GEOCHRONOLOGICAL CONSTRAINTS ON GRANITOID MAGMATISM AND DEFORMATION IN THE SW IRUMIDE BELT, ZAMBIA

[1]Bert De Waele.; [2]Michael T.D. Wingate and [3]Benjamin S.E. Mapani

[1]Tectonics Special Research Centre, School of Applied Geology, Curtin University of Technology, Bentley, WA, Australia (dewaeleb@lithos.curtin.edu.au)
[2]Tectonics Special Research Centre, Dept. of Geology and Geophysics, The University of Western Australia, Crawley, WA, Australia (mwingate@tsrc.uwa.edu.au)
[3]Geology Department, University of Zimbabwe, P.O.BOX MP167, Mount Pleasant, Harare, Zimbabwe.

INTRODUCTION

The Irumide belt of Zambia is a NE trending orogen of medium to high grade, largely composed of granites and gneisses, and an extensive metasedimentary sequence of alternating pure quartzites and pelites (Ackermann, 1950; Ackermann, 1960). The belt formed during NW directed thrusting and crustal shortening, producing fold-thrust belts along its tectonic front on top of the Palaeoproterozoic Bangweulu Block, and extensive granitoid magmatism in its internal domain (Daly, 1986).

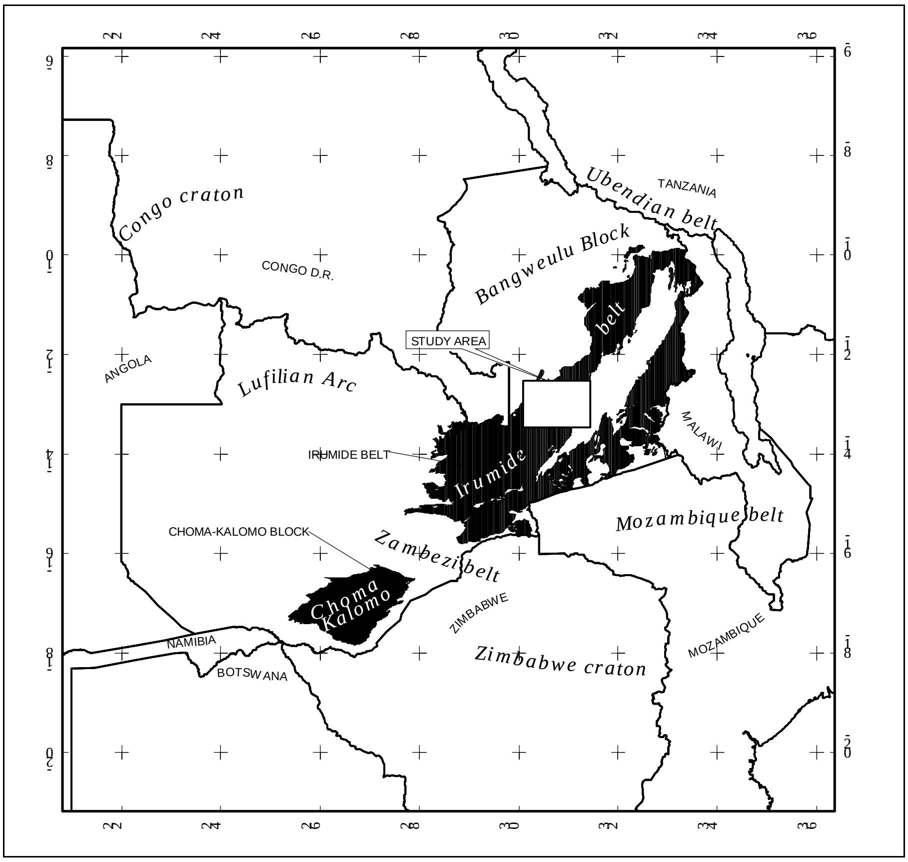

Figure 1: Location of the Irumide belt and Choma Kalomo block in Zambia. The white rectangle indicates the area depicted in figure 2.

Despite 35 years of 1:100,000 scale mapping, considerable controversy still exists regarding the age and extent of the Irumide belt, owing mainly to a lack of reliable age constraints, poor cross-boundary correlations, and poor understanding of geological complexities resulting from successive high-grade orogenic events and subsequent overprinting during the Zambezi and East African orogens. As a result, the orogen is poorly understood, and often unjustifyingly used in regional tectonic models. For example, the NE trending Choma-Kalomo Block on the southern side of the Zambezi orogen, has been interpreted as the SE continuation of the Irumide belt into southeast Zambia (Cahen et al., 1984; Hanson et al., 1988; Kroner, 1977).

METHODOLOGY

In order to form a first idea of the timing of magmatic events and constrain peak metamorphism in the Irumide belt, a transect was conducted and samples collected in the SE part of the belt. A total of six samples were selected from a variety of foliated and unfoliated granitoids, and two samples from a series of high-grade paragneisses and migmatites in the interior parts of the belt. One sample collected from further NE (Mununga Quarry) is added to the dataset. Zircon fractions of the samples were mounted, together with a zircon standard of known age and isotopic composition, in an epoxy resin mount, and polished. All zircons were studied and photographed using transmitted and reflected polarised light, and Cathodo-Luminescence images obtained on a Philips XL30 Scanning Electron Microscope to reveal internal structure and zircon morphology. Selected grains were then analysed using Sensitive High Resolution Ion Microprobe (SHRIMP), using an elliptical spot size of 20-30 μm. Where core-rim morphology was present and measurable using this spot size, analysis were conducted on both. All ages reported below are quoted with 95% confidence limits.

SHRIMP GEOCHRONOLOGY

Two deformed granitoids that define a narrow NW-trending terrane in the Serenje area yield ages of 1647 ± 10 Ma and 1661 ± 8 Ma, and may represent an accreted, allochthonous block deformed within the Irumide orogen. Preliminary geochemical results indicate that they are indistinguishable geochemically from the surrounding younger granitoids.

Late-tectonic (foliated) and post-tectonic (unfoliated) granitoids yield ages of 1038 ± 10 Ma, 1033 ± 15 Ma, 1024 ± 13 Ma, and 1018 ± 6 Ma. These results constrain the ages of magmatic pulses associated with peak compression and subsequent relaxation of the belt.

Paragneisses and migmatites south of the Serenje area contain detrital cores of ~2050-2020 Ma, indicating a rather uniform source material, coeval with the Mkushi Gneiss dated at 2036 ± 22 Ma (Master et al., 2000). Zircon overgrowths in the migmatites and high-grade gneisses indicate that peak metamorphism occurred between 1020 ± 7 Ma and 986 ± 20 Ma.

DISCUSSION

Our new SHRIMP data indicate that granitoid magmatism occurred prior to the Irumide orogen around 1650 Ma. These granitoids occur along a narrow zone between extensive ca. 1040-1020 Ma granites, from which they are geochemically not distinguishable. On a regional scale, both the late granitoids as the older suite contain large rafts of metasediments, and appear to have been intruded into the Muva Supergroup. The significance and position of the ~1650 Ma granitoids remains unclear.

Peak metamorphism in the belt occurred at ~1000 Ma, based on analyses of metamorphic rims on detrital zircons from high-grade gneisses. The detrital zircons, preserved as cores in the paragneisses, give coherent ages of ~2050-2020 Ma, suggesting the presence of a uniform late Palaeoproterozoic basement in the SW Irumide belt, providing the detritus in the basin during the late Mesoproterozoic. The detrital ages are similar to those obtained for the Mkushi Gneiss(Master et al., 2000), which forms the basement further to the southwest, in the Mkushi area.

To date no ca. 1350 granitoid magmatism has been identified in the southwestern portion of the Irumide belt. This seems to suggest that previous correlations between the Irumide belt and either the Choma-Kalomo Block to the southwest, or the Kibaran belt on the other side of the Bangweulu Block, are incorrect.

Additional U-Pb geochronology, together with Sm-Nd systematics, are needed to further constrain the Mesoproterozoic history of the Irumide belt. Our data so far covers only part of the SW Irumide belt, and work is underway on two similar transects further to the Northeast.

ACKNOWLEDGEMENTS

This research would not have been possible without the help of the Geology Department of the University of Zambia. Fieldwork and analyses were funded by the Tectonic Special Research Center. Financial assistance for attending the IAGOD / Geocongress conference in Windhoek was kindly offered by the Tectonic Special Research Center Travel Fund, the J.H. Lord Travel Grant, and IGCP's Grant in Aid. This article is a contribution to both IGCP 440 and IGCP 418.

REFERENCES

Ackermann, E.H., 1950. Ein neuer Faltengurtel in Nordrhodesien und seine tectonische Stellung im Afrikanishen Grundgebirge. Geologischen Rundschau, 38: 24-39.

Ackermann, E.H., 1960. Strukturen im Untergrund eines intrakratonischen Doppelorogens (Irumiden Nordrhodesien). Geologischen Rundschau, 50: 538-553.

Cahen, L. et al., 1984. The geochronology and evolution of Africa. Oxford University Press, Oxford, 512 pp.

Daly, M.C., 1986. The tectonic and thermal evolution of the Irumide belt, Zambia. PhD Thesis, University of Leeds, Leeds, 326 pp.

Hanson, R.E. et al., 1988. Reconnaissance Geochronology, Tectonothermal Evolution, and Regional Significance of the Middle Proterozoic Choma-Kalomo Block, Southern Zambia. Precambrian Research, 42: 39-61.

Kroner, A., 1977. Precambrian Plate Tectonics. Elsevier, Amsterdam.

Master, S., Robb, L.J., Armstrong, R.A. and Rainaud, C., 2000. New Age Constraints on Proterozoic Orogenic Events in Central and Southern Africa.