THE NORTHEASTERN KIBARAN BELT (NKB): A LONG-LIVED PROTEROZOIC INTRAPLATE HISTORY

Tack, L.[1]; Fernandez-Alonso, M.[1]; De Waele, B.[2] ; Tahon, A.[1]; Dewaele, S.[1]; Baudet, D.[1] & Cutten, H.[2]

[1] Department of Geology & Mineralogy, Royal Museum for Central Africa, Tervuren, Belgium; luc.tack@africamuseum.be
[2] Tectonics Special Research Centre, University of Western Australia, Perth, Australia

Introduction

The geological setting of the Northeastern Kibaran Belt (NKB) subdivided in two different structural domains, i.e. the Western (WD) and Eastern Domain (ED), as well as the new uniform stratigraphies for both of them and the GIS-compiled geologic map have been discussed by Fernandez-Alonso et al. (see this volume). In the last few years new well-constrained evidence suggests that the NKB has been the subject of a long-lived history, marked by episodic events spanning most of the Proterozoic. These episodes during the Palaeo- Meso- and Neoproterozoic are reviewed successively in the WD and ED of the NKB.

Palaeoproterozoic

WD: Nowhere can the stratigraphic contact between Mesoproterozoic deposits and underlying basement be observed. The lowest identified formation of the Akanyaru Supergroup is either in fault contact with an older "tectono-metamorphic complex" or in intrusive contact with 1375 Ma old (see below) "Kibaran" S-type granitoids emplaced in antiformal structures. In SW Rwanda, Palaeoproterozoic basement has been evidenced by SHRIMP dating.

South of the WD, the Palaeoproterozoic Ubendian shear belt of SW Tanzania is part of an Eburnean collisional orogenic belt, which welded the Archaean NE Congo-Uganda, Kasai and Tanzania blocks around 2.1-2.0 Ga. In the Ubendian Belt, subduction of oceanic crust occurred under granulite to eclogite facies conditions. It was followed around 1.8 Ga by exhumation under amphibolite facies and abundant post-orogenic emplacement of felsic volcano-plutonic complexes ("Ufipa-Kate-Kipili-Marungu"-type).

ED: Molasse sedimentation of the Kagera Supergroup including early felsic volcanism started around 1.78 Ga in a subbasin (Muyaga and overlying Ruvubu Groups) adjacent to the Eburnean-aged belt. Deposits rest unconformably on the Archaean Tanzania Craton. The detrital components comprise only material of Archaean and Palaeoproterozoic origin.

Mesoproterozoic

WD: Sedimentation in shallow-water (sub)basins of the Gikoro and overlying Pindura

(including bimodal volcanism) Groups of the Akanyaru Supergroup is constrained between 1.420 Ga and 1.375 Ma. Original depositional relationships with the underlying basement have never been observed (see above). The c. 1375 Ma bimodal magmatic event (intrusion of peraluminous S-type granitoids without significant compositional variation with subordinate mafic rocks) in the Gikoro and Pindura Groups is an omnipresent feature in the WD. It culminates just before the c. 1370 Ma emplacement of the Kabanga-Musongati (KM) mafic-ultramafic layered complexes, systematically intruded along the boundary between the WD and the ED. At 1370 Ma, folding is apparently only limited and thermal aureoles of contact metamorphism around the KM complexes overprint a pervasive $S_1//S_0$ metamorphic fabric in the metasedimentary rocks. The S-type granitoids are porphyritic and display flow structures suggesting that they have been emplaced under partially solidified conditions (crystal mush) in large dome-like structures and/or as prominent sheets. In the granitoid bodies a non-pervasive S_1 // to the $S_1//S_0$ metamorphic fabric of the parent rocks may develop as well as thermal metamorphism. Depth of emplacement is inferred to be around 5-10 km.

Around 1205 Ma, N-S trending shear zones in Burundi are reactivated and give rise to the emplacement of small A-type granitoids plutons. This reactivation in turn triggers subsidence of (sub)basins. Renewed onset of sedimentation is documented by the c. 1220 Ma old detrital zircons at the base of the Nya-Ngezie group of DRC Kivu, which can be correlated across the Western Rift on a distance of some 10 km with the base of the Cyohoha Group belonging to the Akanyaru Supergroup. $S_1//S_0$ is less well expressed in this Group by comparison to the underlying Pindura and Gikoro Groups. Between 1370 and 1220 Ma there is thus an important hiatus in sedimentation in the WD, with plenty of time to erode a pile of sediments (of unknown thickness) having overlain the Pindura Group at the time of the 1375-1370 bimodal magmatic event. Remarkably, in the WD the hiatus is not evidenced by an angular unconformity but only by a break in sedimentation, justifying the introduction within the Akanyaru Supergroup of a new overlying Group (“Cyohoha”).

ED: The only event documented in the ED is the c 1370 Ma intrusion of mafic sills into the Bukoba Sandstone Group and simultaneous emplacement of KM-bodies, intruding among others the uppermost formation of the Ruvubu Group, thus giving a young age constraint for the deposition of the Kagera Supergroup.

Neoproterozoic

WD: In the NKB, the spatial distribution of the Central African Sn-Nb-Ta-W(-Au?) metallogenic province of the “tin”-granites coincides in part, but not systematically, with the WD and is totally lacking in the ED. The early Neoproterozoic age of the metallogenic

province (c. 970 Ma, obtained on pegmatites and mineralisations; 986 Ma: new first SHRIMP age obtained on small Sn-granite pluton itself and not on mineralisation) demonstrates that some 400 Ma separate the Sn-magmatism from the 1375-1370 Ma bimodal "Kibaran" magmatic event. Although the specific history of the origin and emplacement conditions of the Sn-granites is poorly constrained, new preliminary studies allow to speculate that in the WD the large amount of mineralised pegmatites and veins – together with some rare geochemically strongly evolved small S-type granitoid bodies - might represent very late evolved differentiates of the earlier abundant 1375 Ma S-type granitoid mush, which were kept at depth during the domes emplacement. Intrusion higher in the crust of this fertile "melting pot" could be ascribed to the predominance of a c. 1.0 Ga compressional regime, also at the origin of the preferential development in the synform WD areas of upright folding of the metasediments and S_2 cleavage. This ~1.0 Ga reactivation may have been triggered by convergent tectonism along the southern margin of the Bangweulu Block in the 1.02 Ga Irumide Belt.

Around 750 Ma, a string of lithosphere scale shear-controlled alkaline complexes were emplaced along the present-day Western Rift. Some of them are accompanied by carbonatites, sometimes mineralised by pyrochlore. They testify to an extensional regime in the WD, which persisted until ~595 Ma in Burundi (emplacement of bastnaesite and monazite veins).

In the WD, local sedimentary (sub)basins have developed during the Neoproterozoic extensional regime. Some include among other diamictites (Itombwe "basin"; Mutuza-Shangu region of SW Rwanda). It is possible that the Rugezi Group of the Akanyaru Supergroup was deposited then.

Around 550 Ma, a N-S trending compressional event is recognised in part of the DRC Kivu province (Itombwe "Synclinorium" displaying subvertical dips) and SW Burundi (Tshene, Mikiko) disrupting intrusions (A-type granite plutons, KM alignment bodies) into imbricate thrust slices, without any pervasive fabric. Only along thrust planes and corridors are the intrusive rocks retromorphosed under greenschist facies conditions into phyllitic material. Nowhere is the locally strong compression episode accompanied by syn-tectonic granitoids nor regional metamorphism. Only, Au mineralisation is evidenced in SW Rwanda-NW Burundi and in the adjacent Kadubu region of the Itombwe Synclinorium in DRC Kivu.

ED: Around 795 Ma mafic volcanics were extruded in SW Burundi and NW Tanzania in the transtensional Malagarazian-Bukoban basin, interlayered with shallow-water sediments.

Conclusion

During the time-frame proposed for amalgamation of the Columbia Supercontinent, Rusizian-

Ubendian orogenesis has welded and stabilised three central African Archaean blocks into a united assemblage around 1.8 Ga. These Eburnean-aged events are controlled by preferentially NS-trending structures, which have been repeatedly reactivated under extensional or compressional regimes in the NKB.

A 1375-1370 Ma bimodal magmatic event corresponds to a subregional prominent thermal anomaly, as a result of lithosphere scale mantle upwelling and preferential emplacement of the KM complexes at the rheological interface between the Eburnean mobile belt (WD) and the Archaean Tanzania Craton (ED). This event is considered to correspond to the final consolidation and cratonisation of the NKB within its adjacent Palaeoproterozoic and/or Archaean units. The locus of the thermal anomaly follows earlier Eburnean-aged collision zones. Long-lasting effects of the thermal anomaly and input and differentiation of radioactive components (mainly U and Th) may account for the maintenance of a thermal anomaly in the crust over a long time period, producing a fertile “melting pot”. The Sn-magmatism mineralising fluids were extracted at 1.0 Ga as a result of far-field compressional effects of the Irumide Belt to the south, and emplaced in the WD at higher structural levels.

In the light of the envisaged 170 Ma long hiatus between the underlying Pindura and overlying Cyohoha Groups of the newly defined Akanyaru Supergroup in the NKB, it is considered necessary to subdivide the stratigraphy of the WD in more than one Supergroup. This however can only be attempted when the three DRC Kivu stratigraphic columns proposed in the last few decades in parts of the Bukavu square degree will have been assessed thoroughly and tentatively correlated with the Akanyaru Supergroup of Rwanda, W Burundi and SW Uganda.

The geodynamic evolution of the NKB is consistent with an intraplate setting and did not occur at plate margins. In the NKB, the two periods of compressional tectonism, respectively at 1.0 Ga and 550 Ma, must be regarded as far field effects of collisional processes along the cratonic margins of the Congo Craton. In the former, the Irumide Belt along the southern margin of the Bangweulu Block, and coeval strike-slip reactivation of the Ubendian Belt are the external trigger, while in the latter, the collision(s) leading to the docking of East and West Gondwana along the East African Orogen, or coeval collisional processes between the Congo and Kalahari Craton along the Damara-Lufilian-Zambezi Belt were the tectonic triggers.