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The tectonic history of a crustal-scale shear zone in the Tanzania Craton from the Geita Greenstone Belt, NW-Tanzania Craton

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ABSTRACT

In this contribution, we present for the first-time field based evidence of a crustal scale shear zone from the southern margin of Geita Greenstone Belt. The Geita Shear Zone is a broad (~800 m wide) ductile, high-strain, deformation zone that can be traced for at least 50 km along the southern margin of the Geita Greenstone Belt. It is near vertical, trends ~E-W and separates the mafic volcanics of the Kiziba Formation, to the north, from the TTG gneisses that crop out south of the shear zone. The shear zone is hosted almost entirely by the TTG gneisses and is characterised by a well-developed mylonitic foliation near the greenstone margin that transitions into a gneissic foliation and eventually becomes a weakly developed foliation further south. It contains approximately equal amounts of dextral, sinistral, and asymmetric shear sense indicators suggesting that the shear zone accommodated mainly flattening strain while the mineral stretching lineation defined by quartz and feldspar ribbons and stretched biotite selvages plunges shallowly W. A series of younger, sub-vertical, NW trending brittle-ductile, strike-slip shear zones truncate and displace the Geita Shear Zone with dextral displacement in the order of 2–4 km. Deformed tonalite interpreted to predate the shear zone yielded U-Pb zircon ages of ~2710 Ma while synshearing granodiorite samples have zircon ages between 2680 Ma and 2660 Ma. The ~2630 Ma age of the undeformed Nyankumbu granite is interpreted to mark the minimum age of movement on the shear zone. The presence of 3000 Ma and 3200 Ma zircon xenocrysts in the tonalite and granodiorite opens the possibility that older basement rocks underlie the greenstone belts in the northern half of Tanzania Craton. Whether or not the greenstone belts were erupted on older basement, thrusted on top of older basement rocks or incorporated older basement fragments has profound implications for the tectonic framework and evolution of the Tanzania Craton.

1. Introduction

Large scale shear zones are well documented features in Archean terrains worldwide (e.g. Bédard et al., 2003; Cassidy et al., 2006; Chardon et al., 2008; Jelsma and Dirks, 2002; Dirks et al., 2013) and their structural style has implications for the tectonic history and crustal growth models of Archaean cratons. One of the most common Archean structural styles is the dome and keel geometry (e.g. Pilbara, Kaapvaal, Western Dharwar), linked to gravity-driven tectonics and redistribution of rock masses through vertical processes (e.g. Choukroune et al., 1995; Chardon et al., 1996; Collins et al., 1998; Bédard et al., 2003; Van Kranendonk, 2011). The majority of these types of structures are characterised by gneiss domes with radial elongation lineations and normal shear sense indicators suggesting diapiric ascent through the crust. Between the gneiss domes, synformal-shaped greenstone belts are preserved. In general, the geometry of the greenstone belts follows the contours of the gneiss domes resulting in cusp-like shapes. Typical examples include the Barberton Greenstone Belt in South Africa (e.g. Dirks et al., 2013; Van Kranendonk et al., 2014; Brown, 2015) and the greenstone belts in the Pilbara Craton of Western Australia (e.g. Collins et al., 1998; Van Kranendonk et al., 2004). Alternative interpretations for dome and keel geometries include core complexes exposed by extensional unroofing (Kloppenburg et al., 2001) or antiformal culminations exposed by cross-folding (Blewett et al., 2004).

Another common Archean structural style is represented by linear belts separated by transcurrent shear zones, which are typically interpreted to indicate lateral terrain accretion (e.g. Polat et al., 1998; Dirks et al., 2002; Blewett et al., 2010; Kabete et al., 2012a). Typical examples include the Yilgarn Craton (e.g. Cassidy et al., 2006; Blewett

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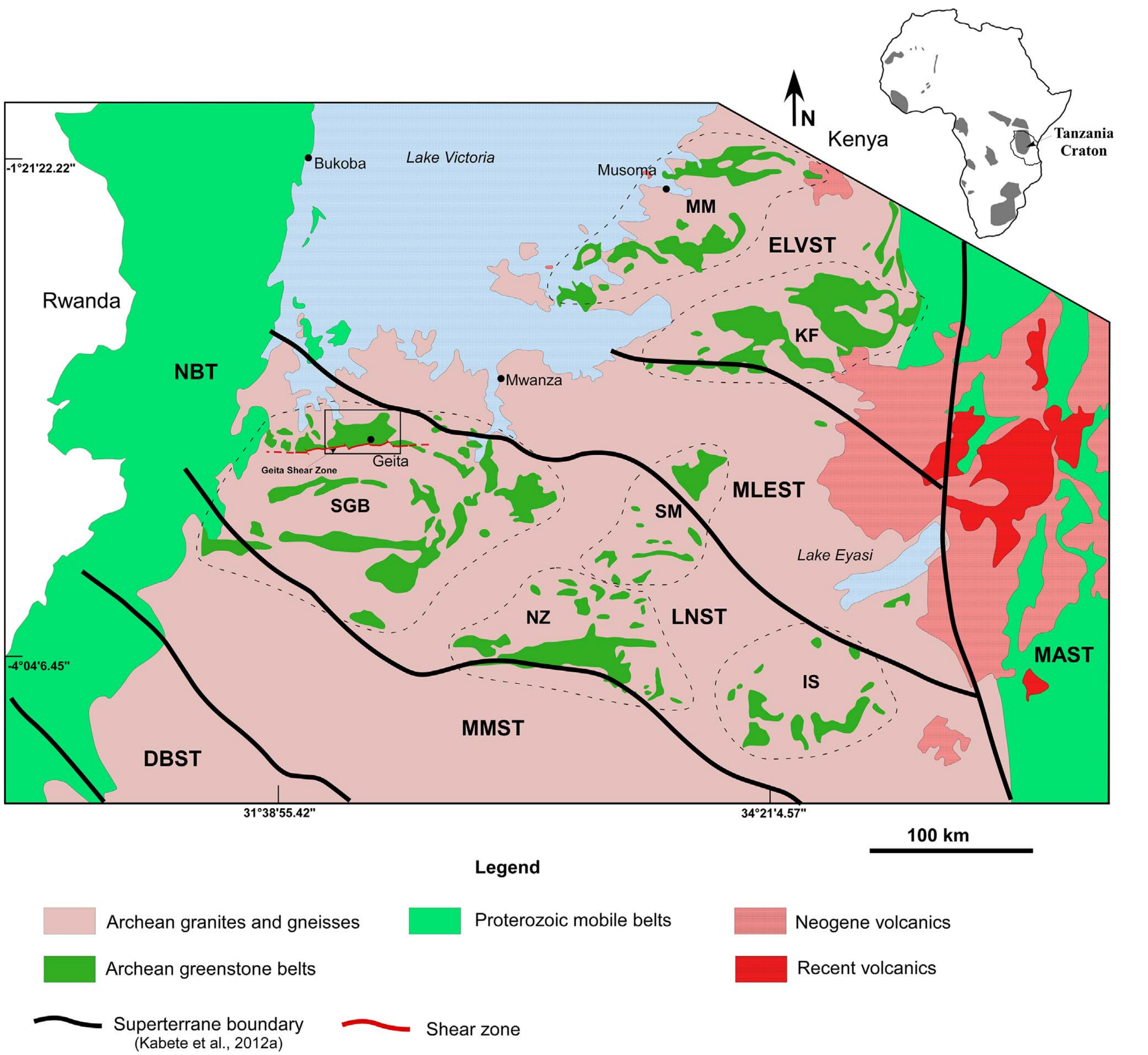

Fig. 1. Simplified geological map of northern half of Tanzania Craton showing the main geological units and the location of the greenstone belts (modified from Sanislav et al., 2015). Super-terrane boundaries are as proposed by Kabete et al. (2012a). SU – Sukumaland Greenstone Belt; NZ – Nzega Greenstone Belt; SM – Shynianga-Malita Greenstone Belt; IS – Iramba-Sekenke Greenstone Belt; KF – Kilimafedha Greenstone Belt; MM – Musoma-Mara Greenstone Belt; ELVST – East Lake Victoria; MLEST- Mwanza Lake Eyasi; LNST- Lake Nyanza; MMST – Moyowosi-Manyoni; DBST – Dodoma Basement; MAST – Mbulu-Masai; NBT – Nyakahura-Burigi. Inset map of Africa showing the location of Archean blocks.

et al., 2010) the Superior Province (e.g. Card, 1990; Polat et al., 1998) and the Dharwar Craton (e.g. Chadwick et al., 2000; Manikyamba and Kerrich, 2012). The transcurrent shear zones form an anastomosing pattern encompassing elongated greenstone belts, many with similar stratigraphy, bordered by granite-gneiss terranes of younger age. For example, in the eastern Yilgarn Craton, detailed stratigraphic analyses showed that the stratigraphy of the greenstone belts, although disrupted by shear zones, can be correlated for hundreds of kilometers (Hayman et al., 2015).

The structural and tectonic evolution of the Archean Tanzania Craton is poorly understood (Kabete et al., 2012a, 2012b) and in many instances stratigraphic correlations based on sparse geochronological data are contradictory (e.g. Borg and Krogh, 1999; Manya et al., 2006; Sanislav et al., 2014). A first attempt to define tectonic and structural boundaries within the Tanzania Craton was made by Kabete et al. (2012a) based on existing geological maps and the interpretation of geophysical datasets. A series of NW trending shear zones were proposed and interpreted to delineate superterrane boundaries (Fig. 1). However, the existence of these large-scale shear zones, their continuity, style, age and kinematic sense was never confirmed with field studies, and the terrane-accretion model, therefore, remains entirely speculative.

In this contribution, we provide the first field-based description of a regional scale shear zone from the northern half of the Tanzania Craton and present new zircon age data from igneous rocks that intruded along and across the shear zone to constrain its kinematic history. Results will be discussed in terms of the regional significance for the structural and tectonic evolution of this part of the Tanzania Craton.

2. Regional geology

The geology of the Archean Tanzania Craton is generally described in terms of three main stratigraphic and tectonic units, the Dodoman Supergroup, The Nyanzian Supergroup and the Kavirondian