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Ion microprobe zircon U–Pb dating of the late Archaean metavolcanics and associated granites of the Musoma-Mara Greenstone Belt, Northeast Tanzania: Implications for the geological evolution of the Tanzania Craton

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Abstract

Ion microprobe zircon U–Pb ages from metavolcanic and associated granitic rocks of the late Archaean Musoma-Mara Greenstone Belt (MMGB) of northeast Tanzania reveal that the oldest mafic volcanism in the belt occurred at 2676–2669 Ma followed by felsic volcanism at ~2668 Ma. The felsic volcanism was coeval with the emplacement of the oldest pulse of massive granitoids that is dated at 2668 Ma. The youngest volcanic episode, represented by a volcanic horizon in the largely sedimentary Kavirondian Supergroup that overlies the greenstone sequence with a marked unconformity, occurred at ~2667 Ma. A younger phase of post-orogenic granites concluded the magmatic evolution of the MMGB at ~2649 Ma.

Our age data suggests that the entire volcano-sedimentary sequence in MMGB was emplaced in a relatively short time interval between ~2676 and ~2667 Ma. It also shows that contrary to arguments based on the degree of deformation, the foliated granites and some amphibolite rafts enclosed in them do not constitute the basement to the greenstone sequence. The data further shows that volcanism in the MMGB was younger than the ~2820 Ma age of volcanism in the Sukumaland Greenstone Belt (SGB) to the far southwest and the ~2720 Ma age of volcanism in the nearby Kilimafedha Greenstone Belt (KGB) to the south. The age of granitic magmatism (ca. 2.69–2.55 Ga) in the three belts was, however, largely coeval. Granitic magmatism of this age has also been reported in different parts of the Tanzania Craton suggesting that it was responsible for the late Archaean crustal growth and marks the beginning of a period of stability (or of cratonization).

Keywords: Tanzania Craton; Greenstone Belt; Metavolcanics; Granitoids; Zircon U–Pb ages

1. Introduction

Archaean granite-greenstone terranes record intricate geological evolutionary histories. They exhibit episodes of distinctly different tectonics, deformation styles, variable magmatism, sedimentation and metamorphism over different scales (Condie, 1997) and their geological evolution continues to be a subject of lively debate. Much attention has been directed at understanding the tectonic setting in which rocks in the greenstone belts were formed together with the processes responsible for their generation (Martin, 1987; Kröner et al., 1988; Srivastava et al., 2004). Whereas some Archaean greenstone belts are considered to have been formed in an oceanic setting (Kerrich et al., 1999; Polat and Kerrich, 2000; Manya and Maboko, 2003), others were formed in a continental margin and are underlain by older continental crust (e.g. Chadwick et al., 2000). In order to establish the tectonic setting and subsequent evolution of the rocks in the greenstone belts, evidence from both field

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geological relations and precise isotopic data are necessary. Single zircon U–Pb dating coupled with imaging techniques provides one of the most appropriate methods for determining the emplacement ages that are a prerequisite for unravelling the geological evolution of Archaean granite-greenstone terranes (Whitehouse et al., 1999). In this paper, we present ion microprobe U–Pb single zircon ages for the entire sequence of supracrustal rocks and associated granitic rocks in the Musoma-Mara Greenstone Belt (MMGB) of northeast Tanzania, with the aim of outlining its geochronological evolution and its implication to the geological evolution of the Tanzania Craton.

2. Geological setting

2.1. Regional geology

The Archaean Tanzania Craton constitutes the central nucleus of preserved continental crust in East Africa, extending from central Tanzania to western Kenya and southeast Uganda (Clifford, 1970). The Tanzania Craton (Fig. 1) can be subdivided into two main terranes: the deformed, high-grade metamorphic terrane of central Tanzania and the low grade granite-greenstone terrane of northern Tanzania, south eastern Uganda and south western Kenya (Clifford, 1970). In Tanzania, the high-grade metamorphic terrane is locally referred to, as the Dodoman Belt (Wade and Oates, 1938) and is made of granite, granodiorite, granitic gneisses and migmatites whereas the low grade granite-greenstone terrane represents the Nyanzian and Kavirondian Supergroups which occur predominantly in the area south and east of Lake Victoria. According to Borg and Shackleton (1997), six greenstone belts have been identified, namely, the Sukumaland, Shinyanga-Malita, Musoma-Mara (the object of this study), Kilimafedha, Nzega and Iramba Sekenke (Fig. 1). The Nyanzian Supergroup has been subdivided into a lower unit consisting predominantly of mafic metavolcanics and an upper unit

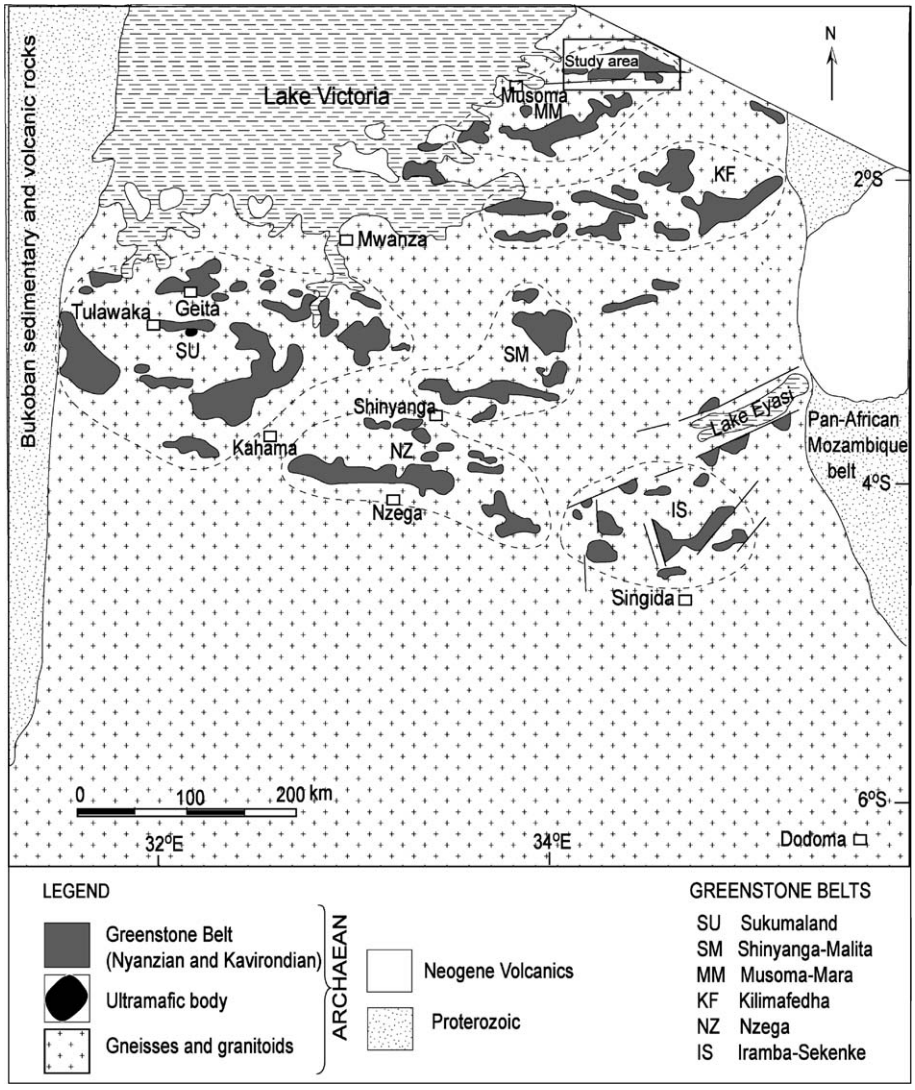

Fig. 1. Geological map of northern Tanzania showing the distribution of the Neoarchaean Greenstone Belts of the Tanzania Craton (after Borg and Shackleton, 1997). Position of frame indicates the study area shown in Fig. 2.