Geological Society of Zimbabwe

Newsletter

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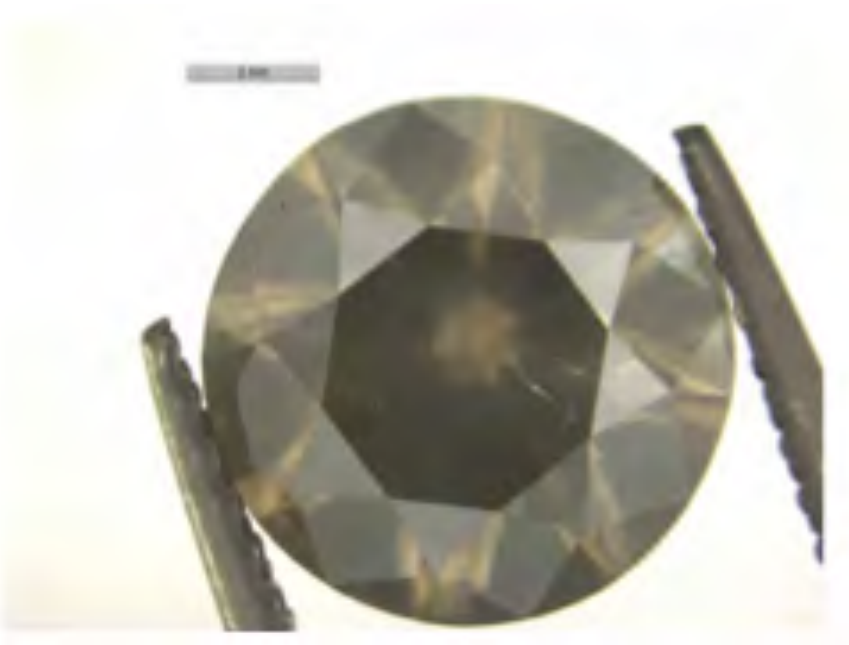

Faceted round brilliant cut Marange diamond; 8.14mm diameter. Brown colour with a few visible channel inclusions. *Photographed by Stewart Cole*

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The Geological Society of Zimbabwe, P.O. Box CY 1719, Causeway, Harare

Contents

Editorial

Another Committee term comes to a close as Ali Ait-Kaci gives way to Brent Barber as Chairman. This will take place at the Society's AGM to be held on Friday 26th February at 5.00pm at what has become our usual venue, the Country Club (CFX) Brompton Road, Highlands in Harare. We hope you will be able to attend, as apart from the serious nature of the meeting, it is a chance to catch up with old friends.

Ali, as Chairman, summarizes the events of the Summer Symposium held in Kariba this year, together with the attendant field trips. The itinerary was an organizational feat, and Andrew du Toit must again be thanked for leading this 'event with a difference'. It was the highlight of the year, and must have been enjoyed by all who attended.

As an adjunct in this Newsletter, Tenyears Gumede summarizes the results obtained from the gravity profiles across the apparent Sinamwenda impact structure. The soil samples encased in aluminium tubes still await shipment to Sharad Master at Wits, where thermo luminescence analysis may throw some 'light' on the age of the structure. Too bad about the metal detector-wielding enthusiasts in their negative quest for new-found meteorite fragments. That could have sealed the deal, but the heat eventually took toll of the enthusiasm.

We present the second part of Vernon and Sue Stocklmayer's review of diamonds in Zimbabwe. Of particular interest are the gemmological observations that are presented on Marange diamonds. We thank them both for sharing this paper with us.

Our regular news correspondents, Maideyi, Forbes and Ernest are thanked yet again for sustaining these important contributions that help keep us abreast with activities at our institutions and within the mining industry. Ernest Mugandani in particular is thanked for maintaining the necessary liaison between the Committee, contributors and the editor.

Tim Broderick

Chairperson's Chat

Ali Ait-Kaci

Our main event of the year, the Summer Symposium and associated field trips, was held from the 19th to the 22nd November in Kariba, perfectly organized by Andrew with his wife, Jane, du Toit, and by Julie Kuhn, our Administrator. About 50 people attended the three parts of the trip, including some foreign members from South Africa, Botswana and Zambia. On Thursday the field excursion across the Magondi Belt and the Makuti Group was led by Dr Sharad Master and Tim Broderick when we visited various exposures *en route* between Karoi and Kariba.

On Friday 20th the Symposium itself was held at the Carribea Bay Hotel, in Kariba. Ten communications were presented on various subjects. The official opening of the Symposium was by Temba Hawadi, Director of the Zimbabwe Geological Survey, and

the keynote address was by Sharad Master on a re-interpretation of the "Basement Gneisses" around Kariba supported by new geochronological data.

Ali comes ashore. *Photo: Tim Broderick*

On the same day, from 5pm, we sailed up-lake on the *Sea Lion* Ferry for a night-long trip to Sinamwenda. There was a lot of fun, excellent food and drinks, so everybody enjoyed the experience. Early on Sunday morning we landed on the lakeshore, not far from the Sinamwenda Research Station. After a good early walk of 6-7km we reached the Sinamwenda Impact Structure, a circular expression on *Google Earth* imagery over Upper Karoo sediments. The trip was again led by Sharad Master and his team, Tenyears Gumede and the Geological Survey geophysicists doing a gravimetry traverse across the impact structure, which is 220m in diameter, and others collecting sand samples for thermo luminescent dating. Metal detectors were used to try to find some meteorite debris, but in vain. Returning to the ferry in the early afternoon heat at around 40^{o} Celsius made the walk back to the shore long and arduous. Then the ferry headed back towards Bumi. With a swim on the way, we moored in the Kota Kota Narrows for the night prior to a dawn landfall at Musango Safari Camp in the Ume estuary, where Steve and Wendy Edwards received us and showed us their collection of dinosaur teeth and bones, and of Lungfish mandibles collected from the Tashinga Formation. The ferry arrived back in Kariba at Sunday lunchtime, when most of us drove back to Harare through the first torrential rains of the season .....

In December and January we had two very interesting talks, both given by our Vice-Chairman, Brent Barber. On 11th December he gave a "Review of the Karoo Supergroup and Younger Rocks in the Zambezi Valley". This talk was followed by a very pleasant Christmas get together, including a braai organized by the Mennell Society. The second talk was entitled an "Overview of the known Large-Scale Coal Potential of Zimbabwe", we had a splendid turn out. Many Zimbabwean geologists we had not seen for years were in attendance.

Members, be ready for the next event! The Macgregor Memorial Lecture for 2016 will be given in the first half of August by Martin Prendergast on “Less known mineral deposits of the northern Great Dyke, more precisely, the nickel laterites and the Snake's Head PGE deposits”. It will be followed by a 5-day field trip along the Great Dyke to Mutorashanga, through Mpinge then to Mvurwi Peak east of Guruve and onto the Snake’s Head and Musengezi Gorge.

After introducing the status of "Associate Member" this year, we are recording numerous applications from people interested in Earth Sciences.

I hope to see you at the AGM, 26th of February 2016 at 5.00pm.

The Sinamwenda group, November 2015. *Photo: Lucy Broderick*

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Articles and Reports

A Review of Diamonds in Zimbabwe – a Century On – PART 2

Vernon and Sue Stocklmayer

Alluvial Deposits associated with the Proterozoic Umkondo Group

In 2001, De Beers, via their subsidiary Kimberlitic Searches Ltd, were exploring for kimberlites within their tenement, EPO 1523, when they discovered what was to become the Marange alluvial deposit. However, the stones were of low value and it was only later that high value gems were found. The tenement expired in 2006 and exploration rights were taken up by British-registered African Consolidated Resources. Diamond discoveries in June 2006 were followed by a chaotic diamond rush, which involved up to 20 000 illegal small-scale miners. Smuggling of diamonds was rampant.

In December 2006, the company was readying trial mining operations when the Government of Zimbabwe took over the rights via the Zimbabwe Mining Development Corporation despite African Consolidated Resources winning a court case allowing them to continue mining.

The initial exploitation of the Marange alluvial diamonds in 2006 was followed by a period of theft, bloodshed and corruption with an eventual recommendation, in 2008, that Zimbabwe should be banned from the rough diamond certification scheme. However, in November 2009, the Kimberley Process decided against the suspension of Zimbabwe and in July 2010 it was agreed that diamonds from Marange could be sold on the international market.

As of February 2014, the diamond fields are operated by 7 private entities all of which are partnered with the Zimbabwe Government under the Zimbabwe Mining Development Corporation (ZMDC). Many of these private companies are allegedly affiliated with Zimbabwe ex-military or political officials and with Chinese entities. The 7 companies currently operating are: Marange Resources, Anjin Investments Ltd., Diamond Mining Company, Gyn Nyame Resources, Jinan Mining Ltd., Kusena Diamonds, and Mbada Diamonds (Paul Zimnisky, 2014; Wikipedia).

The primary source of the diamonds has not yet been established. Several kimberlites are known to occur within the environs of the Marange area and beyond. These are, however, much younger than the age of the Umkondo sediments and thus cannot be the primary sources for the diamonds.

The basal sediments of the Umkondo Group comprise both arkosic material and rounded pebble conglomerates, suggesting both distal and proximal sources. The diamonds are typically sub-rounded and worn indicating considerable transport distances. Tyrwhitt (1966) suggested that initial sedimentation was into a shallow, rapidly westwards transgressing basin that was preceded by the peneplanation of the granite basement. Sedimentological studies of the Umkondo sediments show that the basin was fed by rivers coming from the west off the Zimbabwe Craton (Button, 1978).

A unique feature of the Marange diamonds is the brownish colouration on the outer surface of most stones. This is believed to be the result of surface geological processes in the sedimentary environment and the subjection of the stones to radiation emanating from the basement granite. High heat and pressure resulting from the extensive intrusion of dolerite sills and the effects of the Pan-African orogenesis that affected the Umkondo basin were also considered to be contributory factors (Mugumbate, 2013).

Hainschwang *et al.*, (2014) comment that some of the diamonds they examined (presumably from Marange although not stated as thus) exhibited features consistent with the effects of natural irradiation. However, they were of the opinion that these diamonds have not been exposed to temperatures higher than 400 to 500^{o}C.

Diamonds are known to occur in two broad horizons:

i. Conglomerate, grit or sandstone in the Umkondo Group
ii. Recent eluvium and alluvium

The Umkondo Group Deposits

The Umkondo Group comprises a thick sedimentary sequence unconformably deposited on granites and gneisses of the Archaean Basement Complex and on the eastern part of the Limpopo Mobile Belt. These sediments with their associated dolerites and lavas straddle the international boundary between Zimbabwe and Mozambique and discontinuously outcrop from the Lower Save Valley northwards to Nyanga and beyond, a total distance of more than 400 km.

The Umkondo Group is made up of two distinct suites: a western succession of virtually flat-lying, shallow-water dominantly argillaceous and arenaceous sediments and an eastern succession of deeper-water quartzites and pelites. In the southern Chipinge-Lower Save area, Watson (1969) subdivided the western succession into the following four formations:

Dolerite sills and dykes
Upper Argillaceous Formation
Arenaceous Formation
Lower Argillaceous Formation
Calcareous Formation

Although Watson, and Swift (1962) describe pebbly and feldspathic grits underlying the Calcareous Formation, they did not recognize a distinct Basal Formation such as was recorded from the northern Nyanga area (Stocklmayer, 1978).

Diamonds have been discovered in two of the mapped formations: at the base of the Calcareous Formation (the Basal Formation at Nyanga) and in the Lower Argillaceous Formation. Neither the extent of the diamond-bearing lithologies of the Umkondo Group nor the distribution of diamonds within them are fully known. Consequently, the Zimbabwean Government has established a Reserved Area over the whole of the Umkondo Basin covering some 10, 000 km^{2}.

The basal conglomerate horizon outcrops sporadically along the edge of the Umkondo basin in the southeastern part of Zimbabwe. According to Mugumbate (2013) the

conglomerate, which locally grades into a grit, comprises well-rounded clasts supported by an immature arkosic matrix that resembles the local basement granite in colour and texture. The conglomerate dips shallowly to the east and is typically 2-3 metres thick, thinning out laterally.

The diamonds in the conglomerates are mostly sub-rounded to rounded and up to 8mm in diameter, although there are reports of larger stones. Angular and well-shaped octahedral and rhombohedral stones have been reported, which would indicate that the source of the diamonds is proximal (Chatora, 2013).

Names, locations and resources of individual deposits and mines have proved to be virtually impossible to obtain through normal means; however it is known that the Chiadzwa and Muushu deposits are located within this basal conglomerate.

The only diamond occurrence known within the Lower Argillaceous Formation is the Charleswood deposit located east of Chimanimani village. In 2007, a Russian company DTZ-Ozgeo secured a special grant to explore for gold and, later for diamonds, in an area where artisanal miners had discovered diamonds in grit exposed near the Haroni River. Drilling indicated that the diamonds occur in a 2.5 to 3.6 metre-wide conglomerate horizon lying stratigraphically above the Calcareous Formation of the Umkondo Group.

The diamonds from the Charleswood deposit are of better quality than those from the Chiadzwa deposit, but they are small in size and of low concentration.

The Eluvial and Alluvial Deposits

The eluvial diamond deposits are those that have been derived through *in situ* weathering of the Umkondo bedrock, predominantly the proximal outcropping conglomerate, grit and diamond-bearing sandstone. They comprise poorly sorted unconsolidated silt and clay with some sand and gravel and few pebbles. The bulk of the early mining took place in these rich, easily worked eluvial and alluvial deposits referred to as the Chiadzwa (Marange) deposits.

There are persistent reports in the Zimbabwean press that the richer and more accessible eluvial/alluvial diamonds are nearing exhaustion, with recoveries diminishing rapidly. The same reports indicate that the Umkondo deposits are proving to be expensive to mine.

The Marange Diamonds

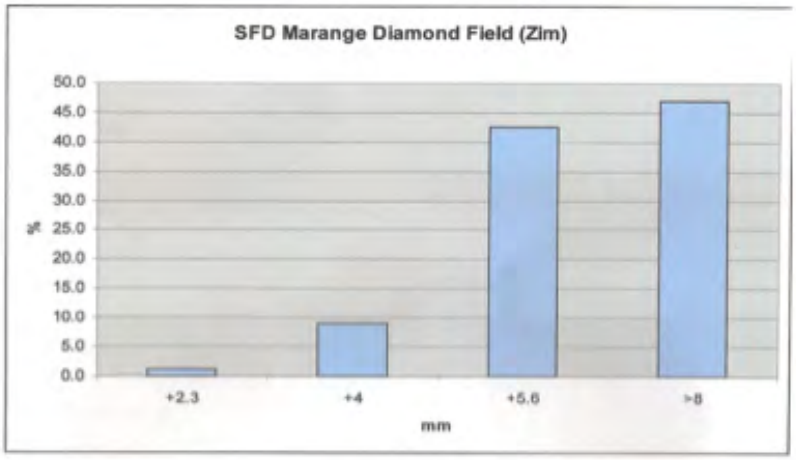
Because specific details on diamonds produced from the various deposits appear to be virtually impossible to obtain, the term “Marange Diamonds” applies to all diamonds, irrespective of provenance, produced from the Umkondo Basin. This term includes both the diamonds occurring in the sand, gravel and conglomerate beds within the Proterozoic Umkondo Group and the proximal Recent eluvial/alluvial diamonds derived from these.

In 2008 the Kimberley Process issued a document entitled “Footprint of Rough Diamonds from Marange Diamond Field (Zimbabwe)” that describes their broad appearance as follows:

"On first sight, strong 'gravel' impression resembling rounded pebbles in a riverbed. Look like tumbled and abraded coarse chips of broken beer bottles with colours ranging from dark brown to black to darkish green. Most surfaces are matt and dulled with rounded corners and edges. Broken surfaces display 'metallic-like' lustre. Two distinct qualities can be observed:

The largest group (~90%) consists of coarse very low quality diamonds resembling rounded pebbles with colours ranging from dark green to dark brown and black. The most characteristic feature of these diamonds is their rounded 'abraded' nature.

A smaller fraction (~10%) consists of near gem and gem quality diamonds with mostly greenish and brownish colours. Most greens tend to be smaller whilst browns tend to be larger and more abraded. Both greenish and brownish diamonds show spots with intense colouration."



Size frequency diagram of Marange diamonds (from Footprint of Rough Diamonds from Marange Diamond Field Zimbabwe; Kimberley Process document)

Reserves and diamond grades are unknown. The Kimberley Process document referred to states that 5% of Marange diamonds are gem (3% sawables and 2% makeables), 5% are near gem (clivage) and 90% are industrial (40% rejection and 50% boart).

An estimate of production and value compared to global production is given by Paul Zimnisky in the table below. Note the apparent low value of Marange diamonds and the fact that the average $ per carat appears to be steadily decreasing from 2011.

	Marange Production			Global Production (GP)			Marange as % of GP	
Year	Prod (M cts)	Avg $/ct	Prod ($)	Prod (M cts)	Avg $/ct	Prod ($)	In cts	In $
2013	16.9	33	558	130.0	93	12,090	13.0%	4.6%
2012	12.0	40	480	127.9	98	12,534	9.4%	3.8%
2011	8.7	45	392	122.8	114	13,999	7.1%	2.8%
2010	8.2	35	287	128.3	88	11,290	6.4%	2.5%
2009	0.8	20	16	120.2	68	8,174	0.7%	0.2%
2008	0.6	40	24	162.9	78	12,706	0.4%	0.2%

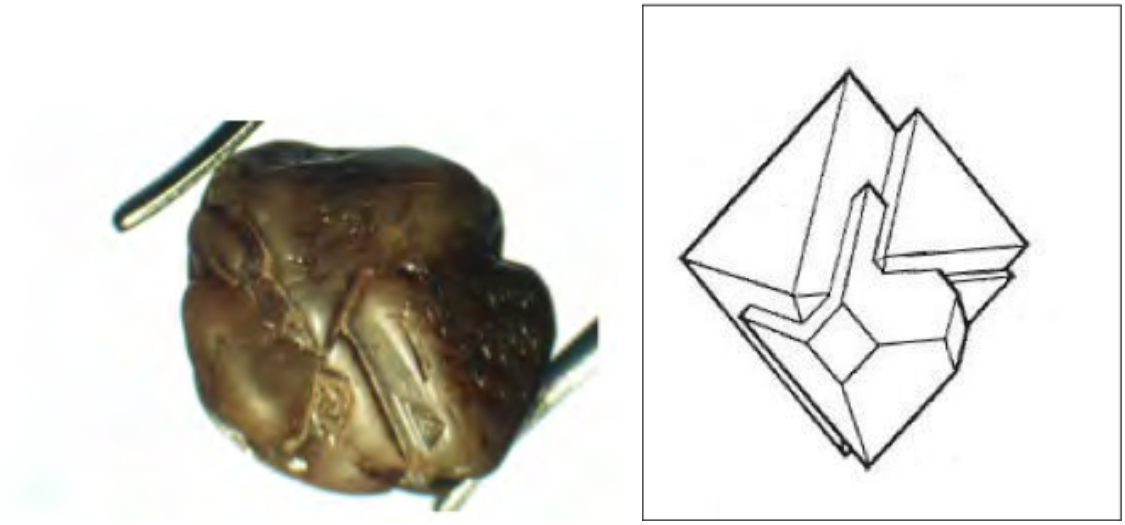
Source: Kimberly Process, Paul Zimnisky analysis

Marange production in terms of carats and dollars from 2008 to 2013 relative to total global rough diamond production. While Marange is the largest producing project in the world in terms of total carats produced, it is the third largest in terms of total dollar value produced, after Botswana's Orapa and Jwaneng mines which produce more valuable diamonds on average. Source: Kimberley Process, Paul Zimnisky analysis

A group of seven rough diamonds, total weight 23.8g, together with three cut diamonds (weighing 2.04ct. 2.02ct and 0.77ct) were made available for this report. The three faceted diamonds are of low clarity (visibly included grades) with colours that are intense yellowish brown (see cover photo) and tinted white.

The rough diamonds comprise relatively large octahedra; six are composite crystals of two or three conjoined and offset octahedra in groups displaying parallel growth, as illustrated by the photograph and figure below, and one is a distorted octahedron. The specimens are highly abraded and of matt appearance with crystal edges and junctions all rounded. Crystal surfaces are pitted by etched trigons with flat bases.

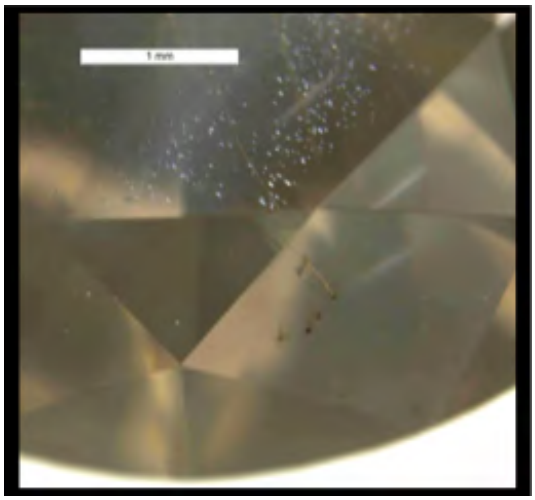
All the rough diamonds are dark greenish yellow and khaki brown in appearance and, when examined by strong transmitted light and x10 loupe, most are transparent and display a yellow body colour. Internal fractures are also evident. Small areas on the surfaces of each specimen show bright adamantine, almost metallic glints, produced by light reflecting from indented small surfaces and crystal intersections that were protected from the abrasion. These bright surfaces are within trigons and between twinned crystals.



Rough diamond twinned aggregated crystals; total width 15mm. General matt appearance of crystals, their characteristic colour and trigons are common to all specimens of the group examined. *Photographed by Francine Payette.*

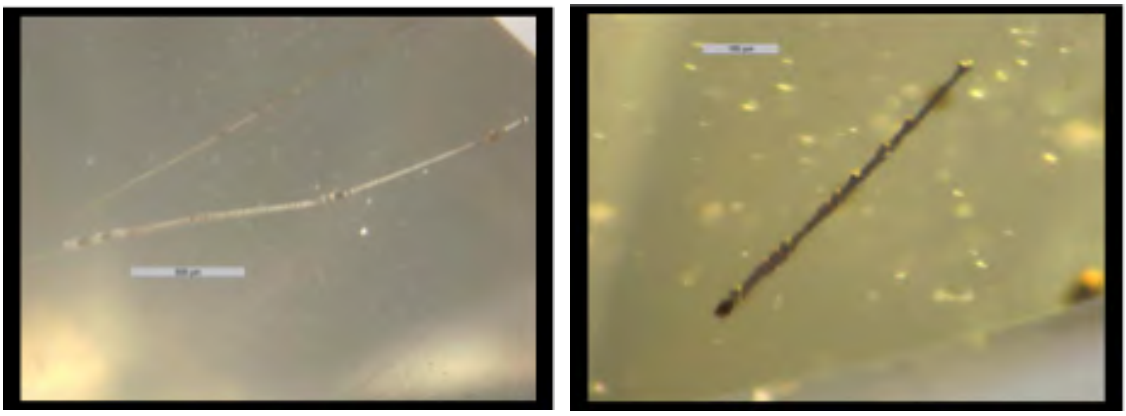
FIGURE: Aggregated habit of octahedral diamond crystals. Growth type characteristic of these Marange diamonds (from Bruton, 1978).

Examination of the three faceted diamonds showed no mineral inclusions; some small fractures were noted and a small group of trigons are preserved on the girdle of one gem. One of the faceted stones (2.02ct) has a hazy appearance usually described by the grading term “sleepy”. The haziness is caused by numerous microscopic platy pinpoint inclusions that scatter the light and lessen the transparency of the diamond.



Faceted Marange diamond with microscopic platelet inclusions. *Photographed by Stewart Cole*

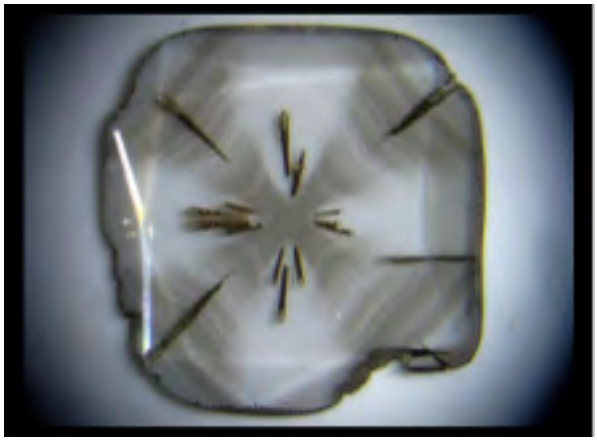
However, the largest cut diamond (8.14mm diameter) contains features of interest; these are numerous hollow channels. These channels comprise a cluster of relatively short lengths (measured to 0.5mm) and a few discrete, relatively long tubular filamentary inclusions (measured to 2.5mm). These tubular inclusions have an apparent random distribution; they do not appear to be aligned in any way to one another or to specific directions within the gem. The shorter, baton like channels are all surface-reaching, appear geometric (squarish) in cross section and are cross banded by stepped growth. Their open ends are stained reddish brown and they do not appear to taper along their lengths. The single longer filamentary channels appear to be tapered. High magnification shows both the stepped nature and geometric profile of all the channels.



Filamentary inclusions in Marange diamond displaying variation in width along the length, cross banded and geometric form in profile. Pinpoint inclusions in the background result in the overall hazy appearance of the diamond

Marange diamond with one tubular baton-like inclusion. Platelet inclusions are also evident. *Photographed by Stewart Cole*

Pearson (2014) shows an image of a sawn slice of a diamond crystal with a side length of about 8mm, reputedly from Marange. In contrast to observations described above, this slice shows an internal pattern of tubules that have a preferred orientation within the crystal. As is suggested in the article, the tubules within this slice seem to have been metal-coated, perhaps for scanning electron microscopy studies. The coating allows the form of the tubules to be viewed more clearly and well shows their stepped, geometric habit. These tubules have measured lengths from 0.6 to 2mm.



Polished section, reputedly of a Marange diamond (approx. 8mm). Growth features in the form of a cross pattern with several tubular baton-like inclusions apparently arrayed crystallographically. *Photograph by Grant Pearson (2014)*

The origin of the tubules is not entirely resolved at this time, but there are several propositions. Pearson (2014) describes the inclusions as natural syngenetic growth features. References have been made to several similar features in diamonds of many different colours and clarities in published laboratory reports of the Gemological Association of America (GIA). In most reports their occurrence is referred to as rare. However, one report (Nemirovskaya and Wang, 2006) states that "*etch channels, which are common in natural diamonds appear in various shapes, from narrow hollow triangles and lines to irregular worm-like features"*.

Kouvula (2007) suggested that some curved filamentary features in a diamond examined may have resulted from structural dislocations within the crystal lattice that have been enlarged by later etching. Crowningshield (1992) describes etched rectangular section tubules with a zigzag pattern in a diamond submitted to the GIA laboratory for examination as dislocation zones within the crystal that have been enlarged by a process of etching.

Hollow channels are not described under the usual internal features for clarity grading of diamonds in most grading schedules, but they would be treated as any other inclusion. The presence of one or two needle-like hollow channels may have been sites originally occupied by needle-shaped minerals, but those present in the Marange diamonds are too many, too diverse and not all are associated with fractures or any means to convey chemicals.

One other possibility is laser drilling, usually performed as part of a treatment to enhance diamond value. Not all artificial drill holes are straight, some have been observed to

curve and to branch but all are round in section (Cracco, 1994). In the Marange diamonds, the squarish profile of the hollow tubular inclusions and the observation that not all are surface-reaching demonstrates that they are natural and are not the result of laser-drilling.

All three faceted diamonds display a chalky appearance under long wave ultraviolet light (LWUV): with two (2.04 and 0.77ct) fluorescing bright green yellow and the third (2.02ct) orange. All three are inert under short wave ultraviolet light (SWUV) examination. Examination of the rough crystal aggregates by LW ultraviolet light produces a yellow fluorescence in many of the zones where surfaces are less abraded.

Recently featured in publications are photographs of sawn slices and polished crystals of diamonds reputedly from Marange. Pearson (2014) shows a sawn diamond with a four-fold transparent to translucent darker Maltese cross pattern against a white background. Hainschwang *et al* (2014) show images of an asteriated diamond (of unknown provenance but, from descriptions almost certainly from Marange) with multiple six-rayed stars dramatically illuminated under natural light and UV in a high-powered UV fluorescence microscope. These complex effects (in the crystal examined in the report) are interpreted by them as a result of the diamond having crystallised as a combination cubo-octahedron. When specially directed light is reflected from microscopic inclusions a six-lobed star phenomenon can be seen within the cubic growth sectors.

In the photograph below Pearson (*pers. comm*.) has also demonstrated asteriated phenomena in other specimens of diamonds from Marange.

An octahedral crystal (7.38mm apex to apex), with one re-polished face, shows a six-ray star phenomenon. A few tubular inclusions and one small octahedral diamond inclusion at the centre are also evident. *Photograph by Grant Pearson (2014)*

Conclusions

Zimbabwe has been a modest producer of diamonds from the time of the discovery of the Somabula alluvial diamonds in 1903. The discovery of the huge Marange Diamond fields in 2006 resulted in a dramatic increase in Zimbabwe diamond production to an estimated 13% of global production in 2013.
The Somabula, River Ranch and Murowa diamonds appear to have been typical of southern African stones; no unusual internal features have been described in the available literature.

The Marange diamonds are different. Not only are there a high proportion of large composite crystals but the stones are predominantly rounded and abraded with colours ranging from dark brown to dark green. Some stones show interesting internal features. Faceted gems, polished crystals and sawn slices reveal internal features such as numerous platy inclusions causing haziness, short baton-like and longer filamentary channels and complex star phenomena.

The primary sources for both the Somabula and Marange alluvial diamonds have yet to be conclusively identified.

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Sinamwenda Structure – Results from the 2015 Gravity Profile

Tenyears Gumede

The Sinamwenda structure is a 200 metre-wide, near circular depression near the southern shore of Lake Kariba (Figure 1). It is located about 4.8km SSW of the Sinamwenda Research Station. Originally spotted from aerial photographs and showing on Panchromatic Spot Image, the structure was visited by students on a geological mapping excursion in 1970, and later in 1994 by a team comprising two geologists and a geophysicist. Most recently the structure was visited in 2015 by members of the Geological Society of Zimbabwe.

The structure is formed in an area underlain by Middle Triassic sandstones and grits of the Upper Karoo Supergroup. The crater rim is elevated some few meters above the surrounding sandstones. There are few rock outcrops within the structure, which appears to be filled with unconsolidated Cenozoic sands. Based on their 1994 field visit Master, 1995 proposed that the structure is of impact origin on the basis of a crater-like morphology, overturned bedding along the rim, alleged striated joints and enhanced micro-deformation of crater rim samples.

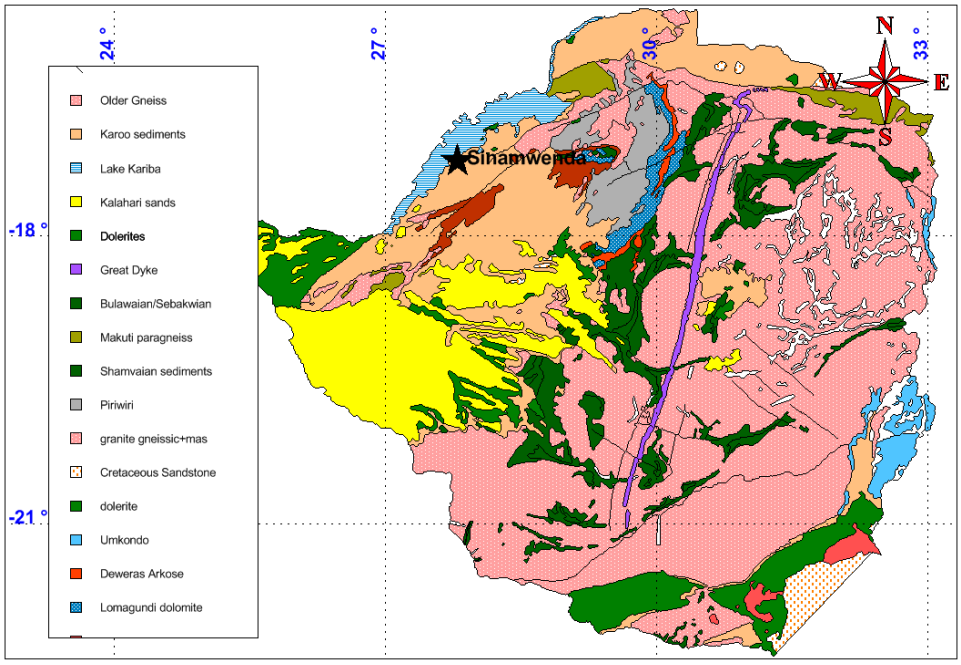

Figure 1 – Locality of the Sinamwenda Structure on simplified geology map of Zimbabwe

The 1970 and 1994 Visits: The geology field mapping excursion found steeply dipping/overturned outcrops of sandstone overlain by stratigraphically underlying shales in the NW rim of the structure. This was evidence for the structure being of an impact nature. In addition, the 1994 visitors observed joints containing variably oriented parallel striations on outcrops along the north and east rim of the structure. These joints were interpreted as being shock generated and similar to those of other proved meteorite craters in the world such as Vredefort and Sudbury, and are absent in the in the flat lying sandstones and grits surrounding the structure. Interestingly, the magnetometer traverse across the structure in 1994 showed no magnetic anomaly (maximum 2nT) ruling out the possibility of the structure being a volcanic plug (Master, 1995). This 2nT variation is interpreted as being due to the small variation of magnetic minerals that may be present within the sandstone and in the material filling the crater.

The 2015 Visit: This visit was multi-pronged and involved. I). Specialized sampling of the sands for age determination using a technique known as quartz luminescence dating. II). Ground observation across the structure for macroscopic evidence such as shock deformation. III). Exploring the possibility of identifying, by means of metal detectors, possible remnants of the meteorite, and IV). Geophysical contributions for the argument for or against the feature being an impact structure.

The dating results are still outstanding and are not part of this report and field observations were inconclusive. A gravity profile across the structure was carried out using a CG5 gravimeter from the Geological Survey, and a Differential Global Position System supplied by Knowledge Factory P/L. It is essential to note that numerous impact structures were initially identified as geophysical anomalies, mostly gravity and magnetic. This approach has proved most useful in identifying structures that are deeply eroded or are buried by post-crater sediments such as Chicxulub in Mexico, Kgagodi in Botswana and the Morokweng Structure in NW South Africa (Reimold, undated).

Interpretation: Typically, impact structures that have not been eroded below the crater floor exhibit negative gravity anomalies, caused by fragmentation of the imploded rock, and ring anomalies caused by uplift of the bedrock, which is generally denser especially around complex craters. Note: A relatively small meteorite forms a small crater, typically less than 3km in diameter, and is a generally smoothly defined, bowl shaped and

nearly circular (Figure 2). This generally gives a negative gravity anomaly. Conversely, a larger meteorite forms a complex impact crater, which generally is more than 3km in diameter. In the center of a complex crater is a distinct central peak formed as the crater floor rebounds following the meteorite impact (Figure 2).

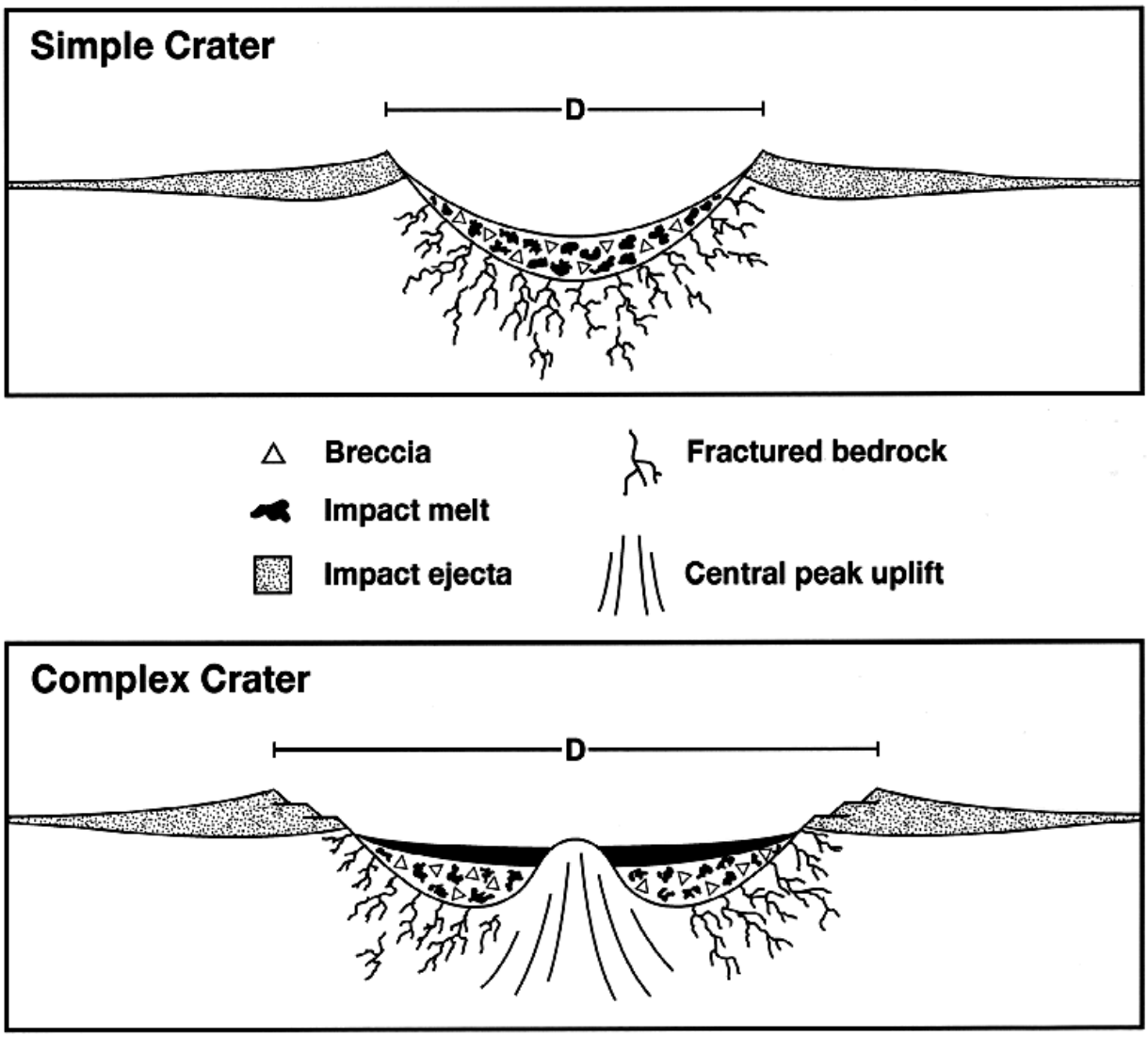

Figure 2 – Morphology of Simple and Complex Craters (Reimold, undated).

Removal of the Regional Gravity Trend: In order to remove the NS regional gravity field derived from the Upper Karoo sandstones and grits, and resulting in a general rise in the measured values from north to south, a 4th order polynomial fit was applied to the data. The result is a symmetric anomaly (Figure 3), showing two gravity peaks corresponding to the rim of the structure, some 8gu above its trough. The anomaly is synonymous with crater morphology, where the rims of the crater have correspond to

gravity highs whilst the centre of the structure is depressed in gravity due to fragmentation of the sandstone and possible over filling of the crater with aeolian sand.

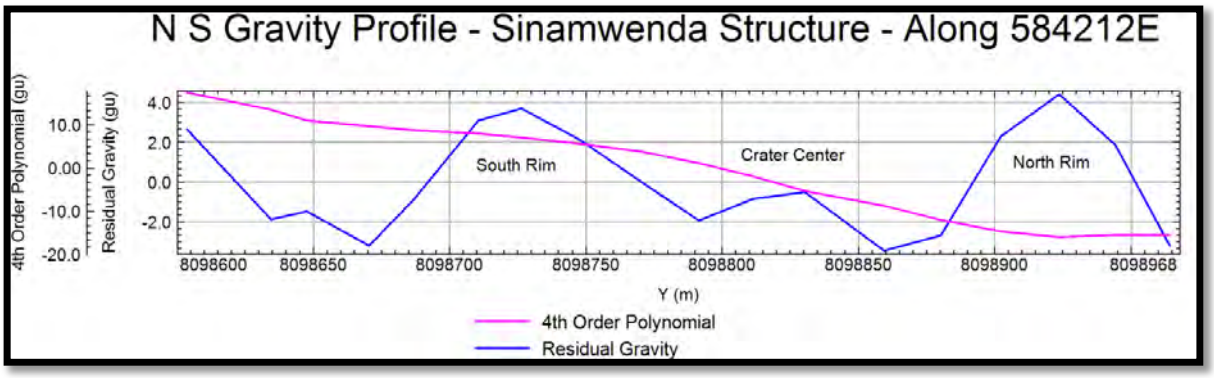

Figure 3 – Residual Gravity Profile across the Sinamwenda Structure

However, the structure has a third gravity peak in the centre, some 3.6gu above the trough. This is not in tandem with simple crater morphology where material in the crater floor fragmented fragmented and less dense. The general gravity signature of a simple low can be modified due to erosional and depositional effects. The anomaly can also be, the effect of remnants of the meteorite buried in the crater floor.

Conclusion: The gravity profile across the Sinamwenda structure gives a negative magnetic anomaly as would be expected in a simple crater, except that the 3.6gu peak within the structure is interpreted as being due to erosional and depositional effects. However, the response of remnant meteorite material at the centre cannot be ruled out. The gravity anomaly, on the rims of the structure is characteristic of a simple crater.

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News

Geology Department, University of Zimbabwe

Maideyi Meck

The Department started 2016 in a positive way. On a sad note Prof Manuel resigned from the Department to take up duties in Mozambique. The contract for Ms Sibanda, which expired in December, is yet to be renewed. This has placed strain on the teaching staff. Teaching is progressing well but resource issues continue to irk.

The academic staff undertook industrial visits to assess the performance of students on attachment. Most students are doing well, and field supervisors generally concur. We are hoping the mining industry will once again accommodate our students for the crucial experience that they need this coming year. Fewer students attended Society talks this quarter as they were writing examinations and later were on holiday.

The university second semester, which was scheduled to reopen on 7 February will now commence on 22 February to allow for a new intake in February of students whose A-level results came out in January. This means that starting in 2016 there will be two intakes at the university - a February / March one and an August / September intake.

As a Councillor of the GSAf for the Southern African Region (2012-2016) term, Dr Meck will happily forward any news from Zimbabwe to the GSAF Newsletter.

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DG Direct line/Fax:	263-4-303557			

Note: DG – Department of Geology; GSZ – Geological Society of Zimbabwe

Other Staff Members at DG: Dr T Mulugheta; Mr G Chinoda; Ms D Mudimbu: Ms S. Sibanda; Ms Ncube; Ms Magaranhewe; Dr R. Owen.

The Professor Tom Blenkinsop UZ Geology Field Trip Fund

Following the successful presentation of the 2013 A.M. Macregor Memorial Lecture in Harare and Bulawayo, and his lead of the field trip in the Renco Mine area, Professor Tom Blenkinsop made a generous donation of $200 to the Geological Society of Zimbabwe (GSZ). This was in support of University of Zimbabwe (UZ) geology student field trips. Over the years the UZ Geology Department has been under funded, resulting in their failure to raise sufficient money to conduct the mandatory field trips for its students. The GSZ responded by donating funds and materials from its own resources as well as from members. This assistance went towards the welfare of the geology students, especially in meeting costs for field trips.

Using the donation from Prof. Blenkinsop as seed money, the GSZ has now established the *"Professor Tom Blenkinsop UZ Geology Field Trip Fund"* to be administered by its Executive Committee. Tom has indicated an interest in supporting the Geology Department on a long term basis, not only to help in mobilizing funds for various activities, but by also providing moral and material support. Annually the students go on their main field trip, which lasts around 2 weeks with direct costs being in the range of $6000 per class. Therefore we are appealing to all our members to donate generously to this worthy cause both in cash or in kind. Materials such as fuel and food are most welcome.

The direct benefits that accrue to the geological profession are that it ensures a properly trained graduate. Referring to the adage that he best geologist is the one who has seen the most rocks, our students need quality field trips. From these field excursions we also want to develop the Zimbabwe Geology Atlas.

Your donations, either in cash or in kind, should be forwarded to our Treasurer, Collins Mwatahwa – E-mail: cmwatahwa@Angloplat.com or to our Administrator, Julie Kuhn - E-mail: geol.soc.zimbabwe@gmail.com

THANK YOU FOR YOUR GENEROSITY

H. N. Gumbo June 2014

ZIMBABWE

Geological Survey Department

Ernest T. Mugandani
etmugandani@gmail.com

Staffing

Sokesimbone Lunga, Frank Muzanenhamo and **Ms Sibongubuhle Mpindiwa (**Principal Geologists) continue to act as Provincial Mining Directors for Matabeleland South, Mashonaland West and Masvingo mining districts respectively.

Ernest T. Mugandani (Principal Geologist) also continues as Acting Deputy Director of the Zimbabwe Geological Survey. Ernest attended the 17th Africa Oil, Gas and Mines Conference (OILGASMINE) and Exhibition, held at Friendship Hall in Khartoum, Sudan, from 23rd to 26th November 2015.

The event was jointly organized by the United Nations Conference on Trade and Development (UNCTAD) and the Government of Sudan, in partnership with Cubic Globe Ltd. The central theme was "*Extractive industries and sustainable job creation*".

The conference was also held in the context of the new development agenda, *Sustainable Development Goal (SDG) 8*, which calls for action "to achieve full and productive employment and decent work for all women and men, including for young people and persons with disabilities, and equal pay for work of equal value by 2030".

Robert Sithole and **Alice Mudzi** (Chief and Assistant Chief Cartographer) were in China for two weeks from 31st December 2015 undergoing familiarization training on the use of the Computer to Plate (CTP 800) machine purchased under the African Development Bank (AfDB) Governance and Institutional Strengthening Project (GISP).

One geologist for Manicaland Mining District, **Tendai Masuku** resigned from the Ministry with effect from mid-November 2015. She had served for only about a year.

Two of the ZGS geology cadets (**Robert Mashambanhaka** and **Evelyn Marumisa**) continued with their 3rd year Industrial Attachment on the 1st September 2015 at the Trojan Nickel Mine courtesy of Bindura Nickel Corporation (BNC).

MOUs

Memorandum of Understanding (MOU) between Japan Oil Gas and Metals Corporation (JOGMEC) and the Zimbabwe Geological Survey (ZGS)

Following signing of the MOU on 10th September 2015 by JOGMEC and Ministry of Mines and Mining Development (MMMD), JOGMEC has increased its co-operation activities with the Zimbabwe Geological Survey.

1. Messrs **Mugandani, Poshiwa** and **Charumbira** attended a JOGMEC workshop on Remote Sensing and Satellite Image analysis held from 27th to 29th October 2015 and a post-workshop JOGMEC seminar on "Sustainable Development of Mineral Resources in Botswana's Mining Sector" held on the 30th October 2015 in Gaborone, Botswana.

2. Messrs **Kashiri, Muteta, Kufahakurambwi, Ndoro, Makuvaza** and **Ms. Mungate** left for Botswana on 7th February 2016 to undergo a two-week training course on Remote Sensing and Satellite Image Analysis at the JOGMEC remote sensing centre in Gaborone, Botswana.

3. A seminar on "Sustainable Development of Mineral Resources for the Mining Sector of Zimbabwe" will also be held at Meikles Hotel, Harare on 3rd March 2016. The seminar has been jointly organized by JOGMEC, the MMMD and the Ministry of Economy Trade and Industry of Japan. The one-day seminar will contribute to strengthening the relationship between Zimbabwe and Japan.

MINING INDUSTRY NEWS

Forbes Mugumbate
fmugumbate@gmail.com

Death Notice

I regret to start with sad news of the passing of **Roy Mtemah**, the acting Provincial Mining Director for Mashonaland East Province, on Tuesday 2nd February 2016 in Harare. Roy collapsed in his hotel room in Kadoma where he was attending the Ministry's 2016 Strategic Planning Workshop. He was rushed to a local hospital from where he was quickly transferred to Harare, but he died on arrival. He was buried on Saturday 7th February at the Provincial Heroes Acre at Warren Hills after being declared a Liberation War Hero. Prior to his assignment to Mashonaland East, Roy was the Chief Chemist at the Metallurgical Laboratory of the Ministry. May his soul rest in peace.

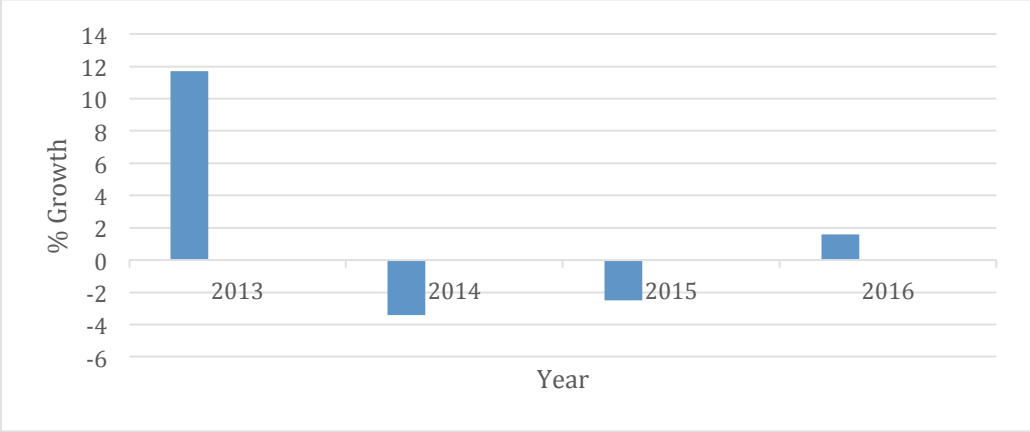
Chamber of Mines - State of the Mining Industry

In an effort to convince Government to enact policies based on researched and factual data, the Chamber of Mines of Zimbabwe presented their 'State of Mining in Zimbabwe' paper with revealing statistics to stakeholders on 28th January 2016. The following statistics compiled by a company contracted by the Chamber of Mines highlight the generally poor performance of the mining industry.

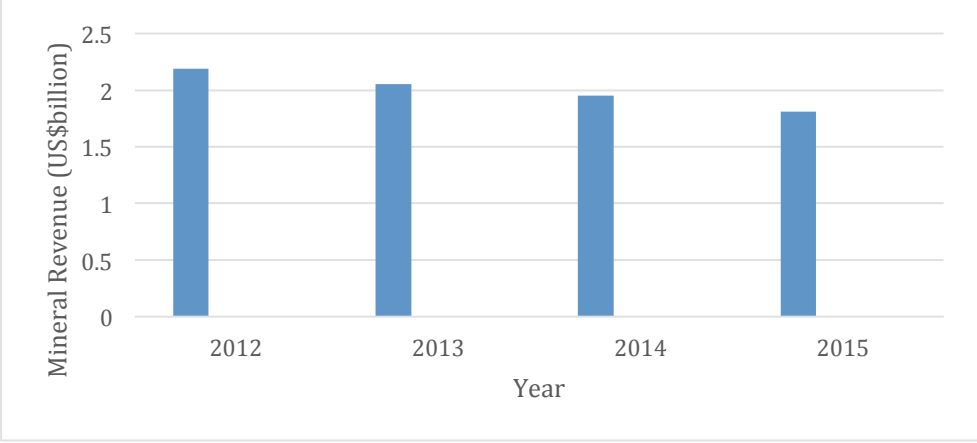
Mineral Production Performance

	2014	2015	% Change
Chrome /'000 t	408	211	-48%
Coal /'000 t	6 353	4 200	-34%
Gold / kg	15 386	20 000	+30%
Nickel / t	16 633	16 108	-3%
Copper / t	8 275	8 262	0%
Platinum / kg	12 483	12 564	+1%
Palladium / kg	10 317	10 138	-2%
Diamonds / '000 carats	4 773	3 360	-30%

Mineral Growth output



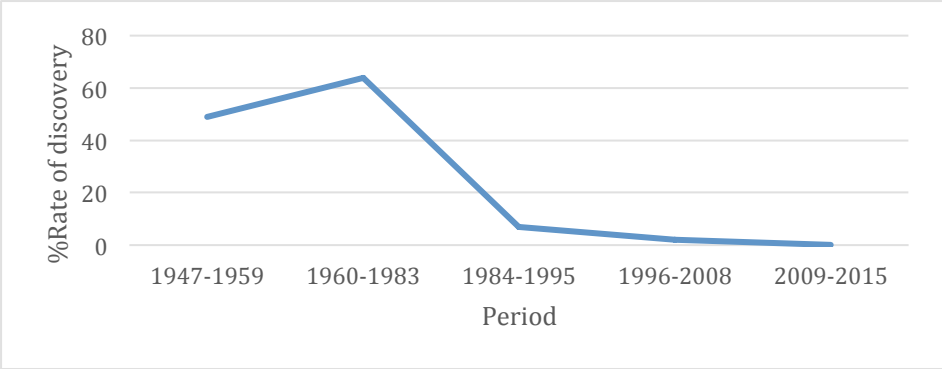
Mineral Revenue



Capacity utilization
The average capacity utilisation in the mining sector declined to 60% in 2015 from 71% in 2014. The steepest decline was recorded in chrome, which slumped to 29% from 67% and coal down to 20% from 34%.

Investment requirements
The mining industry (excluding diamonds) requires about US$3.8 billion over the next 5 years. Of this, US$1.2 billion is required to "stay in business" while US$2.6 billion is for developmental investments.

Exploration
The mineral discovery rate for the last 10 years is 0% as illustrated in the graph below.



The Consolidated Diamond Company
The Government has gone ahead with mergence of diamond producing companies to form the Zimbabwe Consolidated Diamond Corporation (ZCDC), which will incorporate all diamond concessions and claims in the country, despite resistance from the companies concerned. The companies affected are Marange Resources, Mbada Diamonds, Anjin Resources, Diamond Mining Company, Gyne Nyame, Kusena and Jinan all located in the Marange area, Murowa diamond mines in Zvishavane, and the River Ranch Mine at Beitbridge. The Ministry is now in the process of constituting a board of directors who will be mandated to steer the new company. It remains to be seen how the company will operate especially with respect to their search for new diamond deposits.

Government has begun seeking the services of senior personnel to run the new company. According to an advert carried in a weekly newspaper, the Zimbabwe Consolidated Diamond Company wants to recruit the services of a chief executive, chief operating officer, company secretary, chief security officer, mine managers and other senior technical personnel to steer the company to profitability.

False accident alarm at the Pickstone-Peerless Mine
What should go down as the most distasteful joke of 2015 was the report on Saturday, 12th December, 2015 that six artisanal miners had been trapped in an underground shaft at the Pickstone-Peerless Mine in Chegutu. The report indicated that the mine owners allegedly backfilled shafts when illegal miners were still underground. While the Mines and Mining Development Permanent Secretary, Professor Francis Gudyanga maintained that the alleged trapping was a hoax, the local legislator, Dexter Nduna, insisted that the bodies of victims were trapped underground, going to the extent of mobilising other

legislators to support him in his efforts to evict the owners of the mine for cruelty. Despite the fact that no missing persons report was received, the areas where the 'miners' were allegedly trapped were dug over with negative results. The Chief Government Mining Engineer and the acting Provincial Mining Director, fellow geologist **Frank Muzanenhamo**, stayed at the site in vigil throughout the Christmas and New Year holidays. Pickstone management insisted that it was all a hoax meant to disturb normal mining operations and to allow invasion by illegal miners. This is what was predicted in our June 2015 issue of the Geological Society Newsletter whereby new projects are in danger of disturbance by artisanal miners. Now the company has to backfill the pits dug during the search.

Chrome exports

Government has set up a special purpose vehicle (SPV) known as Apple Bridge (Pvt) Ltd, through which small-scale miners can export chrome ore following the removal of an export embargo. Every raw chrome exporter shall pay a royalty of 5% and a prescribed permit fee of $500. Chrome ore exports were banned in 2011 to promote value addition.

Platinum refinery

The government has suspended a 15% tax on raw platinum exports ceding to company requests to have at least two more years to set up smelters and refineries. The levy imposed in January 2015 was aimed to encourage local processing of the metal. Affected companies argue that the volumes mined are not high enough to make construction of multibillion-dollar refineries economically viable. They are also sceptical that the infrastructure and the energy supply would be adequate to run these plants, and they point out that there is excess refining capacity in South Africa.

Mining Fees

The Government has gazetted new mining fees that are generally lower than the previously, thus yielding to the representations of various mining associations that the fees were too high.

Conferences

The 23rd International Geological Congress, Cape Town, South Africa – August 2016.

3D EARTH EXPLORATION (Pty) LIMITED

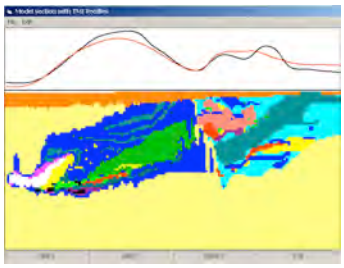
Geophysical Contractors & Mineral Exploration Consultants

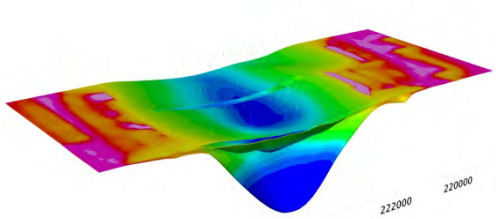
3D Earth Exploration is a Botswana-registered company operating in the Africa theatre and provides the following services:

- Ground geophysics surveys
- Physical rock properties measurements …&… 3D Data processing and interpretation

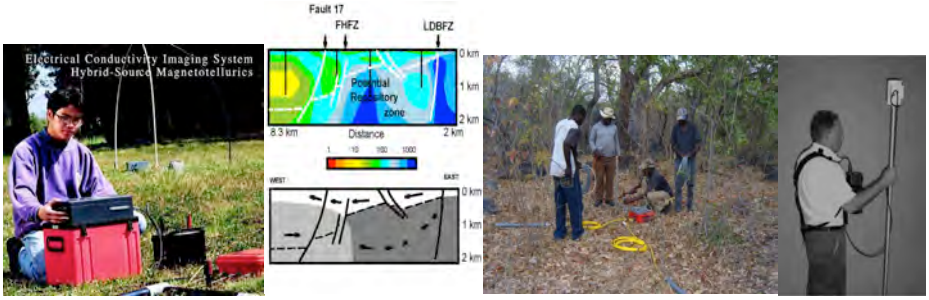
GDD MPP-EM2S+ Magnetic susceptibility and conductivity probe and axim ……..Onsite data processing

- 3D magnetic and gravity data modelling

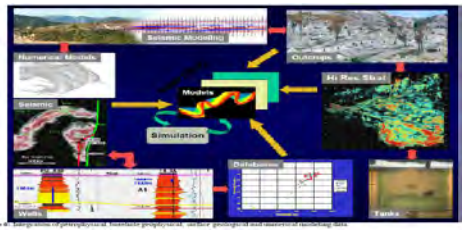




- CSAMT, ground magnetic surveys, Induced Polarisation, gravity (CG3/5, La Coste), rock properties, EM, GPR, radiometrics and a wide range of other ground geophysics surveys.



- 3D Data integration and visualisation



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GSZ Research and Development Fund

Enquiries relating to the distribution of funds through this facility should be made through the standing Chairperson.

SEG Timothy Nutt Scholarship Memorial Fund

This fund will be available to provide financial support for geology students and young economic geologists located in Zimbabwe or in Southern Africa with ties to Zimbabwe. The fund may be used to support SEG student chapter activities, travel to meetings, field trips, for research or study grants, technical lectures or any other activities approved by the SEG Regional Vice President for Africa.

Applicants must describe what the project is, why the research is important and how it is to be done.

An estimate of expenses for the project must be included with the application.

Grants are expected to be fully utilized by year-end.

Grant recipients are required to provide a year-end accounting of how the money was spent together with a suitable progress report or final abstract.

See the Society of Economic Geologists website for further details and the next call for applications.

GEOLOGICAL SOCIETY OF ZIMBABWE:
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Bruker RSA

Chamber of Mines of Zimbabwe

Freda Rebecca Mine

Goldsearch Technical Services

Marowa Diamonds (Pvt) Limited

Metallon Gold

Mimosa

New Dawn Mining

RioZim Limited

Samrec Vermiculite Zimbabwe (Pvt) Limited

Sandvik

SMC Drilling

Trojan Nickel Mine

University of Zimbabwe Geology Department

Unki Mines (Pvt) Limited

Vast Resources

Zimbabwe Geological Survey

Zimbabwe Mining Development Corporation

Zimbabwe Mining Investments

Zimbabwe Platinum Mines Limited