Geological Society of Zimbabwe

Summer Symposium

8am to 5pm, Friday 21st October 2022

Diamond Lecture Theatre

University of Zimbabwe

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Start	**Topic**	**Speaker**
07:45	**Registration**	
08:15	Welcome	Kennedy Mtetwa-Geological Society Chair
08:50	Official Opening	Vice Chancellor Prof. Dr. Paul Mapfumo
09:35	High temperature thermochronology from the Paleoarchean eastern Pilbara craton and relevance to the granite-greenstone terranes of the Zimbabwe craton	Scott Maclennan
10:00	**Tea**	
10:20	Tectonic evolution of the south-eastern Mesoarchaean Mwanesi Greenstone Belt: implications for the construction of the Zimbabwe Craton.	Brian Mapingere
10:55	Zoning in Archaean Li-Cs-Ta pegmatites from the Bikita field: Implications to rare-metals exploration	Godfrey Chagondah
11:25	"Dem Bones, Dem Bones" - Zimbabwe makes Palaeo-history - a Review.	Tim Broderick
12:25	Digital transformation in Mining	Patrick Weeden
12:50	**Lunch**	
14:00	Cloud Mining: Lessons from a parallel universe	Kingray Gowera
14:20	The use of Virtual Reality to promote effective training in the education of Geological Sciences	Tinotenda Chimbwanda
14:40	Summary.	Brent Barber
15:00	**Tea - open to the public**	
15:30	**Geological Evolution and Metallogeny of the Palaeoproterozoic Magondi Belt, Zimbabwe and Botswana**	**Sharad Master - Macgregor Memorial Lecture**

High temperature thermochronology from the Paleoarchean eastern Pilbara craton and relevance to the granite-greenstone terranes of the Zimbabwe craton

Scott Maclennan

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The Pilbara craton represents one of the best-preserved records of Archean crustal, magmatic and structural processes. Due to the difference in the geochemical and structural character of the eastern and western parts of the Pilbara craton, this area is hypothesized to record the onset of “modern style” rigid plate tectonic interactions at ca. 3.2 Ga. The map pattern of the older eastern Pilbara craton is dominated by large granitoid-gneiss domes with intervening meta-volcanic and siliciclastic rocks. This is often referred to as a dome and keel pattern. This map pattern is common in Archean granite-greenstone terranes in cratonic areas around the world, including the Zimbabwe craton. The prevailing hypothesis for the origins of the dome and keel map pattern in the Paleoarchean eastern Pilbara craton is that it was governed by intra-crustal processes and that plate boundaries do not play a major role. In this model, low viscosity grantioids buoyantly rise from the middle-lower crust into the upper crust in large part due to the sinking of mafic-ultramafic volcanic rocks.

High temperature thermochronometers such as U-Pb in apatite or titanite are sensitive to mid-crustal temperatures and thus record exhumation of rocks into the upper crust. Here I present high temperature thermochronology on the granitoids that make up the dome and keel pattern of the eastern Pilbara craton and compare the results with intra-crustal plate tectonic model predictions. In light of these results, I also make some comparisons between the geology of the Zimbabwe and Pilbara cratons.

Tectonic evolution of the south-eastern Mesoarchaean Mwanesi Greenstone Belt: implications for the construction of the Zimbabwe Craton

Brian Mapingere, Jérémie Lehmanna, Karel S. Viljoena, Marlina Elburga, Georgy Belyanina

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The Mwanesi Greenstone Belt (MGB), occupying the central part of the Zimbabwe Craton, remains one of the least studied greenstone belts in the craton. Many fundamental questions remain unresolved regarding the age, deformation record and tectonic evolution of the MGB. We present new structural, LA-(MC-Q)-ICP-MS zircon U-Pb, and biotite and white mica 40Ar/39Ar data from the south-eastern MGB and adjacent granite gneisses to investigate the unresolved aspects of the MGB. The folded volcano-sedimentary sequence of the MGB, characterised by basaltic rocks intercalated with metasedimentary rocks, is structurally underlain to the east by various granite gneisses, some in intrusive contact with the MGB. The granites are transected by the km-wide N-S-striking sinistral Mhou Shear Zone (MSZ).

Zircon U-Pb dating shows that most dated zircons have been affected by hydrothermal alteration and they yielded discordant analyses. The measured trace elements were used to discriminate between altered and unaltered zircons, which are likely to yield reliable ages. The most concordant zircons are characterised by unaltered trace element signatures and very low average titanium content. The indicative age of the MGB is constrained at ~ 2871 Ma from the intraformational felsic volcanic rock of the Lower Greenstone Series (LGS), the oldest series of the MGB, which forms part of the Lower Bulawayan Supergroup as previously suggested by Worst (1962). Zircon U-Pb dating of the underlying granite gneisses on the south-eastern margin of the MGB revealed three distinct magmatic events. The first magmatic event is represented by a ~ 3243 Ma leucogranite gneiss, interpreted as the basement of the MGB and forming part of the Sebakwe Protocraton. This event was followed by the ~ 2852 Ma magmatic event that formed a porphyritic leucogranite gneiss coeval with the 2.8-2.9 Ga Chingezi Suite and interpreted to be the intrusive equivalent of the ~ 2871 Ma felsic volcanic rock of the LGS. The last magmatic event constrained at ~ 2767-2704 Ma is recorded in a granite gneiss and the granite protolith of the MSZ mylonite. This event was coeval with the formation of the Sesombi Suite of granites. The granite protolith of the mylonite is the only recognised granite younger than the MGB based on geochronology and field crosscutting relationships. All the other granite gneisses are older than the MGB.

Structural mapping corroborated with 40Ar/39Ar dating reveals three deformation events. The ~ 2688-2617 Ma lower to middle greenschist facies dextral strike-slip shearing D1 event formed shallow dipping fabrics in the supracrustal rocks and underlying granite gneisses in addition to F1 recumbent folds in the supracrustal rocks. The fabrics include gneissic foliation carrying shallow to moderately NW- to NNW-plunging mineral and stretching lineation in the granite gneisses, and fold axial planar cleavage to F1 recumbent folds associated with shallowly SW- to NW-plunging mineral lineation and fold axes in the supracrustal rocks. We interpret F1 folds as progressive folds formed by layer-parallel shortening with a significant component of shallowly inclined shearing. Regionally, D1 in the study area was broadly coeval with F1 folding and west-directed thrusting in the Bindura-Shamva Greenstone Belt constrained at ~ 2680-2643 Ma (Jelsma and Dirks, 2000). The ~ 2588-2541 Ma D2 event operated at upper greenschist to lower amphibolite facies and formed the mylonites of the MSZ. In addition, D2 formed steeply W-dipping fold axial planar gneissosity in the adjacent granite gneisses and mylonitic foliation carrying shallowly SSW- and NNE-plunging stretching lineation, and cm- to m-scale upright and intrafolial F2 folds. D2 structures show a gradual westward strain increase from the easternmost granite gneisses where D1 structures are preserved to the MSZ where mylonitic foliation and cm-scale intrafolial F2 folds are pervasively preserved. D2 is interpreted as a wrench-dominated localised sinistral transpression in the granite gneisses, which formed under NW-SE (or NNW-SSE) contraction and is likely responsible for forming the MGB syncline. D2 in the MGB was coeval with the 2.58 Ga NNW-SSE contraction in the Limpopo orogeny (Berger et al., 1993; Mkweli et al., 1995; Treloar and Blenkinsop, 1995) and the emplacement of the Great Dyke at 2575 Ma (Oberthür et al., 2002). Lastly, the lower greenschist facies, brittle-ductile D3 event formed steeply NE-dipping fold axial planar cleavage in the supracrustal rocks and granite gneisses, and F3 box folds in the MSZ.

Our structural mapping shows that modern-type tectonics played a significant role in the evolution of the south-eastern MGB. This inference is evidenced by (1) shallow fabrics (S1) in the underlying granite gneisses and supracrustal rocks, (2) inferred detachment separating the underlying granite gneisses from the overlying supracrustal rocks, (3) wrench tectonics in the MSZ, and (4) steeply dipping fold axial planar cleavage S3 and F3 box folds which reflect the horizontal contraction of the crust. Our study gives some valuable insights into the deformation record of the MGB and the construction of the Zimbabwe Craton at large during the Archaean.

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Zoning in Archaean Li-Cs-Ta pegmatites from the Bikita field: Implications to rare-metals exploration

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Complex-type pegmatites characterized by mineralogical, textural, and geochemical zonation patterns are recognized globally and span the geological time from the Mesoarchaean to the Cenozoic. The pegmatites contain common granite mineralogy and are enriched in fluxing agents (e.g., Li, B, P, H2O). The Bikita Pegmatite Field (BPF), situated along the southern margin of the Zimbabwe craton, comprises Neoarchaean complex-type pegmatites of the Li-Cs-Ta family that exhibit classic zonation profiles. The pegmatites are characterized by different degrees of vertical and lateral zonation patterns. Internally, the pegmatites reveal, from the margin inwards, successive zones with differing mineralogical and geochemical compositions, including border, wall, intermediate, and core zones. In individual pegmatite zones, K-feldspar and mica have contrasting concentrations of rare-metals, such as Li, Cs, Ta, Rb, Nb, Be, Ga, Th, U and Sn.

The paragenetic sequence in BPF pegmatites underscores the complementary roles of primary (magmatic) and metasomatic (sub-solidus) stage processes in the crystallization and rare-metals enrichment. After the development of the border and wall zones, classic fractionation indicators in the BFP (e.g., K/Rb, Rb/Sr, Nb/Ta ratios) in K-feldspar, muscovite, lepidolite and beryl suggest that the pegmatites predominantly experienced a bottom-up crystallization sequence. The recognition of mineralogical zonation profiles and geochemical evolution vectors aids exploration of sought rare-metals, since they are laterally and vertically distributed in pegmatite units.

"Dem Bones, Dem Bones" - Zimbabwe makes Palaeo-history – A Review

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From a presentation given to the Zimbabwe Professional Guides Association, a short explanation of Archaean and Proterozoic geology is given as to the distribution and tectonic relationship of Karoo and post-Karoo sedimentation and volcanicity relative to the Zimbabwe cratonic core. The distribution of known fossil vertebrate remains in time and space that have been recovered from Zimbabwe is given upwards from the Permian (Lower Karoo) through Mezozoic history (Upper Karoo, Gokwe and Dande formations). A brief discussion on the type, distribution and zoning of Permian fauna leads to the distinction between Glossopteris and Dicroidium flora, including the presence of fossil wood in the sequence. Working upwards through time from the early Late-Triassic to the Late-Jurassic Period, the significance that palaeontology has made to our evolving understanding of early dinosaurs in particular, is described by outlining recent internationally-sponsored research projects and their discoveries. Collectively this places Zimbabwe in the spotlight within the realm of World Palaeontology, and will continue to do so as facts and new finds emerge and the capacity of our National Museum is enhanced.

See on the rear cover.

Digital transformation in Mining

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In mining, exploration is the foundation of all value creation. It identifies new ore bodies for development, replenishes reserves depleted through production, and replaces those rendered uneconomic by falling commodity prices. Even companies that choose to grow by acquiring ore reserves rely on the exploration success of other companies.

Traditional methods of mineral exploration continue to increase in scale with a steady decline in discoveries. A new approach must be adopted in order to harness the benefits and capabilities of new technology in this space. Join Patrick Weeden from Scout Aerial who will walk us through digital transformation and the technology being used to forge the way.

Cloud mining: lessons from a parallel universe

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One of the biggest challenges of mining is the required capital to extract the resource effectively and efficiently. However, that could be true of most industries and businesses. It is, by and large, why artisanal miners rarely make it to small scale mining status.

One would be tempted to think, what we need is lots of money to fund these artisanal miners. While that could be true, lots of funding alone will not address this challenge sufficiently.

What we need is both a change in mindsets, metrics and organisation. We need a disruptive mindset. We also need different metrics to measure with. In addition to the change in mindset and metrics, we need a different kind of organisation

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The use of Virtual Reality to promote effective training in the education of Geological Sciences

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Field trips are an essential component in the teaching and learning of geological sciences. However, field trips can be very expensive. As such, most institutions do not have budgets to sufficiently finance them. This severely affects field exposure and experience. As a result, most students have to wait until their final years in school to participate in any field work. Apart from being highly costly, field trips can be dangerous, particularly for student geologists who might not yet have enough experience with potentially hazardous environments. Generally, the competency of a geologist is a direct function of experience and skill. In that light, there is a need for improved training methods, and Virtual Reality (VR) technology presents an opportunity to provide high-impact learning for next-generation geologists in a low-risk and controlled environment.

The goal of this study is to use VR technology to provide a realistic and practical simulation of geological outcrops in an experimental geological set up, to promote effective training for geologists. This study then investigates the effects of VR-based training on remote geohazard awareness assessment.

The system has been developed using the Unity 3D game engine. Open-source software Blender is used to create 3D models incorporated into Unity to make a typical geological scene. Geology students as well as geologists in the field are test subjects for this study. This study contributes to a growing body of research that is propelling the use of emerging technologies to promote safe and effective practice in the field of geology.

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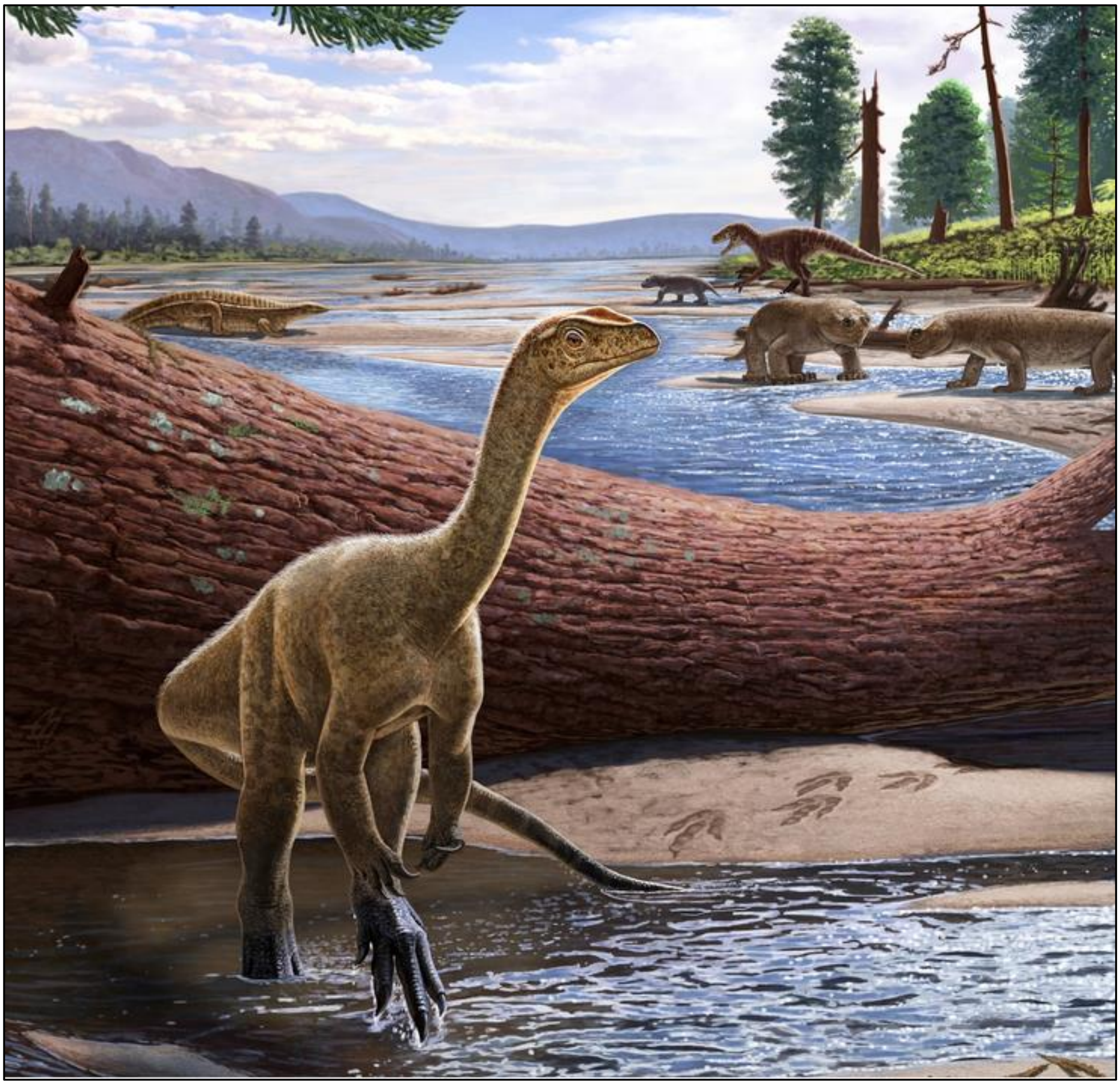
Notes



A reconstruction by artist Andre Atuchin of the palaeo-environment and faunal diversity surrounding what is dubbed ‘Africa’s Oldest Dinosaur’, Mbiresauus raathii, named for the District and in honour of the contributions made to Zimbabwe palaeontology by Mike Raath.