Geological Society of Zimbabwe

Summer Symposium

8am to 5pm, Friday 30th November 2012
Department of Geology
University of Zimbabwe

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Geological Society of Zimbabwe Summer Symposium 2012		
30th November 2012, Department of Geology, University of Zimbabwe		
Registration (incl teas and lunch) $20 for members (non-members should join)		
Start	**Topic**	**Speaker**
07:45	**Registration**	
08:15	Welcome	Bornwell Mapaya, Society Chairman
08:35	**Opening**	**Prince Mupazviriho, Permanent Secretary of Mines and Mining Development**
09:00	Unlocking the Zimbabwe Mineral Wealth and Maximizing the Potential Contribution of the Mining Sector to Socio-Economic Development	Isaac Kwesu, Chamber of Mines
09:35	GSSA and Professional Registration	Gordon Chunnett, GSSA
09:55	Tea	
10:15	New U-Pb ages for the Palaeoproterozoic Magondi Supergroup, Zimbabwe	Sharad Master
11:15	Zimbabwe Coal Industry	Oliver Maponga
11:45	Applications of MRM system in mining industry with specific reference to Unki mine	Oswald Mapengo
12:05	Preliminary appraisal of links between geology and wildlife water supply in the Sub-Kalahari, Hwange	David Love
12:40	Nkombwa Hill	Jock Harmer
13:00	Lunch	
14:00	Geophysics and Gold Mining - Chasing the Vein: A Technical Appraisal of New Generation Ground Penetrating Radar and its Applications in Exploration of Greenstone Quartz Vein Mines"	Ed Magan
14:30	Geophysical Applications for small scale mining projects	Hilary Gumbo
14:50	Ground Penetrating Radar (GPR) as a ground monitoring system	Dumisayi Mapundu
15:10	Tea	
15:25	Ethiopia and Iceland – examples on continental rifting	Gayle Hanssen
15:45	The Geology of Health in Zimbabwe-An Overview	Tendai Njila
16:05	Artisanal Mining in Mozambique	Isadore Manuel
16:25	Diamonds in Chimanimani	Bornwell Mapaya
16:45	Summary	Sharad Master

Thursday 29th November 2012 - Lecture at Department of Geology, University of Zimbabwe		
17:30	Geological challenges in satisfying future global demand for the Rare Earth Elements	Jock Harmer

Unlocking the Zimbabwe Mineral Wealth and Maximizing the Potential Contribution of the Mining Sector to Socio-Economic Development

Isaac Kwesu

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Zimbabwe's mining sector plays an important role in the socio-economic development of the country. The sector's contribution to the economy has grown up substantially in the past 3 years to as high as 13 % of GDP in 2011 from an average of 3.5% between 1990 and 2008. At the current performance the mining sector is now matching the manufacturing sector output which now contributes 14% of GDP (down from above 20% in 1990s). In spite of the above the mining sector is still fragile and experiencing low capacity utilization and a host of challenges, not restricted but including lack of exploration activities, inconsistent and unpredictable mining policies, uncompetitive royalty regime, lack of capital, shortages and inconsistent supply of power. If key challenges currently bedevilling the sector are overcome the sector can contribute as much as 18% by 2015 and well above 25% in 2020, overtaking both agriculture and manufacturing output. It is against this background that the presentation looks at how best to unlock the Zimbabwe mineral wealth and maximize its contribution to socio-economic development. The presentation will be outlined as follows:

- Overview of the Mining Sector.
- Contribution of mining to the economy
- Performance of the Mining Sector.
- Challenges facing the Mining Sector.
- How to unlock the mineral wealth to maximize contribution to the economy.

The Geological Society of South Africa: A View from Johannesburg

Gordon Chunnett & Craig Smith,

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The Geological Society of South Africa (GSSA) was established in 1895 in response to the needs of the earth science professions to develop a better understanding of the geology of South Africa, established even by then as one of the world's major minerals producing countries. The Society was established to promote the study of geology, and to look after the professional well-being of those who practice it, whether in industry, academia or government sectors of employment. Since 1895, there have been many changes to the science and to exploration and mining as well as to the GSSA, yet the broad strategic goals of the Society have remained the same. Importantly, the GSSA serves as both a 'learned' and 'professional' society, unlike some of its larger counterparts in the developed world. The GSSA is growing rapidly, now closing in on 3500 members, and routinely having five to six million Rand annual budgets. For some years it has not been possible to manage the Society on volunteer labour alone. Currently the GSSA employs four full time staff, and will probably need to add more with increased growth. We see growth continuing, given the emphasis on the minerals sector in Africa, as well as the GSSA's involvement in drafting of minerals reporting codes, and its ROPO status with several overseas organizations.

A major benefit for members of the GSSA is the recognition of his/her status as a professional geoscientist. The SAMREC/SAMVAL codes, along with other reporting codes elsewhere in the world, require continued membership in a professional society as a basic requirement. Any professional needs to be subject to a code of conduct or code of ethics, and must also be subject to oversight as regards the quality of his credentials and track record.

Support for the academic community is supplied through cooperation with research funding organisations and direct financial grants by our REI (Research and Education Investment) Fund. The GSSA continues to publish quarterly a full scientific journal, the South African Journal of Geology, which continues to be read around the world, either in its physical format, or in its digital guise via Geoscience World. As is the case with other Societies, a current hot topic is when or if we move to full digital publication, dropping the print version. The digital is in fact the official version of record. For now we retain both options, as has Economic Geology.

The GSSA also publishes the quarterly news bulletin, Geobulletin, an increasingly popular source of news and forum for comment in the southern African earth science community.

The general 'landscape' we see in the global minerals business as well as in geology R&D lead us to believe that the GSSA has an increasingly important role to play in the continued professional and academic development of its members, and supporting exploration and mining geology in Africa, inter alia by arranging courses, workshops and conferences, and by interacting with government with respect to legislation that may affect the profession. Africa is developing rapidly, and clearly will be a major target for exploration and mining investment world-wide. There will be hiccups along the way, such as the current labour unrest affecting the South African sector. But in a world with 7 to 10 billion people, half of whom live in developing countries, increasing numbers of professional earth scientists will be required in all sectors of the economy. The GSSA will continue to support their needs, as well as serve the best interests of the public.

New U-Pb ages for the Palaeoproterozoic Magondi Supergroup, Zimbabwe

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The Palaeoproterozoic Magondi Supergroup is a metasedimentary succession with minor volcanic rocks, forming part of the Magondi Belt on the western edge of the Zimbabwe Craton (Figure 1a). It has been suggested in Master et al. (2010) that the belt extends through western Zimbabwe and northeast Botswana to include the Dete-Kamativi Inlier and the Matsitama Belt respectively. In the low-grade (greenschist to amphibolite facies) part of the Magondi Belt, there are three groups - the Deweras, Lomagundi and Piriwiri, while in the high grade parts of the belt, there are intrusive granitoids dated at about 2 Ga (Figure 1b).

The Lomagundi Group is the type locality for the "Lomagundi" global high δ13C excursion in marine carbonates Master et al. (2010), but its age is very poorly constrained. This study aims at improving the geochronology of the Magondi Supergroup, for both local and global geologic and chemostratigraphic correlations.

The currently available geochronology for the Magondi Belt is sparse and in some instances no longer valid, due to large errors. There have been some newer studies such as McCourt et al. (2001) which have U-Pb dates but more still are needed to constrain both the timing of the deposition of the host sediments and consequently when the Lomagundi excursion occurred.

Zircons from five samples were analysed using the SHRIMP-RG facilities at the ANU in Canberra. Only zircons with ± 10% or less discordance are considered in the age calculations.

DV 11/1 is a pyroclastic mafic agglomerate (with mafic clasts in a chlorite-plagioclase-rich matrix), and DV 11/2 is an overlying wackestone, rich in mafic lithic clasts, both from the base of the Deweras Group. The zircons from DV 11/1 give mainly Archaean ages, ranging from 2580 ± 19 Ma to 2813 ± 23 Ma with an age peak of c. 2.63 Ga, reflecting derivation as xenocrysts from the underlying Neoarchaean terrains of the Zimbabwe Craton. The youngest zircon grain, dated at 2235 ± 32 Ma shows good igneous zoning, though it is not euhedral, and could be either indigenous or xenocrystic, giving a maximum age for the Deweras Group. The 67 zircons studied in DV 11/2 are mainly Neoarchaean, with a bimodal age distribution, with peaks around 2.64 Ga and 2.86 Ga, with a total absence of ages between 2.70 Ga and 2.80 Ga. There are only two Palaeoproterozoic zircons, with ages of 2439 ± 23 Ma and 2171 ± 11 Ma. The youngest age provides a maximum age for the wackestone, and for the rest of Deweras Group.

A lithic crystal tuff in the upper Lomagundi Sakurgwe Fm (Z11/C–SKR2B) contains a xenocrystic population of Palaeoproterozoic zircons ranging in age from 2070 to 2492 Ma, and an Archaean population ranging from 2604 to 2719 Ma. The youngest zircon age of 2070 ± 17 Ma provides a maximum age for the tuff. A felsic agglomerate from the Nyamakari "centre" within the Lomagundi Group (NC 1), consisting of an altered assemblage of alkali feldspar, quartz, carbonate and haematite, yielded only a xenocrystic zircon population dated at between 2615 and 2860 Ma, with a distinct peak at about 2635 Ma. There are numerous younger discordant zircons in this sample, which would yield upper intercept ages between about 2.1 and 2.2 Ga, but they are too discordant to yield reliable ages. A felsic crystal tuff from the Godzi "centre" in the Piriwiri Group (GD-Z/11-2A) contains many discordant zircons, and among the more concordant zircons it has a large xenocrystic population of Palaeoproterozoic zircons, ranging from 2051 to 2492 Ma, and numerous Archaean xenocrystic zircons with ages ranging from 2558 to 3339 Ma. The youngest peak in the age distribution is at 2115 Ma, however, the youngest zircon age of 2051 ± 9 Ma may provide a maximum age for the tuff.

These results indicate that the basal Deweras Group volcanics are younger than 2235 ± 32 Ma, while the rest of the Deweras Group is younger than 2171 ± 11 Ma. Volcanic tuff units in the upper parts of the Lomagundi and Piriwiri Groups indicate maximum ages of 2070 ± 17 Ma and 2051 ± 9 Ma respectively. Since all these age constraints are obtained from just one zircon grain in each sample, more data is needed to confirm them.

Additional work is currently underway to obtain more dates, not only for the main exposed part of the Magondi Belt but also for the Dete-Kamativi Inlier, in western Zimbabwe, where high-grade metamorphosed supracrustals of the Malaputese, Kamativi, and Tshontanda Formations are regarded as possible equivalents of the Deweras, Lomagundi and Piriwiri Groups (Master, 1991, Master et al., 2010).

References

Master, S., 1991. Stratigraphy, tectonic setting, and mineralization of the early Proterozoic Magondi Supergroup, Zimbabwe: a review. Econ. Geol. Res. Unit Inform. Circular: No. 238, Department of Geology, University of the Witwatersrand, Johannesburg, 75 pp.

Master, S., Bekker, A. and Hofmann, A., 2010. A review of the stratigraphy and geological setting of the Palaeoproterozoic Magondi Supergroup, Zimbabwe – type locality for the Lomagundi carbon isotope excursion. Precambrian Research, 182(4): 254-273.

McCourt, S., Hilliard, P., Armstrong, R.A. and Munyanyiwa, H., 2001. SHRIMP U-Pb zircon geochronology of the Hurungwe granite northwestern Zimbabwe: Age constraints on the timing of the Magondi orogeny and implications for the correlation between the Kheis and Magondi Belts. South African Journal of Geology, 104: 39-46

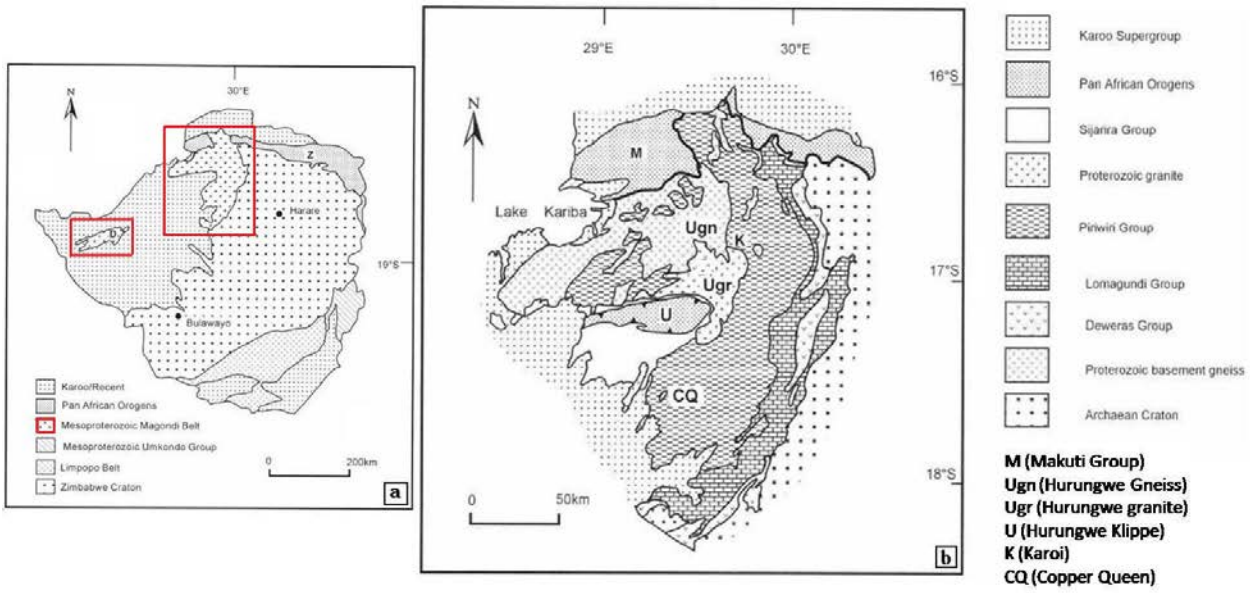

Figure 1 Fig. 1a – Geographical position of the Magondi Belt and the Dete-Kamativi Inlier in Zimbabwe. Fig. 1b – Main exposed part of the Magondi in NW Zimbabwe, modified after McCourt et al. (2001).

The Zimbabwe Coal Industry

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The development of a Nation is directly proportional to the production and utilization of energy.

Zimbabwe is endowed with huge coal resources estimated at 26.5 billion tonnes. The coal deposits occur in the two basins occurring on either side of the country's geographic watershed. Some deposits may lie beneath ground yet to be discovered. The quality of the deposits is varied, but is consistent with a variety of energy-related applications. This ranges from power generation to coke making.

The history of the Nation's Coal Mining Industry dates back some 108 ago, commencing with the entry into Zimbabwe and subsequent pegging of the first claims in 1895 in the Hwange District by a young German geologist called Albert Giese. Production commenced in 1902 from the Hwange Colliery Company's Number 1 Shaft. With improved means of transport, the Colliery grew and was able to satisfy the Nation's demand. Coal from Hwange also played its part during the two world wars, providing energy needs of the Imperial Army.

Up to circa 1980's the coal mining industry was a preserve for Hwange Colliery Company. From the aforementioned date the industry was de-regulated. This has resulted in the entry of new players. To date no less than 20 coal mining licenses have been issued by Government and these licenses are now at varying stages of development.

Enablers to the development of the industry include abundant water resources, reasonable transport network, simple geology, and a sound skills base. Challenges remain in the remote location of some of the deposits in relation to rail, electricity transmission. The location of Zimbabwe though on one hand is strategic and pivotal to the region, is, on the other hand, a disadvantage with regards to future coal exports, as the growing number of players will eventually saturate the local market, and could lead to the demise of the coal industry itself.

Application of MRM Systems with Reference to Unki Mines

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The MRM system is an integrated software suite designed for the mining industry aimed at providing an integrated business solution for mineral resource management. It focuses on the process of defining, depleting and reconciling ore reserves. This allows for planning, optmisation and control of mining activities. The MRM system consists of interrelated modules that cover: Geological Modeling and Estimation; Sampling; Survey Measurements; Ore Reserve Management; Graphical Mine Design and Scheduling; Production Monitoring and Ore flows.

Unki Mine has recently acquired the MRM system to ensure that the value of the ore resource is known to acceptable accuracy limits at all times and that extraction is done in such a manner as to ensure maximum profits. The MRM system provides the enterprise with quick and reliable information regarding the status of production and ore resource support activities which implies that data contributing to the information has to be correct, consistent, complying with business standards and available to the business in the appropriate format as and when required.

The MRM systems improves the quality and availability of information being used as an enabler for informed decision-making within the Unki Mines and Anglo Platinum Mining domain as a whole by providing cross-functional standardised reporting capabilities and analysis of information to assist in root cause analysis, problem identification and resolution. The aim is to achieve one version of the truth. Dynamic reports that are generated from the MRM system include sampling work done reports; progressive summary reports, best cut comparison reports; detailed ore reserve reports; depleted ore reserve reports etc.

Preliminary appraisal of links between geology and wildlife water supply in the Sub-Kalahari, Hwange

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Most of the 14,651 km2 Hwange National Park is on Kalahari Sands. These are (mainly) monotonous Aeolian sands, with endorheic drainage. The large game populations of the park are sustained by seasonal accumulations of water in grassy pan depressions and year-round supply of groundwater to pans (except in the northwest where there are rivers and dams). Some of this is from natural seeps, such as at Shakwanki, Nehimba and Ngweshla but most are supplied from boreholes. Game animals show clear preferences for some pans over others and it has long been speculated by wildlife managers that there is a nutritional or taste basis for this discrimination.

In this preliminary study, the location, host geology and probable sub-Kalahari lithology of a pan are compared with the frequency of use by game animals. Results show that many of the more popular pans are hosted in fossil rivers, with limestone horizons (calcrete) developed within the Kalahari Sands. Many popular pans are also found on Kalahari Sand overlying the meta-sedimentary Malaputese Formation of the Kamativi - Dete Inlier.

Future research will involve determining the water chemistry of the pans and relating this to the Kalahari and basement lithologies.

Elephants enjoying groundwater at Longone Pan pumped from aeolian Kalahari Sands above the Malaputese Formation – delicious!

REE and Phosphate Mineralisation in the Nkombwa Hill Carbonatite, Zambia

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The Nkombwa Hill carbonatite is located in the Muchinga Province in north-eastern Zambia and lies within the Luangwa Valley rift segment of the western arm of the East African Rift system. The intrusion is composite, built of several phases of intrusion of carbonatite magma of magnesian composition: the earliest recognisable phase is a relatively uniform-textured, medium-grained dolomite carbonatite which makes up the bulk of the intrusion. Reaction between this dolomitic magma and the gneissic country rock produced a phlogopite carbonatite which is found as a discontinuous marginal facies. Vari-textured, coarse to pegmatoidal, iron-rich carbonatites occur as large lensoid to sheet-like bodies within the dolomite carbonatites: although generally concordant with the foliation in the earlier carbonatite, cross-cutting relationships are sometimes seen suggesting these represent a later intrusive phase. Carbonate minerals are iron-rich ankerites while dark, interstitial siderite is common. Vari-textured carbonatite is most abundant in the upper levels of the northern parts of the hill. All of the carbonatites are sub-vertically disposed. Iron-rich cherty rocks cap the central parts of Nkombwa Hill and represent pervasive silica alteration of the various carbonatites.

The pegmatoidal vari-textured carbonatites have elevated REE contents, commonly reaching ore grades of 3-10% total rare earth oxides. Apatite is an abundant primary cumulus mineral in the dolomitic carbonatites. Hydrothermal remobilisation of apatite has generated high phosphate concentrations within the pegmatoidal carbonatites hosted in secondary apatite and isokite (CaMgPO4F). Current exploration data suggests that zones of phosphate and REE mineralisation are spatially distinct. Phosphate and REE mineralisation also occurs within the silicified carbonatites: remobilisation of REE and phosphate minerals in the primary carbonatites re-precipitated predominantly as low-Th monazite-(Ce) with minor bastnaesite and traces of cerianite.

Current exploration results suggest that Nkombwa Hill offers the prospect of a high tonnage, easily mineable, multi-commodity deposit which will produce economic rare earth, phosphate and agricultural lime products.

Geophysics and Gold Mining - Chasing the Vein: A Technical Appraisal of New Generation Ground Penetrating Radar and its Applications in Exploration of Greenstone Quartz Vein Mines

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- A brief history of the evolution of GPR technology &a basic description of the underlying physics and equipment used is given.
- The technical characteristics of enhanced power ground penetrating radar (Terravision Radar) developed in Russia are reviewed, being the radiation of ultra wideband electromagnetic pulses penetrating into subsurface medium and registration and recording of the reflected signals created at the medium interfaces,.
- The qualification of Terravision Radar as a "research tool" is argued. The issue of "Mapping" versus "exploration" is explained and the importance of "Calibrating" the radar and methodology to determine effectiveness in "greenfield" sites.
- Targets and features that are commonly seen are reviewed: Oxide zones or alluvial cover over hard rock, oxide ore over fresh basement, Intrusions, pipes and dykes, felsic porphyry or ultramafic bodies and massive sulphide deposits.
- Gold – Greenstone gold deposits by their very nature consist largely of narrow often high-grade veins and often more subtly mineralised shears in a variety of cross-cutting orientations. The veins are often associated with sulphides, but normally in quite small tenors. Gangue mineral assemblages and associated alteration patterns are very variable, though typical gangue assemblages are quartz and carbonates dominated. These minerals normally have little geophysical contrast with typical greenstone host rocks.
- Classical direct geophysical techniques are subsequently often not effective for mapping out auriferous veins, though of course magnetics is a powerful structural as well as lithological mapping tool. Structures well–mineralised in sulphides can be defined by IP and EM, though those lacking high levels of sulphide or extensive mineralised haloes will not be clearly discernible.
- Terravision Radar has proven that it can identify relatively narrow sporadically mineralised shears. Small concentrations of metals, including gold create enough changes in the dielectric constant to be discerned by the Terravision system. The technique appears to work equally well for steeply dipping and more shallowly dipping mineralised structures.
- Reporting and export to compatible software programmes, and examples of sections merged with drilling data and geological cross sections to create a composite interpretation that greatly aids GPR analysis are outlined.

Geophysical Applications for Small Scale Projects

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In Zimbabwe today it is common occurrence to meet a small scale miner or owner of single gold claim seeking geophysical services. I am still wondering what this is driven by. Could this be the common use of metal detectors to find gold nuggets leading to many a gold rush? Typically the client requests for IP (and magnetic) surveys at the end of which they expect a detailed report of the new "orebody"! There is also a wide range of service providers for this work. Some of the reports that I have come across are shocking such as IP results that give you grade of the gold mineralization. In this presentation I attempt to give an insight into the best use of geophysics for small scale projects of very limited budget with some examples. Currently geophysics has a very limited ability to map gold mineralization directly, but interpretation of the geophysical data often helps to understand the geology and therefore likely location of economic mineralization. Geophysiscs for small or large scale project works best in combination with other techniques such as soil geochemistry and geological mapping.

GPR - A ground monitoring Geophysical Survey system

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Ground Penetrating Radar is a geophysical survey system. This system has a wide range of cutting edge equipment designed to address a wide range of challenging applications.

GSSI first introduced the first commercial GPR equipment in 1974

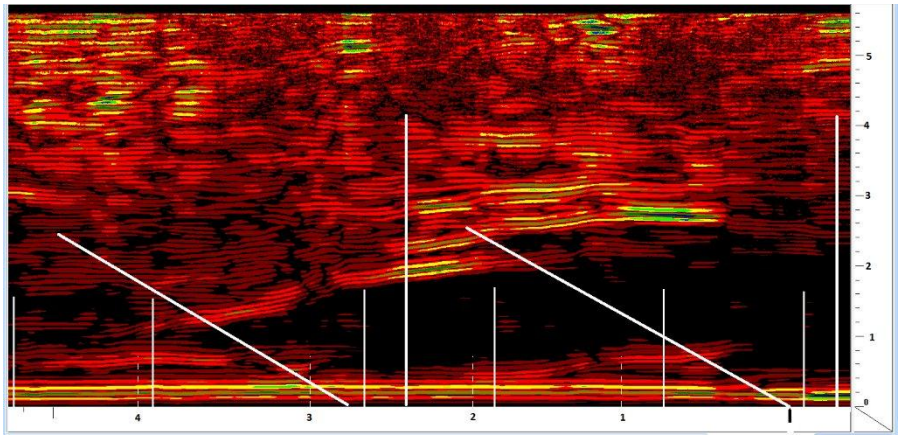

Figure 1 GPR Scan Image

Presentation Outline:

- An overview of the instrument and how it works
- Manning of the instrument
- Data gathering
- Interpretation of the data collected by the instrument
- Processing of the data collected
- Use of data on in-stope support design
- Check and balances

Figure 2 The Equipment in Use

Ethiopia and Iceland – examples on continental rifting

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The author has travelled to Ethiopia and Iceland during 2012 to observe continental rifting and the presentation gives a pictorial overview of the sights of new crust being made, and what is sometimes considered the "birth of an ocean". In Ethiopia the trip travelled along the Main Ethiopian rift, which is also the birth place of hominids, and the route passed not far from where Lucy, a 3 million year old decendent of ours first walked upright. Volcanic activity is a constant in these parts and in the Main Ethiopian rift around the Kone caldera, sinter cones of an age of 200 years were observed. Rifting fractures were observed in both Ethiopia and Iceland, and in Ethiopia Lava 'bubbles' were observed. The trip in Ethiopia was predominantly in the Afar region and passed through the Danakil depression, which is below sea level, and one of the hottest places on earth. A highlight was to stand on the triple junction, where the African plate is splitting in 2 along the African Rift valley, and also splitting away from the Arabian plate. Erta Ale, one of only 4 permanent lava lakes was to be visited by terrorist activity in the area prevented this.

In Ethiopia in 2005 there was a major sub-terrain rifting event at Dabbhu. This event has been compared to the Krafla rifting event of 1975-1984 in Iceland, where lava was actually extruded from the fissure. The comparison encouraged the author in her private capacity to tour Iceland, and observe the extreme volcanic activity of this land. A trip around the island showed the creation of very recent rocks, and some spectacular columnar jointing in the south. Volcanic activity around 2,500 years ago in the Myvatn region in the north resulted in some very interesting volcanic features, but was is not in human records, as at this time, Iceland was not settled by humans. The Krafla rift was located and allowed the author to stand on the point where the North American plate is moving away from the Eurasian plate.

The Geology of Health-An Overview

Dr. T. Njila[1], Prof. I Manuel[1], Dr. M.L. Meck[1], Ms D. Mudimbu[1], Dr. P. Chikwema[2]

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Introduction

Geochemical anomalies of arsenic, cadmium, mercury, (radon) and chromium in soils, sediments, and water that may adversely impact human and animal health; Sampling in these media is required to assess the possible health impacts of these anomalies. Data collection from public health and related professionals is fundamental in trying to find lasting solutions to prevent or minimize these problems. Interaction and communication is necessary between the geoscience, biomedical, and public health communities to protect human health from the damaging effects of physical, chemical and biological agents in the environment.

Toxicity and diseases due to essential and non-essential geologic material deficiencies and excesses

Some of the common medical conditions caused by deficiencies and excesses of known chemical elements in geological spheres include different types of cancers caused by Arsenic, Cadmium, Lead, Chrome, Mercury and Cobalt; cardiovascular diseases, dental fluorosis due to these and other toxic chemical elements.

Brief overview of the situation in Zimbabwe

Zimbabwe's health services were the last segment of the public sector to collapse in 2008, and the Ministry of Health and Child Welfare was the first to recover after the inclusive government was formed in early 2009.

This collapse presents a major setback to the already side-lined public and ecosystem health issue regarding the geological impacts on these health sectors. No research is currently in place to gather information and provide solutions to the medical conditions caused by naturally occurring geological elements.

Discussion

Having reviewed the sources referred to in this paper, it can be implied that a large number of locals in the mining towns (e.g gold, coal mining places) and artisanal miners, as well as the ecosystems, are prone to contracting diseases due to water and food poisoning.

In view of the fact that the Zimbabwean economy is highly strained, tackling the issue of health hazards presented by mining and geological toxic elements equates to a mammoth task. This can be reflected by the struggle in other developing countries (e.g South Africa) to find lasting solutions to such a matter.

There is need to cumber the issue of dental fluorosis in areas like Mt Darwin. The unavailability of information and funding is hindering research in the field of Medical Geology, which, in essence, relates to human and ecosystem health from a geo-environmental point of view.

Artisanal Gold Mining in Mozambique: The Case of Manica Province-Mozambique

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The artisanal gold mining (AGM) activities in Manica Province- Mozambique are concentrated in alluvial and primary gold deposits. The common AGM methods used in Manica Province consist mainly of digging open pits and few shallow underground operations. Since 1987, AGM activities in Manica Province have been expanding rapidly and often uncontrollably. The artisanal gold mining activities in Manica Province are posing on environmental and social impacts which cause enormous losses. The main impacts are the extensive deforestation and land degradation, high red turbidity and heavy metal contamination in rivers, unsafe use of mercury, occurrence of deadly accidents, inadequately use of child labour, practice of inadequate and inefficient gold prospecting, mining and processing techniques. In addition, the AGM activities are stimulating illegal and informal artisanal mining and they contributed very little revenues for the government's coffers. The factors that have contributed to aggravating these environmental and social impacts are economic, technical, legal, and operational in nature. Currently, all these mining and processing activities are negatively impact on various sectors as agriculture, fisheries, tourism, immigration, education and health sectors. Despite the negative environmental and social impacts, the AGM activities are generating valuable benefits; as being a way of subsistence for thousands men and women mainly informally and from rural areas. The AGM contributes also to rural economy through money circulation, demand for products and services and investment activities. Presently, the way that artisanal gold mining is developing is not sustainable on long term. However, the AGM as a whole indubitably remains a positive activity for Manica Province in Mozambique.

Geology and Petrology of the Umkondo Diamond Deposits with Emphasis on the Chimanimani Deposit

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In Zimbabwe, there are three known formational types of ancient diamondiferous alluvia related to clastogenic formations of marine origin, hosted in the Proterozoic Umkondo Basin namely the Marange-type, the Chimanimani-type (Haroni river valley) and the Chinyadadzi-type of Karroo age, located south-west of Hotsprings. Interestingly, all these three formations are geographically close to each other. Ironically, with such a blessed unique geology, the scientific and geological information from the deposits is scanty. If scientific geological information is systematically generated and synthesized, this will result in increased exploration efforts in the Umkondo Basin, and perhaps provide analogues with other sedimentary basins in the country.

In this article, the geology, litho-stratigraphy and litho-petrographic compositions of the host conglomerates of the Marange Deposits and the Chimanimani deposits are presented. It is shown here that the Marange conglomerates overlie basement granite whilst the Chimanimani conglomerates form part of the lower Argillaceous Series, i.e. they occur in the Upper stratigraphy of the Umkondo Basin. Also, the two deposit-types also differ in their litho-petrographic compositions, where the Marange conglomerates are coarse-grained quartz-feldspar variety. The feldspar is recrystallized pinkish-red K-feldspar that often cements the conglomerates. In contrast, the often metamorphosed Chimanimani conglomerates have smaller pebbles in porous quartz cement. Daily heavy mineral concentrates generally contain magnetite, ilmenite, limonite, tourmaline; single signs of zircon, diopside and picroilmenite. In the Chinyadadzi area north of Birchenough Bridge, are Karoo sediments which are associated with younger Mesozoic marine sediments: boulder conglomerates, grits and sandstones. The composition of the debris is polymictic: sandstone of different colours and grains, argillites, cherts and rarely dolerites. The cement is porous, sand and clay. Worldwide, this deposit-type contains in some places minor contents of diamonds, though here investigations are still on-going.

Diamonds from the Marange Deposits are generally rounded and the majority have a brown coating, probably due to radioactive effects of the basement granites. A careful study shows that despite these masking effects, the deposit yields diamonds of various morphologies such as octahedrons and flaky types. However, the Chimanimani deposit has quite a huge variety of these diamond morphologies, including well-formed octahedral crystals. Textured surfaces are predominant due to primary diamond etching in the magmatic melt in the form of triangles of dissolution and parallel striation. Another notable feature in these diamonds is colour. The Chimanimani deposit has a wide variety of colours with particular colours for each size fraction.

Indeed, the differences in the diamonds of the Umkondo basin have some genetic and age bearings on the host-formations. Especially that the formational types have differences both in stratigraphic position, mineral composition and morphology of diamonds

Geological challenges in satisfying future global demand for the Rare Earth Elements

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REE are essential to many high technology applications: without REE, there would be no notebook or tablet computers, mobile phones, colour TVs or monitors; REE are used as catalysts in oil refining and are essential components of rechargeable batteries, lasers and optic fibres. But it is the magnetic properties of REE-metal alloys that have become the major demand driver in the 21st century. In 1985 most of the world's REE supply came from the Mountain Pass mine in the USA but by 1998 China was producing more than 80% of world demand and now supplies over 95% of the world's REE.

In recent years China has implemented several long-term policy changes that have significantly impacted the amount of REE available for export. Consolidation of the Chinese REE industry from large number of small producers to fewer, large integrated corporations that are easier to regulate has begun; illegal exports (smuggling) of REE have been reduced. At the same time, stricter controls have been implemented to address serious environmental impacts resulting from extraction and refining of the REE. China has also committed to stricter emission controls implementing several clean energy initiatives including increased domestic production of hybrid and electric motor vehicles and mopeds and the construction of wind energy farms (China spent $28 billion on wind energy in 2009). These applications use major quantities of Nd(Dy,Tb)FeB permanent magnets – a technology discovered in the early 1980's.

These policy changes have led to significant reduction of production along with increased domestic consumption of the REE. Export quotas have been implemented that reduced supplies of RE Oxides to non-Chinese consumers by 40% in 2010.

Significant non-Chinese REE production will start to enter the market in 2012/13 from the Mt Weld [1] and Mountain Pass [2] deposits, both operations producing predominantly LREE. Market projections show that demand for Eu, Tb, Dy and Y (all HREE) as well as Nd (a LREE) will remain higher than supply beyond 2015.

The demand for HREE poses a serious challenge to explorers. LREE are an order of magnitude more abundant in the crust than HREE and most geological REE enriching processes tend to enrich the LREE relative to the HREE. In addition to generally being of low grade, in many HREE-endowed deposits the HREE are hosted in mineral phases that are difficult (hence more expensive) to concentrate and/or dissolve requiring major capital outlay to generate a saleable product.

Advanced African, and non-Chinese, deposits will be reviewed and their ability to satisfy future demand critically assessed.

NOTES

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