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The Mesoproterozoic Karagwe-Ankole Belt (formerly the NE Kibara Belt): The result of prolonged extensional intracratonic basin development punctuated by two short-lived far-field compressional events

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ABSTRACT

The Mesoproterozoic Kibara Belt (also Kibaran Belt or Kibarides in some references) of Central Africa was often portrayed as a continuous, c. 1500 km long orogenic belt, trending NE to NNE from Katanga, Democratic Republic of Congo (DRC) in the south, up into SW Uganda in the north. Recently however, the Karagwe-Ankole Belt (KAB; formerly the NE Kibara Belt) has been redefined as the part north of a NW oriented Palaeoproterozoic basement high of the Ubende-Rusizi Belts, while the Kibara Belt (KIB) is now limited to the part south of this rise.

We present a lithostratigraphy for the KAB that takes into account two rheologically contrasting structural domains (Western and Eastern Domain); each of them being characterised by independent sedimentary sub basin(s) and depositional conditions: the ED with Archaean basement versus the WD with Palaeoproterozoic basement. We document new volcanic and detrital U–Pb SHRIMP zircon data which provide new constraints on the timing of deposition and on the detrital provenance of the sedimentary sequences in the KAB. We discuss the evolution of the KAB in a wider regional context, comparing it to other Mesoproterozoic units and with reference to the general geodynamic history of this part of the African continent in Proterozoic times.

The lithostratigraphic successions of the KAB are only valid respectively in the ED (Kagera Supergroup) or in the WD (Akanyaru Supergroup), with no correlations between them. Deposition of the Kagera Supergroup in the ED is bracketed between 1.78 Ga and 1.37 Ga and the deposits have to be considered an Eburnean-age “molasse”. Detrital components comprise material only of Archaean and Palaeoproterozoic age, consistent with derivation from nearby source regions. In the WD, deposition of the two lowermost groups of the Akanyaru Supergroup is bracketed between 1.42 Ga and 1.37 Ga. The large contribution of detrital Palaeoproterozoic components in the WD strengthens the view that this domain is underlain by Palaeoproterozoic basement and supports the concept that part of the Akanyaru Supergroup sediments consists of reworked Eburnean-aged molasse. In the WD of the Kivu-Maniema area (DRC), later sedimentation periods are documented at respectively 1222 Ma and 710 Ma. The KAB documents a long-lived period of intracratonic intermittent depositional activity (with periods of interruption of deposition, erosion and magmatism) showing a recurrent subsidence trend controlled by structural activity moving with time from E to W.

On a regional scale, we postulate that since 1.8 Ga, following the amalgamation of Archaean and Palaeoproterozoic landmasses into a single coherent ‘proto-Congo Craton’, various long-lived shallow-water intracratonic basins (aulacogenes) developed. These basins underwent a comparable Mesoproterozoic geodynamic evolution, as shown not only in the sequences of the KAB and of the relatively close Kibara (KIB), Bangweulu Block and Northern Irumide Belts, but even in more distant sequences located in SW Angola and E Brazil.

The long-lived aulacogene history of the KAB within the proto-Congo Craton is interrupted only twice by short-lived compressional deformation reflecting far-field effects of global orogenic events, external to the proto-Congo Craton. The first event at 1.0 Ga is related to Rodinia amalgamation. The second event at 550 Ma results from Gondwana amalgamation and develops a N–S Pan African overprint in the KAB which has previously been underestimated or even overlooked. Three mineralisation provinces

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occurring in the KAB, respectively the Bushveld-type, the tin-coltan-wolfram and the gold province, can be ascribed successively to the 1375 Ma Kibaran magmatic event, the 1.0 Ga Rodinia and the 550 Ma Gondwana amalgamation events.

Our results give additional weight to the recent redefinition of the KAB and the KIB, forming two distinct Belts respectively north and south of the Palaeoproterozoic basement high of the Ubende-Rusizi Belts, the more that within this basement rise local Mesoproterozoic strike-slip basins, with their own unique lithostratigraphic and geodynamic characteristics (e.g. Itiaso Group) are documented, which differ from those of the KAB or the KIB.

1. Introduction

The Mesoproterozoic Kibara Belt (also Kibaran Belt or Kibarides in some references) of Central Africa is often portrayed as a continuous, c. 1500 km long orogenic belt, trending NE to NNE from Katanga, Democratic Republic of Congo (DRC) in the south, up into SW Uganda in the north (e.g. Brinckmann et al., 2001). Satellite imagery however, supports older schematic representations (e.g. Furon, 1958; Cahen and Snelling, 1966) showing that this belt consists of two distinct northern and southern segments (Fig. 1). These two are separated in the DRC between the Katanga and Kivu-Maniema regions by a NW-trending basement rise, partially consisting of a Karoo-age (Late Carboniferous to Early Jurassic) rift, itself superimposed on the Palaeoproterozoic Rusizi Belt (Lepersonne, 1974; Lavreau, 1985), which extends beneath Lake Tanganyika, and links up with the Palaeoproterozoic Ubende Belt of SW Tanzania (Klerkx et al., 1987; Theunissen et al., 1996). The apparent paradox of Palaeoproterozoic belts cross-cutting a Mesoproterozoic Kibara Belt results from repeated, to the present day, crustal-scale structural reactivation along the pre-existing Ubendian-Rusizian structures (Klerkx et al., 1998).

The two segments of the Belt, north and south of the basement rise, have been redefined by Tack et al. (2010) as (1) the Karagwe-Ankole Belt (KAB), spanning Rwanda and Burundi, SW Uganda and NW Tanzania as well as the Kivu-Maniema region of the DRC and (2) the Kibara Belt (KIB) further SW in the Katanga region, including the Kibara Mountains type area near Mitwaba town (Fig. 1).

Recent zircon U–Pb SHRIMP magmatic ages, laser ablation zircon Hf data and $^{40}Ar–^{39}Ar$ dating have shown that the magmatism in the KAB results from a major intracratonic (c. 1375 Ma) bimodal event (Tack et al., 2010). This event consists of widespread, voluminous S-type granitoid rocks (Fernandez-Alonso et al., 1986) with accompanying subordinate mafic intrusive rocks and the 350 km-long mafic–ultramafic Kabanga–Musongati alignment (KM) of layered Bushveld-type complexes (Deblond, 1994; Tack et al., 1994; Deblond and Tack, 1999). The KM alignment is emplaced in a 10–35 km-wide arc-shaped boundary zone between two structurally contrasting domains in the KAB: a Western Domain (WD) and an Eastern Domain (ED) (Fig. 2).

Tack et al. (2010) have shown that the coeval magmatic suites originate in a regional-scale intracratonic setting under an extensional (transtensional) regime, and proposed to restrict the use of the term 'Kibaran event', only to this prominent extensional phase. This event pre-dates compressional deformation of the KAB. Later magmatic events occurred at c. 1205 Ma (A-type granitoids) and c. 986 Ma (tin-granites) (Tack et al., 2010). These represent minor additions to the crust, although the c. 986 Ma event forms the Central African Sn–Nb–Ta–W–Au metallogenic province (Pohl, 1994; Dewaele et al., 2007a,b, 2008a,b, 2010; De Clercq et al., 2008).

In this paper, we build on Tack et al. (2010), on the 1:250.000 scale geological map of the KAB (Fig. 3; Fernandez-Alonso, 2007) and on new detrital and volcanic zircon U–Pb SHRIMP data. We also discuss published and unpublished data, airborne geophysics and metasedimentary sequences of the KAB. We propose a consistent belt-wide lithostratigraphy, document timing of sedimentation and evolution of the KAB sedimentary basins and propose an intracratonic evolution for the KAB within a wider regional setting.

2. General setting of the Karagwe-Ankole Belt

2.1. Two structurally contrasting domains

The Karagwe-Ankole Belt (KAB) is characterised by two structurally contrasting domains: the Western Domain (WD) and the Eastern Domain (ED) separated by a boundary zone, the Kabanga–Musongati (KM) alignment comprising mafic and ultramafic layered complexes (Fig. 2).

The WD consists of deformed, greenschist- to amphibolite facies metasedimentary rocks and subordinate inter-layered metavolcanic units intruded by numerous extensive massifs of S-type c. 1375 Ma granitoids which are devoid of economic minerals and by the c. 986 Ma tin-granites with accompanying mineralisation. In Rwanda, these rocks overly crystalline basement of Palaeoproterozoic age (Fernandez-Alonso and Theunissen, 1998; Tack et al., 2010). The WD corresponds to strongly deformed parts of the KAB. Contacts between the S-type granitoids and the parent metasedimentary rocks or crystalline basement are intrusive or tectonic.

The ED is characterised by an eastwards decrease of both deformation and metamorphism (Tack et al., 1994). A basal conglomerate in the ED unconformably overlies either gneissic basement, which is part of the Archaean Tanzania Craton, or the Palaeoproterozoic Ruwenzori Fold Belt. In contrast to the WD, the ED is devoid of S-type granitoids and economic mineralisation.

2.2. Airborne geophysical data

Most of the area occupied by the KAB has been covered by a number of local geophysical surveys including gravimetry, magnetometry and gamma-ray spectrometry, collected between 1974 and 1981. Although a continent-wide geophysical compilation was carried out in the early 1990s as part of the African Magnetic Mapping Project (AMMP – ITC, The Netherlands, and Leeds University, UK), most of this data remained proprietary and only subsets had been released for academic work (e.g. Nyakaana et al., 1999). In 2002, one of the co-authors (Barritt) reprocessed part of this data into a single georeferenced dataset of the KAB and surrounding regions at 200 m-resolution. This provided additional support for the model by Tack et al. (1994) of the two contrasting structural domains of the KAB, previously based only on field evidence.

Geophysically, the boundary zone including the KM alignment between the WD and ED is expressed as a magnetically textured arc (Figs. 2 and 4). The intrusions, in the field in Burundi and Tanzania, including a hidden body at depth (underneath the Nkoma Group in Burundi) are revealed by a strong anomaly apparent in the Total Magnetic Intensity image (TMI) (Fig. 4). In Burundi there is agreement between the field observation and aeromagnetic data (Fig. 5a). However, in Tanzania the arc coincides with a 5–10 km-wide band of subdued quartzite ridges with intercalated pelites, which become dominantly pelitic in the south in the area to the