Geological Society of Zimbabwe

ABSTRACTS

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Summer Symposium

8am to 5pm, Friday 26th November 2021
Department of Geology

University of Zimbabwe

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TANDAMANZI DRILLING

SOCIETY OF ECONOMIC GEOLOGISTS FOUNDED 1920

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Start	Topic	Speaker
07:45	**Registration**	
08:15	Welcome	Renias Tirivabaya-Geological Society Chair
08:35	Official Opening	Prof P. Mapfumo, Vice Chancellor University of Zimbabwe
09:10	GSZ Mentorship Program	Steve Duma
09:25	Society of Economic Geologists	Andrew du Toit
09:30	**Tea**	
09:50	GSZ Professional Registration - Questionnaire Feedback	Kennedy Mtetwa
10:10	Chemical and Petrographic Composition and Depositional Environment of the Hwange Coal Seam	Oliver Maponga
10:30	Detrital zircon geochronological data bearing on the reconstruction of the late Mesoproterozoic Umkondo-Ritscherflya foreland basin (Zimbabwe/Antarctica)	Sharad Master
11:15	Update On The Petroleum Exploration Completed In the Cabora Bassa Basin In Zimbabwe During 2021	Brent Barber
11:45	The tectonic setting of the Umkondo Chimanimani Diamondiferous Grits- preliminary results discussed.	Bornwell Mupaya
12:05	Structural constraints on the evolution of the south-eastern Mwanesi Greenstone Belt and adjacent granitoids, central Zimbabwe Craton: implications for gold mineralisation	Brian Mapingere
12:25	Geophysical Modelling of the Ni-Cu Mineralised Jacomynspan Ultramafic sill, Northern Cape, South Africa.	Mhaka Ushendibaba
12:45	**Lunch**	
14:00	A review of the regional aeromagnetic, gravity and electromagnetic data of Zimbabwe with special emphasis on the Lonely, Empress and Hunters Road areas	Tenyears Gumede
14:20	Geophysics for Groundwater Search in Tsholotso	Hilary Gumbo
14:40	Data Integration & Automation	Eugene Snyman
15:00	**Tea**	
15:20	The use of mobile laser scanning to 2D & 3D map old underground workings	Matthew du Toit
15:40	Which assay method to choose for your geological samples?	Spicer Munjeri
16:00	Summary.	Tony Martin

Proposed GSZ Geologist Mentorship Programme

Steve Duma

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An industry mentorship programme is proposed to operate under specific guidelines which will be set and monitored by the GSZ and could be run by an inclusive subcommittee of the GSZ Committee. The programme will largely be in line with other existing professional Mentorship platforms around the world which are aimed at availing an opportunity for scientists operating in the exploration and mining industry to impart knowledge and skills to young graduates and aspiring geoscientists.

The mentorship programme will be designed in such a way that Mentors and Mentees are identified and paired through a formalized system which allows a seasoned professional to offer coaching and to help a young scientist to navigate through the early stages of their career.

The industry programmes are voluntary and can be described as formalized professional relationships between an experienced person who voluntarily and deliberately decides to transfer knowledge and experience to a young mentee or protégé, to assist them to develop the skills that they shall need to achieve their career or life goals.

The GSZ is considering the benefits that could accrue to the profession and to the industry and is actively exploring methods in which this opportunity could be harnessed.

GSZ Professional Registration - Questionnaire Feedback

Kennedy Mtetwa

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Professional registration requires that the GSZ is as representative as possible of the geology population in the country, and the drive to encourage as many members as possible needs to be strengthened.

Over the years there has been an on-going discussion on five separate but linked issues of whether to register the GSZ as a professional organization or not. Your Committee resolved to pursue the issue of registering the GSZ as a professional organization, as discussed at the 2021 AGM.

Registering the GSZ is a legal process and some requirements need to be met:

- Registration – verification and validation of professional qualifications and experience;
- Guidelines for professional behaviour/norms –
  - Developing and adopting a Code of Ethics for the GSZ’
  - Disciplinary procedures;
- Continued Professional Development

. Competence.

A professional registration sub-committee led by then Vice Chairman. Renias Tirivabaya was formed last year to focus on this important issue. This sub-committee did a sterling job and came up with the GSZ code of ethics and disciplinary code documents, which were discussed and adopted at the 2021 AGM. From these documents the GSZ then sent out a Professional Registration questionnaire during July 2021, whose results are detailed below:

GSZ Professional Registration - Questionaire Feedback

A questionnaire was sent out via Survey Monkey and 40 responses are summarized below.
Explanation - (8-20%) means 8 members and their % to the question
1. How many years post graduate experience in the geological field do
you have? Recent Graduate (0-0%) or 2 to 5 years (8 -20%), 5 to 10 years (6-15%), 10 to 20 years (10-25%), greater than 20 years (16-40%)

2. Have you read the proposed GSZ code of ethics document? Yes (39-97.5%) or No (1-2.5%)

3. Do you think that the proposed GSZ code of ethics document in it's current form is adequate for what it is proposed to achieve? Yes (37-92.5%) or No (3-7.5%)

4. Have you read the proposed GSZ disciplinary code document? Yes (39-97.5%) or No (1-2.5%)

5. Do you think that the proposed GSZ disciplinary code document in it's current form is adequate for what it is proposed to achieve? Yes (38-95%) or No (2-5%)

6. Do you think that geologists require professional regulation? Yes (38-95%) or No (2-5%)

7. Do you think that the GSZ should become a registered professional body under an act of parliament? Yes (34-85%) or No (6-15%)

8. Do you think that the GSZ committee should continue with taking the code of ethics and disciplinary code documents for a legal opinion? Yes (34-85%) or No (4-15%)

9. Are you aware that taking these two documents for legal opinion might require you to pay extra fees? Yes (33-82.5%) or No (7-17.5%)

10. Are you prepared to pay the extra fees to see the GSZ professional registration through? Yes (32-80%) or No (8-20%)

Thank you for your contribution.

Chemical and Petrographic Composition and Depositional Environment of the Hwange Coal Seam

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Chemical and petrographic attributes of coals are governed by the environment of deposition of the coal. Thus the study of nature and content of the building blocks (i.e., macerals) gives an insight, not only on the nature of coal, but also on the mode of deposition and coalification of the coal deposit.

This presentation taps from a PhD study (by the author) aimed at explaining the origin of anomalies encountered during the carbonization process of the Hwange coals following the commissioning of two mining blocks of Chaba Opencast and 3 Main Underground Mine. For example, coal from Chaba which previously was classified as coking coal, could not cake. The study included footwall profiling, processing of historical drill-hole data and analyses of 40 new samples collected from the operating mining blocks at Hwange Colliery. This presentation is based on the results of the chemical and petrographic analyses carried out during the study.

The study revealed that:

a) The coal seam footwall, which is characterized by a series of crests and troughs, plunges from approximately 840m above sea level in the northeast (Chaba Area) to below 490m in the southwest of the coalfield;

b) The commercial seam comprises a basal low ash, high volatile matter and vitrinite-rich layer overlain by a high ash, low volatile matter and inertinite-rich horizon.

c) The coal is Medium Volatile bituminous in rank

d) Ash and volatile matter, particularly the latter, is not a good indicator for cokeability.

e) From the vertical profile, the depositional environment is considered to be an initial wet forest swamp characterized by a high water table during which the low ash vitrinite-rich basal horizon was formed. This was followed by a gradual drop in the water table resulting in the wet forest swamp changing to dry forest where the swamp vegetation was subjected to oxidation and decomposition. This later environment resulted in the formation of the high ash inertinite-rich coal.

Mesoproterozoic Umkondo-Ritscherflya foreland basin (Zimbabwe/Antarctica).

Sharad Master, Robert Bolhar, Dirk Frei, Johan Krynauw, Riafana Nemakonde, Tiffany Seema

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The Umkondo Group is a late Mesoproterozoic sedimentary and volcanic succession that non-conformably overlies the Neoarchaean granite-greenstone terrain of the Zimbabwe Craton in eastern Zimbabwe, along the frontier with Mozambique. A basal conglomerate and grit sequence (which is diamondiferous in the Marange area), of fluvial origin, is transgressively overlain by a thin marginal marine carbonate platform succession, containing stromatolitic dolomites, followed by black shales, sandstones, and mafic volcanics and pyroclastics (Watson, 1969; Button, 1977; Stocklmayer, 1981; Master, 2016). The Umkondo Group is intruded by the 1108 Ma Umkondo sills, part of the Umkondo Large Igneous Province (LIP) (Hanson et al., 1998), which were emplaced into unconsolidated wet sediments (Master, 2006).

We have examined the basal Umkondo beds, and have dated detrital zircons (U-Pb, ICP-MS, only <±10% discordant grains considered) from diamondiferous conglomerate of Marange, non-diamondiferous conglomerate and granulestone from Birchenough Bridge (Seema, 2015), and a sandstone MTS4 from Mutsago Hill, in eastern Zimbabwe (Watson, 1969). The two conglomerates have zircons with ages clustering close to 2.6 Ga, with, in both cases, single concordant zircons of c. 2 Ga. The granulestone has mainly discordant zircon grains, which define a Discordia line, due to Recent Pb-loss, with an upper intercept age of c. 2.62 Ga. The sandstone has three Archaean zircons with age ranges of 2.67-2.64 Ga, four Palaeoproterozoic zircons with ages between 2.02 and 2.0 Ga, and 14 zircons with Neoproterozoic ages of mainly 0.62-0.61 Ga. These data give us an absolute upper bound on the age of the Umkondo Group, of c. 2.6 Ga (which is the age of the Neoarchaean granites of the Chilimanzi Suite, which form the immediate basement rocks underlying the Umkondo Group in the areas studied). The zircons of c. 2.0 Ga age in the conglomerates and sandstone indicate a younger maximum age of c. 2 Ga. They may possibly be derived from the same source as c. 2.0 Ga zircons recorded in garnet-sillimanite gneisses of the Gairezi and Rushinga Groups, in Mozambique (Mänttäri, 2008). No younger ages (possibly deriving from the kimberlitic intrusion from which the contained diamonds would have been eroded) have been found in the diamondiferous conglomerate from Marange. The detrital zircon data from all four samples point unequivocally to the Neoarchaean Zimbabwe Craton as overwhelmingly the main source of the basal Umkondo sediments, with just a few zircon grains derived from a c. 2 Ga terrain. A Neoproterozoic (early "Pan-African") metamorphic overprint at c. 620-610 Ma is recorded from zircon rims in the sandstone. This is similar to a biotite K-Ar age of 615 ± 30 Ma recorded from gneiss at Nyapanani Hill, Nyanga (Snelling et al., 1964). It is also similar to the ages of the youngest detrital zircons in the Sijarira Group of western Zimbabwe (Master et al., 2020).

The Ritscherflya Supergroup is a supracrustal sequence of sedimentary and volcanic rocks exposed in numerous nunataks in West Dronning Maud Land, East Antarctica. It is composed of the mainly sedimentary Ahlmannryggen Group, overlain by the mainly volcanic and volcaniclastic Jutulstraumen and Straumsnutane Groups (Krynauw, 1986; Perrit, 2001). The Ritscherflya Supergroup is intruded by tholeiitic sills of the Borgmassivet suite (Krynauw et al., 1988, 1991), dated at 1107 Ma (Frimmel, 2004, in Grantham et al., 2021). The sills were intruded into the Ritscherflya sediments while they were still unconsolidated, unlithified and wet (Krynauw et al., 1988, 1994). The Ritscherflya Supergroup overlies Archaean basement rocks of the Grunehogna Craton, wherein the Annandagstoppane granite has been dated at 3067 ± 8 Ma (Marschall et al., 2010).

Several samples of sandstones from the Högfonna Formation, Ahlmannryggen Group, originally collected and described by Krynauw (1986), were composited, and their detrital zircons were dated using the U-Pb method (Nemakonde, 2015). The detrital zircons give several groups of ages, ranging from Palaeoarchaean to Mesoproterozoic. The oldest group of 15 grains give ages between 3331 ± 33 to 2636 ± 35 Ma. There are two Palaeoproterozoic zircons dated at 1950 ± 42 and 1935 ± 39 Ma. The largest group of 44 zircons have ages between 1227 ± 45 to 1121 ± 51 Ma, while the three youngest zircons have ages of 1079 ± 54 to 1056 ± 76 Ma. The Archaean and Palaeoproterozoic zircons in the Högfonna Formation are derived from the Grunehogna Block (Marschall et al., 2010), while the Mesoproterozoic zircons are derived from arc rocks of the Maud Belt (Marschall et al., 2013). The youngest ages, with large errors, reflect metamorphic overprints. The detrital zircon record of the Högfonna Formation of the Ahlmannryggen Group indicates that the Ritscherflya Supergroup was deposited in a foreland basin during the collision of the Maud Belt with the eastern edge of the Grunehogna block.

The Ritscherflya foreland basin, which derived detrital input from the Archaean Grunehogna block from the forebulge side, as well as from the Maud Belt adjacent to the orogenic foredeep, was continuous with the Umkondo Basin, which derived detritus from the Archaean Zimbabwe Craton from the forebulge (western) side, as well as (possibly, but not yet documented) from the southern Mozambique Belt (Barue Complex) to the east (Master, 2010, 2016) (Figure 1). The Southern Mozambique Belt is a continuation of the Maud Belt in Rodinia and Gondwana reconstructions (Jacobs et al., 1998). The rare Palaeoproterozoic detrital zircons from both the Umkondo and Ritscherflya basins may be derived from an old passive margin of the Zimbabwe-Limpopo-Kaapvaal-Grunehogna palaeocontinent ("Zilikag"), represented by the Gairezi schists and Chimanimani quartzites. The identical 1107 Ma ages, field evidence for intrusion into unconsolidated sediments, and similar compositions and palaeomagnetic poles of the Umkondo and Borgmassivet intrusions indicate that the Umkondo-Ritscherflya foreland basin was intruded by the Umkondo LIP shortly after deposition of the foreland basin sediments. Much later, during the Neoproterozoic, a Pan-African collision event recorded in Antarctica and the southern Mozambique Belt (Jacobs et al., 1998) resulted in the renewed deformation and overthrusting in the Chimanimani Mountains and Southern Mozambique Belt, with ages ranging from about 620 Ma (this study) to c. 550 Ma (Snelling et al., 1964) and c. 500 Ma (Chaúque et al., 2018).

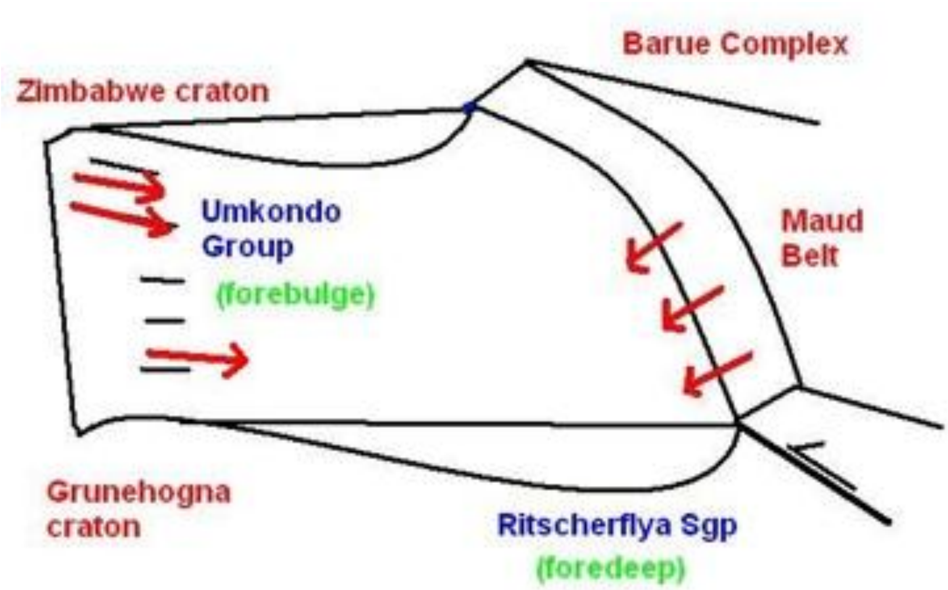

Figure 1: Schematic reconstruction of the Umkondo-Ritscherflya foreland basin, formed by the collision of the arc rocks of the Maud Belt and Barue Complex (southern Mozambique Belt) with Archaean rocks of the Grunhogna block and Zimbabwe Craton.

Acknowledgments

We thank Brian Mapingire and Lingululani Mukwevho for help with sampling and preparation of sample MTS4. We are grateful to the Geological Survey of Zimbabwe for supplying some of the samples. Andrew du Toit is thanked for his generous assistance during the 2012 GSZ Marange excursion when some of the samples were collected.

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Update On The Petroleum Exploration Completed In the Cabora Bassa Basin In Zimbabwe During 2021

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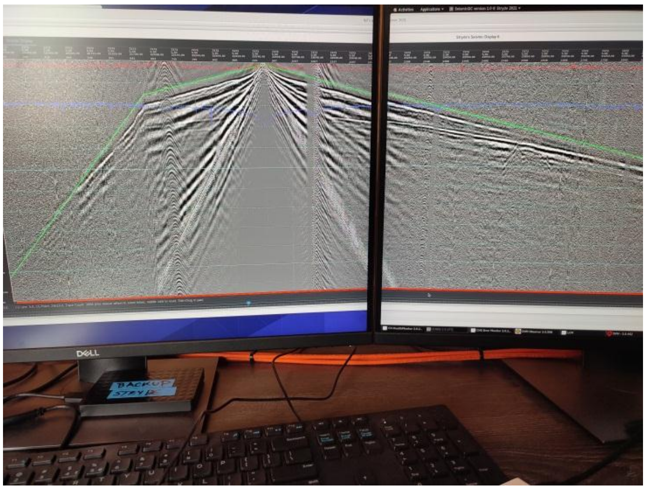
Following the signing of the Petroleum Exploration, Development And Production Agreement with the Government of Zimbabwe, on 26th March 2021, Invictus Energy, through its subsidiary company, Geo Associates engaged Polaris to undertake a seismic acquisition programme in the Cabora Bassa Basin in Zimbabwe.

During this survey a total of 839.5 line kilometres of high resolution 2D seismic was acquired. The final retrieval of the geophone spreads for data harvesting being completed at the beginning of November.

Preliminary evaluation of the seismic acquired, which has been despatched to a specialist company in Canada, Earth Signal for processing, indicates the data is of excellent quality. Once the processing of the seismic data has been completed an interpretation of the full dataset will be undertaken with the objective of identifying and maturing additional prospects and leads. The initial imaging of the better quality imaging obtained over the giant Muzarabani Anticline and other structures is encouraging and, once the interpretation of the full dataset is completed, it is anticipated that the location of the Muzarabani – 1 well, which is scheduled to be drilled next year, will be selected.



The tectonic setting of the Umkondo, Chimanimani Diamondiferous Grits- preliminary results discussed.

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Various explanations have been advanced on the genesis of diamonds in the Umkondo Proterozoic Basin particularly the recently discovered Chimanimani deposit and the famous Marange Alluvial Deposits on the western parts of the same basin. The Marange deposit is hosted in basal conglomerates overlying Archaean granites (Roberts, 2006), whilst the Chimanimani diamondiferous conglomerates are hosted in the upper facies of the Umkondo stratigraphy in the Lower Argillaceous Series

To add to this debate, this paper reviews the tectonic setting and the provenance of the Chimanimani diamondiferous grits and discusses results of preliminary geochemical analyzes of the grits. Of note is that several assertions have been made on the provenance of the Chimanimani diamonds. In an attempt to explain the origins of the Chimanimani diamondiferous grits, several authors adopted the interpretation by Watson (1969), that lithic fragments in the ferruginous sandstones in the Zimbabwe Facies east of Chimanimani town were thrusted from the Frontier Series (Mozambique Facies) along the eastern boundaries of the country concluding that the fragments could have been derived from the Frontier Series since they were already metamorphosed before deposition in the Zimbabwe Facies. Based on this conclusion, some authors who include Zhou (2015) assumed that the diamonds in the Lower Argillaceous Series of the Zimbabwe Facies could have been thrusted from the Frontier Series as well. On the contrary, Roberts (2006) proposed a theory whereby diamonds in the western portions of the Umkondo Basin (Marange), were derived from the Zimbabwe Craton as a result of loading of the Craton by sediments during amalgamation of the Rodinia Supercontinent, that ultimately triggered the eruption of kimberlites on the Craton. In support of this model, through observations of the decrease in size of diamonds from Marange in the west to Chimanimani in the east, Bockstael (Person. Comm., 2010), suggested that the diamonds were derived from the same kimberlites in the Craton, with differences in sizes being a mere facies change deeper in the basin eastwards.

The apparent unsequential deposition of fine argillaceous sediments above coarse diamondiferous grits that in turn overlie fine sandstones was postulated to imply allochnous deposition of the grits (Master Person Comm., 2012). This concept was alluded to by Watson (1969) that the Frontier Series were thrusted westwards and mapped by Payne (1984) in the same Mozambique Facies, as the Gairezi Series in Nyanga. Linking the source of the diamondiferous sediments to the allochtonous Frontier Series though sounding logical complicates, the whole scenario, as the Frontier Series itself was derived from two sedimentary basins (Watson, 1969, Cutten et al., 2004).

A critical review of the tectonic models for kimberlite magmatism and source of the sediments of the Frontier Series (Mozambique Facies) suggests three possible sources of the diamondiferous conglomerates in Chimanimani. These include the Zimbabwe Craton, the allochnous Frontier Series and its source two sedimentary basins, then lastly, possible kimberlites/ lamproites within the Frontier Series itself. Inorder to establish the most likely possible source terrane/ reworked source sedimentary basin of the diamondiferous sediments, tectonic discrimination diagrams and element ratios of major oxides and trace elements were undertaken. Preliminary bivariate plots of major oxides indicate maturity of the diamondiferous sediments, and analyses of 20 samples done so far suggest a passive continental margin setting consistent with the model described by Bhatia (1983). Three zircon grains from mill concentrates, picked under the miscroscope and two zircons identified in polished thin sections will be dated in order to constrain the timing of deposition of the sediments which will be linked to various tectonic activities from Rodinia to Gondwana.

Structural constraints on the evolution of the south-eastern Mwanesi Greenstone Belt and adjacent granitoids, central Zimbabwe Craton: implications for gold mineralisation

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The Mwanesi Greenstone Belt (MGB) occupies the central part of the Zimbabwe Craton and trends in a NNE direction. The MGB consists of greenstones (intercalated with banded iron formations, BIF) of the Lower and Upper Bulawayan Supergroup. The MGB is described as a doubly plunging NNE-trending syncline, with BIF units defining fold closures at both the northern and southern ends of the belt. Gold mineralisation is hosted in quartz reefs in the supracrustal rocks and adjacent granitoids and gneisses. The MGB is one of the least studied greenstone belts of the Zimbabwe Craton. In particular, the deformation record of the belt is only known from colonial mapping programs in the 1950s. We report new data from lithological and structural mapping of the south-eastern MGB (the focus of this study) and adjacent granitoids and gneisses.

The south-eastern MGB reveals that the lower structural units of the MGB are composed of mafic rocks (locally pillowed and pyroclastic breccia) and to a less extent felsic volcanic rocks, intercalated with thin-bedded and medium-laminated metasedimentary rocks, traditionally referred to as the Lower Greenstone Series (LGS). These are overlain by phyllites and BIFs (i.e., the Lower Sedimentary Series, LSS). The LGS and LSS are intruded by mafic rocks and are overlain by locally pillowed basaltic rocks of the Middle Greenstone Series. The MGB is underlain to the east by a variety of granites and gneisses, some in intrusive contact with the MGB. The granites and gneisses are transected by a km-wide N-S-striking sinistral shear zone (the Mhou Shear Zone, MSZ). A new LA-(MC-Q)-ICP-MS U-Pb age at 2717 ± 21 Ma (MSWD = 2.1) from a MSZ mylonite is interpreted to date the crystallisation of the granitoid protolith of the MSZ.

Our structural mapping reveals three deformation domains based on the orientation and kinematic interpretation of tectonic fabrics, overprinting relations, and microstructural characteristics. (1) The MGB is characterised by a shallow-dipping bedding parallel schistosity carrying a mineral, intersection lineation. This schistosity encloses dm-scale recumbent, intrafolial folds. The schistosity is overprinted by steeply NE-dipping axial planar cleavage to cm-scale folds, which carries a NNW-plunging crenulation lineation. (2) Orthogneisses west of the MSZ and structurally below the MGB are characterised by a shallow SW-dipping gneissosity (carrying a shallowly NW-plunging mineral lineation), which is associated with a top-to-the NW shearing as evidenced by K-feldspar sigma porphyroclasts. The gneissosity is overprinted by steep NE-dipping axial planar cleavage to cm-scale open folds. (3) Orthogneisses east of the MSZ reveal a shallow SW-dipping gneissosity overprinted by the steeply W-dipping gneissosity and mylonitic foliation of the

MSZ. The MSZ carries a shallowly SSW-plunging stretching mineral lineation. Mylonitic foliation in the MSZ is associated with a sinistral sense of shear based on K-feldspar sigma and delta porphyroclasts. We suggest a wrench dominated transpression model to explain the deformation in the MSZ based on shallow-plunging stretching lineation carried by a steep mylonitic foliation.
Gold mineralisation hosted by broadly W-dipping quartz veins occurs in the MGB and MSZ. The crystallisation age of the granitoid protolith of the mylonite in the MSZ is contemporaneous with the intrusion of the Sesombi granitoid suite (2720-2640 Ma) in the Zimbabwe Craton. The lithostratigraphy and deformation record of the south-eastern MGB and adjacent granites and gneisses from our work have important implications for understanding the tectonic evolution of the MGB and the link between deformation and the gold mineralisation in the MGB.

Geophysical Modelling of the Ni-Cu Mineralised Jacomynspan Ultramafic Sill, Northern Cape, South Africa

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The Jacomynspan Nickel-Copper (Ni-Cu) occurrence in the Northern Cape Province of South Africa is located 50km east of Kenhardt and 130km south of Upington the commercial centre of the region. It is located within the Namaqua Tectonic Province which is part of the Kibaran-aged (1400 – 950Ma) orogenic event. The aim of the presentation is to demonstrate geophysical modelling of the Ni-Cu mineralised Jacomynspan ultramafic sill through inversion modelling of various Time Domain Electromagnetic (TDEM), magnetics and Audio-frequency Magnetotellurics (AMT) data. The Jacomynspan Ni-Cu sulphide mineralisation is hosted within a 100m thick steeply dipping tabular, differentiated, sill of mafic to ultramafic composition intruded into country gneissic rocks of the Namaqualand Metamorphic complex. The sill is predominantly composed of tremolite schist (metamorphosed pyroxenite) containing lenticular bodies of harzburgite. Massive sulphide veins and stringers are occasionally present within the harzburgite. The sulphide minerals are a typical magmatic assemblage of pyrrhotite, chalcopyrite and pentlandite. The sill covers an approximate strike length of about 5km but only a small portion covering 1km x 1km was selected for this presentation. Physical properties studies carried out on the drill core (magnetic susceptibility and conductivity) indicate that the country gneissic rocks are not conductive and neither are they magnetically susceptible. However, the mineralized sill has elevated values of both magnetic susceptibility and relative conductivity compared to its host making it a suitable target for both magnetic and electromagnetic inversion. The mineralised ultramafic sill is clearly mapped in both the 3D model representation from Mag2dc modelling and VOXI's 3D unconstrained smooth model inversion for the study area. Based on the physical properties studies, EM data (both ground and downhole EM) were modelled using Maxwell software. The mineralised tremolite schist was clearly modelled with very large EM plates. 2D inversion modelling of AMT data clearly maps the mineralised ultramafic intrusion. Integration of the different models with the geology model is carried out.

A review of the regional aeromagnetic, gravity and electromagnetic data of Zimbabwe with special emphasis on the Lonely, Empress, and Hunters Road areas

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Aeromagnetic surveys have been of assistance to mineral and petroleum exploration identifying target areas and in geological mapping projects. Developed computer-assisted interpretation techniques have vastly increased the value of magnetic data for these purposes.
The first part of the phase1 was an airborne magnetic survey performed by Kenting Earth Sciences Ltd. on a part of the country covering the great dyke and most of the greenstone belts. These are the formations historically most favorable for mineral deposits. 100,000 line kilometers of digital magnetic were acquired over an area of 90,000 square km at a flight line spacing of 1km and terrain clearance of 305 meters.

The end products were contoured magnetic maps at a scale of 1:50,000 and 1:250,000.
Colored maps of the same area were provided of the total field and vertical gradient at a scale of 1:100,000 and 1:1,000,000.

The second part of phase1 was an airborne electromagnetic survey of selected greenstone belts performed by Geoterrex Ltd. using a time-domain electromagnetic system known as INPUT (Induced Pulse Transient E.M.). This covered 20,000 line kilometers at a line spacing of 250 meters and terrain clearance of 120 meters and was completed in 1983. This survey provided maps showing conductive zones which are indicators of possible base metal deposits in the Hunters Road Area, Empress, Lonely, and Shangani Areas.

The commonly used interpretation techniques rely on a qualitative review of data and these include anomaly shape, symmetry, strike extent, and variability within the conductive zone. Other factors are:

- i) Shape and size of the INPUT anomaly
- ii) Strike length and degree of isolation
- iii) Associated geophysical anomaly e.g. aeromagnetics
- iv) Geological environment and the relationship of anomalies to known mineralization

Phase 2 aeromagnetic survey was carried out in the eastern, southern, and southwestern parts of Zimbabwe by Sanders Geophysics Ltd. Total number of lines kilometers flown was 158,006 and the survey area covered 145,000 square kilometers.

Intera -Kenting Ltd. was contracted to complete the aeromagnetic coverage of Zimbabwe from May 1990 to April 1991. The survey covered the least mapped portion of Zimbabwe, the northwestern third of the country. The total number of line kilometers flown was 155,810.5.

On the other hand, gravity measurements that map the Greenstone Belts, the Great Dyke, and Mobile Belts are a composite from private companies and individuals. Mobil, through its oil exploration program, generated data in the north. Anglo American and De Beers have fair contributions. Researchers, namely Dr. F Podmore, Dr. O Gwavava, and Dr. R Ranganai have a huge contribution with their along-road surveys and across the Great Dyke.

Geophysics for Groundwater Search in Tsholotso

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3D Earth Exploration recently carried out a survey for ground water in the Tsholotsho area. The Stratagem EH4 Controlled Source Audio-frequency Magnetotelluric (CSAMT) unit was used to survey resistivity profiles at 25m station spacing. The Nyamandlovu Epping Forest aquifer area was used as a test site to gauge how well the instrument is able to map various stratigraphic layers that control the aquifer in the area. The CSAMT unit was able to clearly map the various stratigraphic layer alternating as high and low resistivity as well as breaks in the layers attributed to faulting. Some drilling done subsequently confirmed the geological layers and abundant water was found in some drill holes.

Data Integration and Automation

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Data is being generated at volumes and rates never seen before and this leads to new challenges in keeping up with the loading and validation of data after extraction from third party vendors' systems such as Application Programming Interfaces (API) and Amazon S3 buckets.

This is making the need for data integration and the automation of these processes more pressing than ever before in geological data management.

At the same time advances in the way data is transferred online mean that we are moving away from the classic .csv or Excel file towards streaming data in JSON or .xml formats which need to be converted to database and human friendly table structures at their destinations.

And within large mining organisations there's a need to automatically consolidate data from various operations into a master data warehouse in a central location which is geared towards data analysis and reporting.

We look at some examples of Maxgeo's automation of transferring and validation of downhole orientation survey data, assay data and others.

The use of mobile laser scanning to 2D & 3D map old underground workings

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We are a small company providing the laser scanning and drone photogrammetric services. We have a hand held mobile laser scanner capable of capturing up to 43,000 points a second with a maximum range of 15meters. The scanner has a relative accuracy of 1-3 cm and an absolute accuracy ranging from 3-30cm when a RTK GPS is used to set control points. So far we are primarily working with small scale gold mines. We are able to produce 3D point clouds, 3D solid meshes, as well as 2D rasters and polygons, which accurately represent the reality of the structures being scanned.

Our laser scanning capabilities allows us to bring the reality of underground mines, and other structures to the office. We have proven that our laser scanning has proven benefits over traditional underground surveying as well as in architectural working. Laser scanning is able to capture details that are easy to miss details, as well as hard to reach or measurable objects.

Which Assay method to choose for your Geological Samples?

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For most geologists and metallurgists, there is always some confusion on which method to use for their samples. Exploration samples, ore grade samples and plant samples are treated differently. The information that is to be obtained from the analytical results will also determine which method to use. There are various methods that are used for assay for different minerals. For example, Gold there several methods that include Fire Assay by lead collection or Nickel Sulphide collection, Aqua Regia, Bottle Roll, Titration etc. The nature of sample and the levels of the mineral of interest will have a bearing on the method that is chosen. So it is imperative for the geologist to be clear on what they want to use the analytical results for.
