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New insights on proterozoic tectonics and sedimentation along the peri-Gondwanan West African margin based on zircon U–Pb SHRIMP geochronology

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ABSTRACT

New mapping and age data from rocks of the West African Craton and its western margin, as well as a review of published age data for the region indicate that the southwestern margin of the craton is composed of an Archaean basement of TTG gneisses and granitoid rocks that formed over a long period of time between 3.54 and 2.64 Ga. The age data refute the previously held notion of two craton-forming events, the ~3.0 Ga Leonian and ~2.7 Ga Liberian cycles, but instead indicate a pulse at ~3.4 Ga, followed by near-continuous crustal growth between ~3.05 and 2.64 Ga. Age data for the Kenema Assemblage, a strip of Archaean rocks separated from the main Archaean exposure further east by Neoproterozoic cover, suggest that this represents a tectonic window.

To the west of the Archaean craton, the Rokel-Kasila Belt occurs, which incorporates two tectonic terranes: the Palaeoproterozoic Kasila terrane, accreted to the Archaean craton and comprised of granulite-facies paragneiss units of the Kasila Group, and the Meso- to Neoproterozoic Marampa terrane, thrust on top of the Archaean basement, and comprised of greenschist-facies schists and metabasites of the Marampa Group. A metavolcanic unit in the Kasila Group provides an age of 1941 ± 4 Ma interpreted to date the emplacement of the Kasila succession. Xenocrystic zircon in the sample suggest the presence of cryptic older crust with components of 2.7–2.6 Ga and 2.2 Ga, and the Kasila Terrane is interpreted to represent a Ganderian-type peri-Gondwanan terrane left attached to the West African Craton. Detrital age data on two schist units of the Marampa Group suggest a maximum age of deposition of between 1076–1030 Ma. The detrital age peaks indicate source terranes in part consistent with a West African affinity, but also comprising significant sources of between 2.0 and 1.0 Ga for which no suitable source terranes are known in West Africa. We suggest that at the time the Marampa Group was deposited along the West African margin at ~1.05 Ga, a source terrane with significant matching components of Palaeoproterozoic and Mesoproterozoic source rocks, was present to provide the sedimentary input, possibly the Amazonian Craton.

1. Introduction

The western part of North Africa, is underlain by the Archaean WAC, which is exposed in the north as the Reguibat Shield and in the south, between Nigeria and Guinea, as the Leo-Man Shield (Fig. 1A). Both Archaean Shields are subdivided into a western, purely Archaean segment, and an eastern Archaean segment affected by Palaeoproterozoic reworking during the Eburnean Orogeny. In the south, these segments are known as the Kenema-Man and Baoulé-Mossi Domain respectively (Bering et al., 1998; Kouamelan et al., 1997; Trompette, 1994).

A series of Neoproterozoic belts delineate the western margin of the WAC and record a series of tectonic events spanning 750 to 530 Ma (termed the Pan African I and II events in Villeneuve et al., 2008, 2010). To the north of the Reguibat Shield the Anti-Atlas Belt occurs, while to the southwest the Mauritanide Belt runs southwards and under Phanerozoic cover (Fig. 1A). Both those belts were reworked by the Hercynian Orogeny between 320 and 270 Ma

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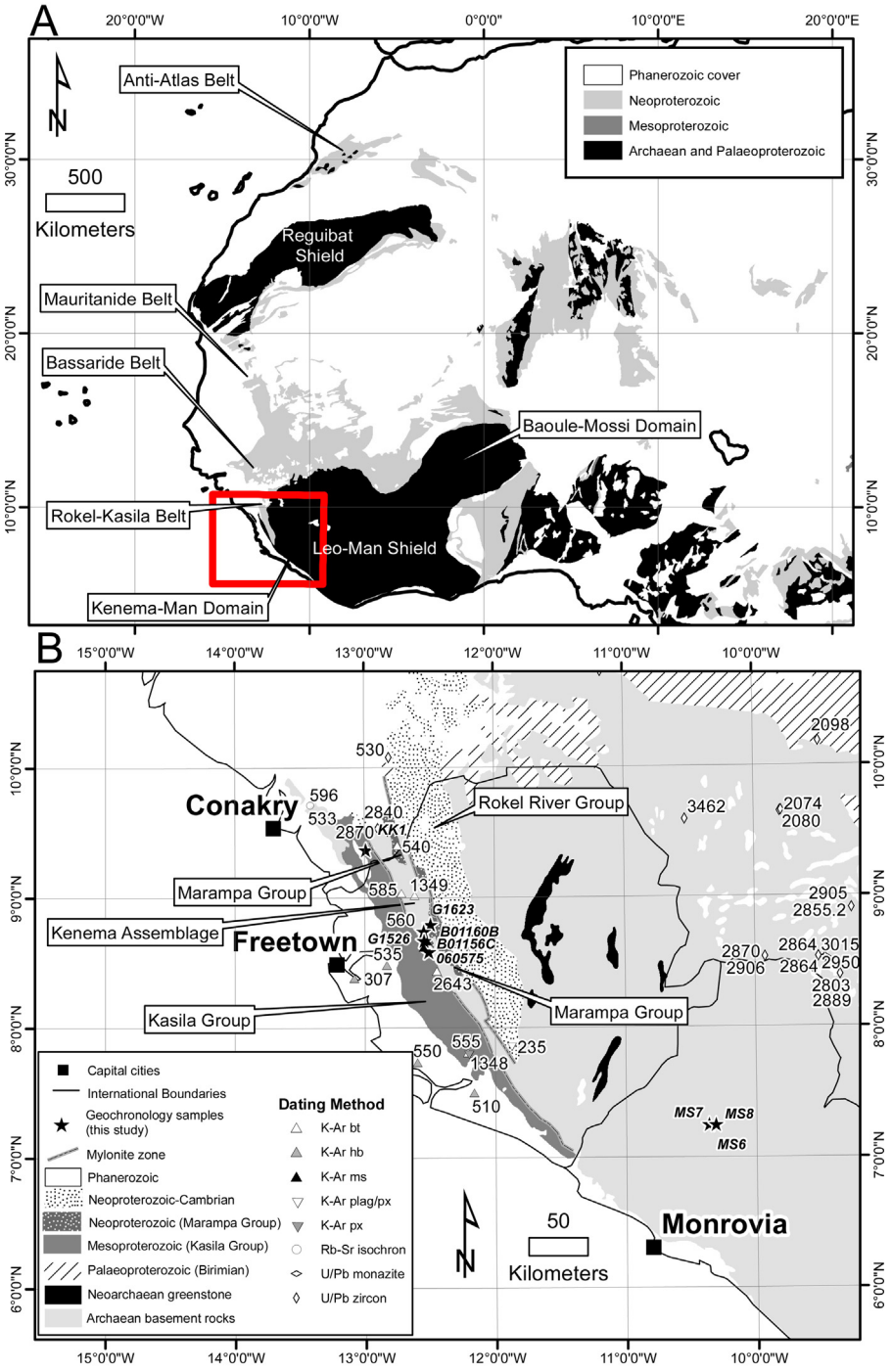

Fig. 1. (A) Regional overview of the geological make-up of West Africa showing the location of the main tectonic units discussed in the text; (B) simplified geological map of the study area, showing the units discussed in the text, the location of studied samples and previous age data (see Table 5 for the sources of the historic age data).

(Villeneuve et al., 2010). In the central zone, the Neoproterozoic belts were thought to include an eastern older system, called the Bassaride Belt, which developed between 650 and 620 Ma and a western belt, extending south into Liberia, called the Rokelide (or here renamed the Rokel-Kasila) Belt, which developed between 560 and 540 Ma (Villeneuve et al., 2010). However, recent data have cast doubt on the existence of the internal Bassaride Belt (Villeneuve, pers. comm.). A tectonic window within the Neoproterozoic Rokel-Kasila Belt exposes Archaean crust, which is referred to as the Kenema Assemblage.

Trompette (1994) suggested that the West African Craton and the Amazonian Craton formed part of a megaplate, and separated with the breakup of Gondwana in the Late Neoproterozoic-Cambrian. Pre-Gondwanan world-class deposits are known in and along the margins of the West African and Amazonian Cratons and include: (1) extensive banded iron formations, deposited during the Meso- to Late Archaean and the Palaeoproterozoic such as Guelb el Rhein in Mauritania (Key et al., 2008; Taylor et al., 2012), Simandou and Mount Nimba in Guinea (Billa et al., 1999), Tonkolili in Sierra Leone (Reston et al., 2001) and Cerro Bolivar in Venezuela (Dardenne and Schobbenhaus, 2003); (2) major orogenic gold deposits of Paleoproterozoic age formed during the Trans-Amazonian (e.g. Omai in Guyana, Norcross et al., 2000) and the Eburnian (Ashanti Belt in Ghana, Griffis et al., 2002; Oberthür