THE TECTONOTHERMAL HISTORY OF THE IRUMIDE BELT OF ZAMBIA. REGIONAL SIGNIFICANCE OF NEW GEOCHRONOLOGICAL CONSTRAINTS

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1. INTRODUCTION

The Irumide belt is a Mesoproterozoic fold and thrust belt to the SE of a foreland exposed in the Paleoproterozoic Bangweulu block. The belt runs from central Zambia in the SW, where it is truncated by the Neoproterozoic Zambezi belt, to the Zambia-Tanzania and Zambia-Malawi borders in the NE, where it appears to be terminated by a series of Neoproterozoic shear zones within the Paleoproterozoic Ubendian belt. To the immediate SE it disappears beneath Paleo- to Mesozoic Karoo grabens, and the medium- to high-grade lithological packages on the other side of the graben are difficult to relate to the Irumide belt due to extensive Neoproterozoic overprinting and tectonic reworking

U-Pb SHRIMP zircon data have established the timing of peak metamorphism in the Proterozoic Irumide belt of Zambia, and constrained the age of four magmatic episodes (G1–G4) and a thick supracrustal sequence (the Muva Supergroup) that are deformed within this belt. Basement granite gneisses of the Bangweulu block (G1a: 2050-1940 Ma and G1b: 1880-1860 Ma) are overlain by Muva Supergroup quartzite and pelite sequences, the lower parts of which include G1b 1880 Ma rhyolitic tuff layers. Most of the Muva is believed to have a Paleoproterozoic depositional age, but there is also a younger Mesoproterozoic series, the Kasama Formation, which contains detrital zircon as young as 1440 Ma. Both basement and supracrustals were intruded by three generations of granitic pluton (G2:1650-1550 Ma; G3: 1360-1340 Ma and G4:1050-950 Ma). G2 and G3 intrusions predate Irumide tectonism, but G4 granitoids are syn- and late-kinematic with respect to the Irumide orogeny, which has been dated at 1015 Ma by low Th/U zircon rims in peak metamorphic migmatite.

The age data presented in this paper are used to compare the Irumide orogen with various Mesoproterozoic events described elsewhere in central Africa.

2. GEOCHRONOLOGY

2.1. Palaeoproterozoic magmatic rocks of northern Zambia

The Bangweulu block, which forms the foreland to the Irumide belt, is well exposed near Mansa, where it consists of largely undeformed biotite granites that intrude a volcanic sequence referred to as the Luapula volcanics. Three biotite granites from this area have been dated at 1866 ± 9 Ma, 1862 ± 8 Ma and 1860 ± 13 Ma, while two samples of the volcanics yielded ages of 1868 ± 7 Ma and 1862 ± 19 Ma. Deformed granitic basement occurs throughout the internal part of the Irumide belt. In the southwest, this basement is referred to

as the Mkushi gneiss, and consists of variably deformed biotite granites and highly deformed mylonitic granitoids. The Mkushi gneiss was dated from three localities, yielding emplacement ages of 2052 ± 13 Ma, 2037 ± 12 Ma and 2036 ± 7 Ma. A granite near Kapiri Mposhi yielded a date of 2738 ± 4 Ma, interpreted as the emplacement age of this granite, indicating the presence of late Archean crust in the area. In the northeast, a body of weakly deformed biotite granite called the Luwalizi granite has been dated at 1942 ± 6 Ma and 1937 ± 10 Ma.

2.2. Muva Supergroup

The Muva Supergroup consists of a largely undeformed succession of shallow marine, lacustrine and fluvial deposits in northern Zambia (Mporokoso Group) and the deformed metasedimentary sequences of the Manshya River and Kanona Groups in the Irumide belt. An isolated occurrence of fluvial supermature sedimentary rocks in between the outcrop of the Mporokoso and Manshya River/Kanona Groups is referred to as the Kasama Formation, and form a younger sequence, largely derived from reworked Mporokoso Group sediments. The Mporokoso Group overlies a plutono-volcanic basement dated at ~1860 Ma (see above), and contains volcanic tuff layers near its base, placing the age of sedimentation soon after 1860 Ma. Two rhyolitic tuffs within the Irumide belt, constrain the timing of deposition of the Manshya River Group at 1879 ± 13 Ma and 1856 ± 4 Ma, roughly time-equivalent to the Mporokoso Group. Detrital provenance data on the Mporokoso and Manshya River Groups, and the Kasama Formation indicate striking similarities in locally derived source material with detrital peaks at ~2000 and ~1800 Ma. The youngest concordant zircons for the Mporokoso and Manshya River Groups indicate a maximum age of around 1830 Ma, while the Kasama Formation quartzite is a much younger sequence, with maximum age of 1434 Ma as indicated by its youngest concordant zircon. The Bangweulu block, and the overlying Mporokoso Group and Kasama Formation, record no significant tectonism after the 1860 Ma (G1b) magmatic event, and acted as a buttress over which the Manshya River/Kanona Group sequences were thrust during the Irumide orogeny.

2.3. Late Paleoproterozoic to early Mesoproterozoic granitoids (G2 granitoids)

G2 granitoids consist of biotite granite gneisses, and are identified throughout the Irumide belt. The tectonic setting and significance of these intrusions remain poorly understood. The absence of any ~1600 Ma metamorphic event, together with the A-type geochemical characteristics of the intrusions, supports an anorogenic model of their emplacement. In the southwest, G2 granitoids are known as the Lukamfwa hill granitoids, and consist of porphyritic biotite granite gneisses, and leucocratic granite gneisses. Dates have been obtained from four plutons, giving emplacement ages of 1664 ± 4 Ma, 1650 ± 4 Ma, 1639 ± 14 Ma and 1627 ± 12 Ma. In the northeast, G2 granitoids are known as the Mutangoshi and Musalango gneisses, the latter of which yielded an emplacement age of 1610 ± 26 Ma. Dates of 1055 ± 13 Ma and 1027 ± 13 Ma on rocks previously mapped as belonging to the Mutangoshi gneiss, indicate that at least some of this unit actually belongs to the G4 (syn-orogenic) granite suite (see below). A date of 1551 ± 33 Ma for the Lubu granite gneiss, interpreted as the emplacement age, indicates that it belongs to the G2 suite of granitoids, and not the (G1a) Bangweulu block suite as previously believed.

2.4. Mesoproterozoic pre-tectonic granitoids (G3 granitoids)

The 1360-1340 Ma event is identified only from two dated intrusions, one nepheline syenite and a metatonalite, in the far NE portion of the Irumide belt. Their proximity to the intersection between the Ubendian, Irumide and East African Orogen, together with their sporadic occurrence complicates their interpretation, and it cannot be excluded that they represent exotic crust unrelated to the Irumide orogen. No G3 granitoids have been identified in this study.

2.5. Mesoproterozoic syn-orogenic granitoids (G4 granitoids)

A major magmatic pulse is responsible for large volumes of coarse biotite granites across the belt. This magmatic event is accompanied by amphibolite grade regional metamorphism, defining the Irumide tectono-thermal event. Emplacement ages of a total of 22 granitoids have been obtained across the belt, with the earliest magmatism at 1055 ± 13 Ma, the latest intrusion at 943 ± 5 Ma (Figure 1).

3. DISCUSSION

The new U-Pb SHRIMP zircon dates, which are the first available robust geochronological data on the Irumide orogen, allow a critical review of previously proposed correlations of Mesoproterozoic terranes in Central and Southern Africa. An overview of all 38 U-Pb SHRIMP zircon ages, interpreted to date the emplacement of granitoids, is given in figure 1. In the past, poorly constrained time markers for the Irumide belt were used to support a correlation between the Irumide belt and the Choma-Kalomo block of Southern Zambia, and between the Irumide belt, and the Kibaran belt of Central Africa. The new constraints on the Irumide belt however indicate substantial differences in its geological history as compared to both the Kibaran belt and the Choma-Kalomo block, which record magmatism at ~1350 Ma and ~1200 Ma.

The significant differences in geological history between the Irumide belt and the Choma-Kalomo block represent either a marked and rapid lateral change in geological processes along a single belt, or indicate that the Choma-Kalomo block and Irumide belt represent two separate terranes that were juxtaposed during the Zambezi Orogen. The uncoupling of the Choma-Kalomo block from the Irumide belt allows for substantial crustal movement during the Neoproterozoic , and a wide separation between the Congo-Bangweulu-Tanzania cratons and the Zimbabwe-Kaapvaal craton prior to the closure of the Zambezi basin at ~550 Ma.

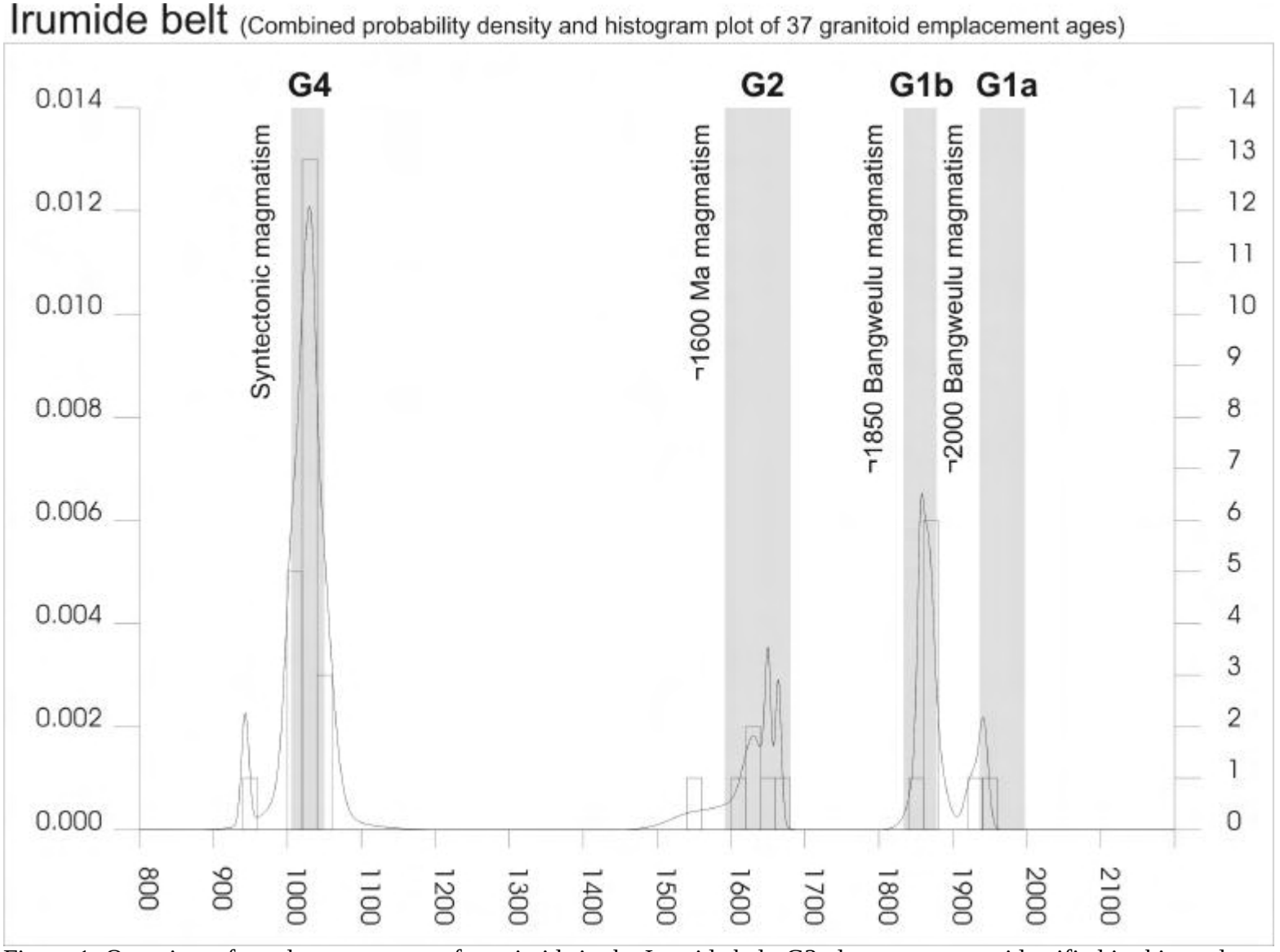

Figure 1: Overview of emplacement ages of granitoids in the Irumide belt. G3 plutons were not identified in this study.