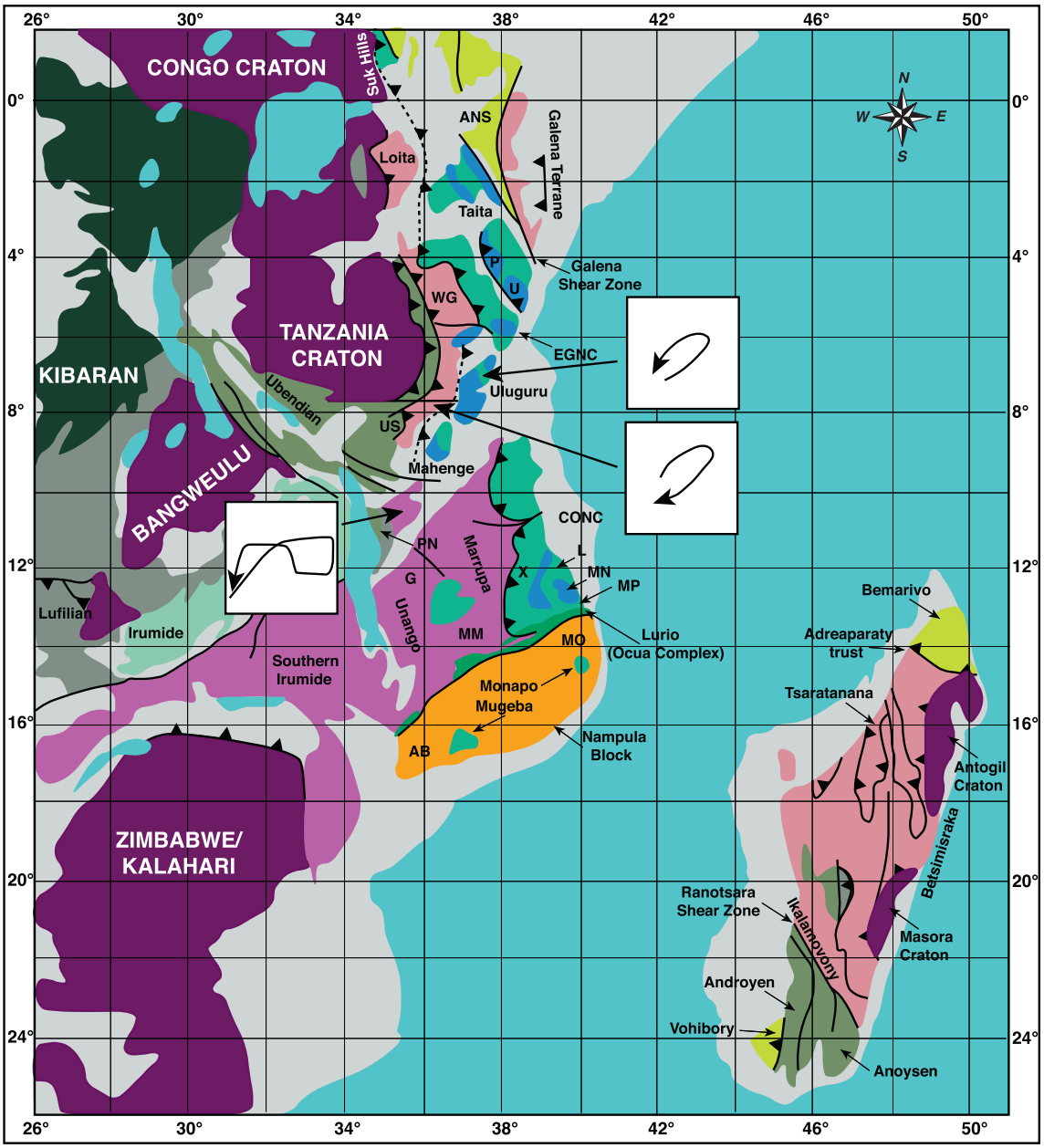

Fig. 1. Geological sketch map show the different crustal age domains, the major litho-tectonic units and the most prominent *P-T* paths in the southern part of the East African Orogen (modified after Appel et al., 1998; Fritz et al., 2013; Sommer and Kröner, 2013; Sommer et al., 2003). AB: Alto Benfica; ANS: Arabian–Nubian Shield; CDGN: Cabo Delgado Nappe Complex; EGNC: Eastern Granulite Nappe Complex; G: Geci Group; L: Laloma Complex; Me: Mecuburi Group; MM: M'Sawize and Muaqala Complex; MN: Meluco, Nairoto Complex; Mo: Molo Group; MP: Montepuez Complex; P: Pare Mountains; U: Usambara Mountains; PM: Ponta Messuli Complex; Tx: Txitonga Group; WG: Western Granulite Complex; US: Usagaran Belt; X: Xixano Complex.