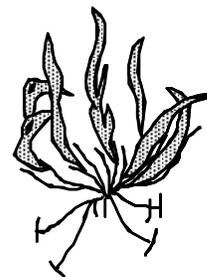


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# Geological Society of Zimbabwe



Newsletter



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February 2011

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**ZGZS - 100**



*Participants on the Belingwe field trip, 23<sup>rd</sup> – 25<sup>th</sup> October, 2010. Photo: Allan Wilson*

**THE GEOLOGICAL SOCIETY OF ZIMBABWE, P.O. BOX CY 1719, CAUSEWAY, HARARE**

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The Committee, on behalf of the Geological Society of Zimbabwe, would like to offer a sincere vote of thanks to Marion de Beer of *Cadline* for continuing to support the Geological Society, especially with respect to her digitization efforts on 'The Million Map'. We can only encourage all you geologists and mining houses to steer your Autocad mapping work in her direction and to take advantage of at least 30 years of hard-won cartographic experience. *Cadline* also offers monochrome printing and scanning services in formats up to A0. Their telephone contact is 04-2917261/60 Tel/Fax is 04-301855 and the address is 94B Pendennis Road, Mount Pleasant in Harare. [marion.debeer@cadline.co.zw](mailto:marion.debeer@cadline.co.zw)

## Editorial

Here we are another year on as we approach another AGM when Daniel Chatora hands the baton on to Houda Bouamar and a new committee. A lot has happened in 2010, not least of all the staging of our symposium to celebrate 100 years since the establishment of the Zimbabwe Geological Survey with its associated field trips to the North Dyke and the Belingwe Greenstone Belt. The outcome of these deliberations were most satisfying, made possible by the convergence of so many visitors from far and wide, many of them old friends, who combined with us locals in a stimulating and moral-boosting experience.

The AGM and dinner is to be held, as it has been for the past number of years, at Highlands Sports Club (CFX) at 17.00 hours on Friday 25<sup>th</sup> February. At \$15 a head for dinner and participation in the proceedings, we encourage all our Members to attend and enjoy a convivial time in friendship.

We are reserving Sharad Master's summary of the symposium proceeding for next newsletter as well as Houda's account of the North Dyke field trip, which was led by Allan Wilson. In this edition we present the first half of a memoir written by Keith Viewing in commemoration of the ZGS Centenary. It includes a wealth of hands-on experience in the development of mineral deposits in the region since the 1950's, and in particular the development, application and pitfalls in geochemistry as have been used in the exploration for these deposits. The lessons are there for us all to glean, and we are grateful for the leadership and guidance that Professor Viewing has provided us over all these years. The Hon. Editor has also summarized his impressions of the Belingwe Field Trip led by Tony Martin.

Our thanks are extended to Maideyi Meck, Forbes Mugumbate, Bornwell Mupaya and Mitchell Maisera for their contributions and support to our usual news coverage of events at the Geological Survey, the Geology Department and within the mining industry in general. When all is said and done, these contributions combine as a tangible record of events that have affected these institutions since our newsletter first included these summaries in 1993.

*Tim Broderick*



## Chairman's Chat

Daniel Chatora

My compliments to you all. May the New Year bring good health, wisdom and prosperity.

The International Symposium to celebrate the Centenary of the Geological Survey of Zimbabwe took place as planned from the 20<sup>th</sup> to 25<sup>th</sup> October 2010. The event was a tremendous success thanks to the commendable work by the conference sub-committee ably guided by Andrew du Toit. Our gratitude also goes to Dr Tony Martin for guidance through the planning and implementation stages, and to the keynote speakers Tim Broderick, Allan Wilson, Sharad Master, Thomas Oberthur and Euan Nesbit.

Due to popularity request, the proceedings kicked off with a 1-day pre-conference field trip, led by Professor Allan Wilson of Wits University to the North Dyke on the 20<sup>th</sup> October. On their return to the capital that evening, delegates were guests to a cocktail hosted by the Minister of Mines, Honourable Obert Mpofu, to celebrate the Centenary of the Geological Survey.

Starting with technical sessions on the 21<sup>st</sup> and 22<sup>nd</sup> October at the Crown Plaza Hotel, the conference was officially opened by the Deputy Minister of Mines, Honourable Gift Chimanihire. The Deputy Minister highlighted the importance that Government gives the mining industry because of its contributions to the development of the country and the economy; adding that an efficient Geological Survey was essential if the country's mineral potential is to be realized. He hoped that the conference would rekindle interest in the country's geology and mineral potential. Following the two days of varied and thought provoking presentations, the Symposium ended in a high note when the venue was opened to the public for Prof. Terrence McCarthy's Alex du Toit Memorial Lecture on the Okovango Delta and its place in the geomorphological evolution of southern Africa.

Led by Dr. Tony Martin, the post conference field trip into the Belingwe Greenstone Belt commenced on the 23<sup>rd</sup> October and ended on the 25<sup>th</sup> October with a visit to the Bougai platinum project in the Selukwe Subchamber of the Great Dyke where delegates were able to look at the outcrop of the main sulphide zone.

For those of us who managed to attend both the technical sessions and the field trips this was a memorable event as we were able to mingle with some internationally renowned figures in this field of Earth Sciences. It also provided us with an opportunity to meet old colleagues and to make new friends.

The mining industry is stabilizing as a result of the political and economic initiative following the formation of the Inclusive Government in 2009 and the general firming of commodity prices on the international markets. Currently mining is contributing 65% of the country's exports made up of pgms ~45%, gold ~22%, diamonds ~11%, ferrochrome ~8% and others ~14%). This contribution in terms of value has potential to increase significantly if EPO applications are urgently processed, given the benefit gained by the release of more exploration ground. As it stands no applications for the numerous EPO have been approved by the MAB for the past 8-9 years. The exception has been the approval of some 12 Special Grant applications, but little ground work is taking place due to lack of funding. What is required from government is timely and consistent policy formulation/implementation, coupled with the creation of a conducive environment for mining companies to avail exploration funds.

My term as Chairman of your Society ends on the 25<sup>th</sup> February 2011 with the AGM. I would like to take this opportunity to thank Tim Broderick for the timely production of the Newsletter every quarter. My gratitude also goes to committee members for the unconditional support they gave in efforts to try and meet the objectives the Society. We look forward to seeing you all at the AGM when we welcome Houda Bouamar as our incoming Chairperson.

All the best for 2011 and beyond.

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## Articles and Reports

### A Selection of Mineral Discoveries: Retrospective and in Perspective (Part One)

*Keith Alan Viewing*

#### **Abstract**

A pattern of mineral exploration is illustrated from experience during the second half of the century of the Geological Survey. The first half is from the tales of friends who were involved and from the reports of the Rhodesia Congo Border Concession, north of the Lukanga Swamps.

At first the search was for coloured stones and gold, and then in Zambia by using vegetation as a guide to the underlying geology and the Series des Mines, host rocks to the copper deposits. In the next phase the search was controlled by survey and the target horizon was tested by the geophysical Self-Potential technique.

The second half-century included the acceptance of Continental Drift, enthusiasm for regional and local structures and consistent support for geochemical exploration in Zambia and Zimbabwe. Research investigations of the dispersions of Cu, Co, V, As, Sb, Cr, Be and Ni provided the foundations to the blanket exploration of huge tracts of country. In general the results were satisfactory in areas of residual soils for industry anticipated potentially exploitable deposits to have a clear chemical expression near surface.

Discoveries of copper, nickel-copper and nickel deposits illustrate the application of the techniques that revealed the deposits and outlined the targets. The philosophy of the time did not include blind deposits, or leached gossans, including those in arid terrains. Experience taught that contaminated anomalies should always to be tested.

The success of geochemical surveys depended upon a thorough knowledge of the pedology, the analytical methods selected, and the techniques used to interpret the results. The techniques became progressively more sophisticated but were not always understood and often overlooked the need for the weathering history, and an orientation survey in a competitive environment. Similarly, geophysical techniques could lack adequate geological controls.

Throughout the century, the Geological Survey of Zimbabwe has developed and maintained a valuable support to the Mining Industry on all scales. The record and the reputation are assured and the necessity for a logical and sober enquiry after the truth is confirmed.

#### **Introduction**

The Centenary of the Geological Survey of Zimbabwe! We reflect upon progress, but not all is recorded in the literature, for many lessons are entirely personal and include the experience of others often related by chance in some obscure setting in the quiet of the bush.

The Geological Survey, the Inspector of Mines and the Mineralogist were there in the first three years, followed by Plant Hire in 1927 and a metallurgist in the following year. The Government of the time bought the Mineral Rights in 1933, to the huge advantage of all. Bulawayo Technical School has taught Mining from 1936, and during the Returned Service-mans' Scheme, those very mature students formed the backbone of two hundred Small Mines that went into production. The definition varies, but we accept that the owner/manager takes an active part in the day-to-day operations, for example pointing the rounds, loading and firing the explosives and dressing the

amalgam plate, say about 3000tpm.

Government support to the Mining Industry has a list of 36 separate entries from the inception of the Geological Survey to 1987, when the Gold Refinery and Remote Sensing facilities were implemented<sup>(1)</sup>. Air photography was tested at the Survey by Dr Phaup in 1932, and Geophysics in 1938. Geology was an early subject at the University of Zimbabwe, 1960, followed by the Institute of Mining Research, 1969, and Mining Engineering and Metallurgy to complement the other engineering disciplines, 1985.

The Geological Survey has continued to support Geophysics, but Geochemical Mapping and Remote Sensing were developed elsewhere, due mainly to the facilities required. The support to small mines over the period was substantial and the history was of scientific integrity to form the foundation of mineral exploration and the development of a significant and broad-based mining industry.

### **Coloured stones**

Almost at the start Jimmy Beaton, surveyor, and his colleague Andrew Osterberg, prospector, had walked from the Zambezi north towards the Katanga watershed. The search in May 1923, was for sufficient coloured stones to indicate either a potential mine, a promising prospect, or simply something to be followed up in due course. Their discovery was judged as a 'promising prospect', and received eventually a reward.

Beaton was Director of Works, retired from Government, as his tale was encouraged fifty years later by a new boy. The response was dead-pan, he didn't care. 'No, but my share of about £114, was sufficient to be married and buy a small car at the time'. And, 'Was that discovery ever mined?' 'Oh yes, they said it did quite well, and became (in 1931, the huge) N'changa Copper Mine.' 'Any bronze bust of you both to celebrate that long walk through the bush, and back again, and the discovery too? Stone Lions were for Nelson, but as the conversation moved on, the imagination took in the marching compass and bicycle wheel, the head-loads, and where they might find water and food in the dry season of a country that extends forever.

The great Roan Antelope Copper Mine was an early discovery in 1902 but was dormant until 1931<sup>(2)</sup>. The copper stains seen by William Collier were probably a weak smear of malachite or even the dull red cuprite or black copper oxide. Less likely still was the greasy mix with manganese as tennorite that needs practice to be sure. There was little to see on the tiny river cliff fifty years later for the argillite was in the shade of the afternoon sun and there was no indication of where the antelope fell. We walked back along the strike of the basin for about 3km following a narrow band of argillite at surface with no evidence of staining, or of the chalcocite somewhere below. Completely leached out, it seemed. It was only at the top of that gentle slope about 8.5 km along the strike to the west, over the Muliashi ore-body, that we found a clearing and the wonderful display of bright blue flowers amidst olive green-leaves that proved the copper flower.

Great chunks of shot-drill core, about 15 cm diameter, littered the strike of the Roan Basin, a reminder that the first drill collars were spaced at 305m apart, a sure sign of a faultless interpretation of the strike and stratiform mineralization. There, in one pass were large samples for assay and flotation, and a demonstration of the ground. The production at the time of the visit was 5 million tpa containing 2.45% Cu, plus 1 million t of waste hoisted. The reserves were maintained for a life of 20 years.

There was no geological map of the surface at Roan in 1955, but only a map of the magnetic

response of the argillite-quartzite boundary that was remarkably accurate (Watts Vertical Force Variometer). The files included the superb and detailed pit logs drawn by T. F. Andrews, geologist, who in 1926 had recorded his observations, but never his interpretations. The records on his pit-cards were clear, unequivocal, and a delight as the map was drawn.

Coloured stones if present at all, would be buried from 10m to 15 m under the soil and weathered rock and exploration had to rely on prospecting pits 90cm in diameter. The agile could climb up and down with toes and fingers in the side-wall, but a bosun's chair and a carbide lamp gave more comfortable access. At depths from 8m to 12m the rock was often recognisable as relicts in white clay, tinged perhaps with limonite. The dip and plunge of minor folds could be read and provided the key to major structures. That was very important to Anton Grey in those early days, and it was he who understood the fold at Chambishi<sup>(3)</sup>. He believed the drill had stopped-short, and the discovery was assured.

There were few outcrops of the host-rocks in the Series des Mines and the prospecting pits were on traverses across the supposed strike, and spaced first at about 61 m apart. These were closed progressively to a minimum of 3.6 m apart as the target horizon was defined. A cross-cut between them became a nightmare as you crawled on your belly, hard-hat jammed on the roof, and the carbide lamp extended in one hand, tape in the other with note book and Brunton to record the minor fold structures as you moved. Search always for a trace of oxide, and if supremely lucky, malachite in those lime-poor and soft argillites. Was a snake hiding in the next pit, coiled around the narrow bell-shaped collapse at the base? Baluba was the name, but no copper-clearing was here on the watershed, just a leakage dispersion into the wetland on the flank<sup>(4)</sup>.

The exploration pits were dug and logged at a rate of about 25 pits/week and the lead time to site the collar of the first diamond drill was about three months. The intersection depth of a deep hole, say from 500-700m, was expected from 2.5 to 3 years of double twelve-hour shifts. The ground was bad even at those depths and the core-size might be reduced to X-Ray, or even stopped a few metres above the target.

An unexpected change in the species of copper sulphides was a problem for the metallurgists as they dealt with the mass-balance of rich and poor ore to the mill, and concentrates of variable tenor to the smelter. There was no mineralogist then, although seven in the group later, but there was sufficient knowledge to follow and to predict the mineral zones from near surface down into the deep fold structures. The pattern down-dip was first of chalcocite that gave way to bornite, then to chalcopyrite, and finally to pyrite and cobalt enhanced pyrite on the fringe<sup>(5)</sup>. Bill Garlick had thought about the problem when on Nkana Mine, in about 1935, and had forecast the discovery of uranium mineralization up-slope from the chalcocite, and found it!

The idea seems to have lain dormant as geological enthusiasms waxed and waned until 1985 when a Joint Venture between AGIP and COGEO MIN, the French Atomic Energy Agency, had re-explored the huge Lumwana deposit of 1 billion tons containing about 1% Cu. Those cheerful fellows had found the uranium zone as Bill would have predicted!

Was it by chance only that the Copper Belt was poor in silver, say 30 tpa in 650 000 tpa Cu, and why was Nkana Copper Mine by far the largest source of selenium in the Copper-Belt? By contrast Zimbabwe had produced 30 tpa Ag from only 80,000 tpa Cu.

But in another generation more coloured stones were to be found at Shamrocke, where the Angwa river cuts the Zambezi Escarpment. A little faint-washed malachite was discovered on a

few ragged stones of the outcrop that served as the DP. No soil cover in that rugged country and not sufficient vegetation to illustrate a copper-clearing. Perhaps the cubanite (iron-rich chalcopyrite), did not release sufficient active copper and iron to bond as gossan in that rugged country.

A sometime tobacco farmer, a cheerful optimist, had found Shamrocke and was never discouraged even when the deposit was drilled by Rand Mines to reveal a jumble of drag folds in every core. There was a problem of interpretation until the simple solution was tested, and accepted, that soft rocks were caught in a planar structure. This was one limb of a steep fold, and where was the other? There was no treasure trove at Shamrocke 50 years after Mr Beaton's adventure, but the mine was opened with Government assistance and exploited by Lonrho until the war<sup>(6)</sup>, fig.1.



*Figure 1: The Shamrocke Copper Mine*

This was the northern-most of our larger copper-silver deposits and much later the association was traced to Mangula-Alaska, Gwaai River, the Bushman group, Maun, and on to the coast to include Oamites and several other small deposits in Namibia.

The old Falcon Mine and the smelter had drawn malachite from several ancient workings in the Lomagundi and elsewhere<sup>(7)</sup>. At Alaska, the ancient workings were in argillite, but years afterwards disseminated sulphides were found in the arkose below. And, it was said that the geophysical Self-Potential method had given a positive result over that shallow overburden.

#### **Less attractive coloured stones**

It was coloured stones for nickel-copper too at Bare-Bottom Hill and Empress, and at Madziwa where Euan Morrison was involved. Empress was discovered in a pit, so they said in 1956 and Mrs Leslie had sold for a fortune, and then paid her taxes accordingly. Dr Noel Sharpe of Mineral Search of Africa (RTZ) had led the fray but the problems of extraction and recovery could not be anticipated. Empress was found to be a large carrot-shaped structure where a relatively weak core of dunite (nickel, but no copper), was surrounded by competent pyroxenite (nickel and copper). By contrast, the only other pyroxenite mine in Zimbabwe at Madziwa was strongly disturbed by faults and dismembered by several major, and some minor, planes. The nickel-copper reserves seldom exceeded a life of eighteen months and the resources defied imagination.

Garnierite, the beautiful apple-green nickel silicate appeared to be a very stable mineral in weathered rocks and soon there were many nickel targets. The search was encouraged by the discovery in 1962, of the large nickel-copper strike in the pyroxenite of the Pikwe-Selibe basin,

Botswana, but most of these targets were in serpentine and the inherent practical problems were not recognised.

In serpentinites, and in the dunite at Empress, massive amounts of talc contaminated the nickel sulphide concentrates. The problem came to roost in the Empress coal-fired reverberatory furnace, about 1970 for the charge was smelted to form a high-temperature slag that eroded the refractory linings of the smelter. A thick bed of chromite mixed with matte had accumulated at the hearth and the furnace was re-built. Eventually an electric furnace replaced the pair of blast furnaces at Bindura, and this accepted concentrates from three serpentine mines and Madziwa. The nickel market dominated by INCO and Falconbridge at Sudbury was challenged at last.

### **No coloured stones**

Elsewhere in Zimbabwe, the exploration for copper, nickel-copper, and nickel seemed to be devoid of coloured stones, but some could read the signs better than most and Major John Hilton at Trojan was assisted by the Government Metallurgical Laboratory with a pilot plant that included talc-depressants and two small blast furnaces. Cecil Sack at the Government Metallurgical Laboratory had overcome that problem to the huge advantage of all concerned, but the fluxes were another problem that was solved by Hugh Bartlett and his colleagues, also in Zimbabwe <sup>(8)</sup>.

A few drainage samples along the north flank of the Trojan serpentine near Bindura had revealed little. The copper content of the deposit was very small and the background nickel content of the serpentine was very high. The crest of Cardiff Hill exposed only serpentine that was more deeply weathered than the fresh blue rock along the ridge, and what did the Major really know? A little disseminated sulphide in a tiny exposure at the base was not impressive, but Union Corporation, South African Manganese and eventually Anglo American took a chance and each spent their quarter of a million pounds in exploration, one building upon the results of the other, until the mine could be designed and developed.

But the problem remained; was there any clear indication at surface of the nickel-sulphide deposit below? A field-day was planned at Trojan Hill, out of sight but close to Cardiff, and a dozen diligent company men searched the ridge. No evidence of the sulphides was found and it was left to drill cores and to an adit to prove the point.

A similar problem was revealed at Hunters Road where the discovery outcrop, if you could call it that, rose as the most gentle slope from the fringe of a minor wetland. A little pale garnierite, or some other member of that family of secondary silicates, showed the faintest of blue-green stains on a pale grey-blue weathered outcrop. Once again it was geochemical soil sampling that defined the deposit and provided the wagon drill targets.

### **Less direct methods of prospecting**

The major vegetation of the forest, the top and under-storey, was a sure guide to the principal lithologies in the extensive searches on the Copper-Belt in 1927, and again in 1952, but reports of copper-clearings were rare <sup>(9)</sup>. The early work by Rhodesia Congo Border Concessions was by small field units using a compass and bicycle wheel to traverse the strike of the major fold structures <sup>(3)</sup>. The maps were remarkably accurate and the geology was confirmed, as air photographs were available in 1954. Now the search for copper-clearings could be extended from a comfortable office, but what characteristic could identify a copper clearing on the flanks of a wetland? Lumwana, all 1 billion tons of it, was a small clearing that extended, say an unimpressive 150 m upslope from the stream, and might generate a small spring in season.

The monthly reports by the heroes of the bicycle-wheel seldom referred to the geology and never to coloured stones in the country west of Ndola. Their traverses were spaced about 500 m or more apart, and perhaps 15 km long, and how they closed was a mystery. In the next phase in the same country, 1952, the traverses were reduced to 305 m apart and controlled at their limits by survey. The blocks were each 8 km on strike and the traverses 4.8 km long, pegged at intervals of 61 m, mainly for observations in geophysical, Self-Potential surveys. The dangers were there and a tragedy for Paddy Hayes of Dublin on 4th May 1954, a grand fellow.

The Self-Potential method relied upon good contacts of porous pots with damp soil. The instruments recorded the potentials in millivolts and strong anomalies were revealed above intensely folded rocks of different porosities where deeply weathered. Occasional hills of weathered quartzite were remarkable for the coincidence of the anomalies with the contours and the peak of the huge Kanga Hill was 1 volt. The theoretical maximum of weathered massive sulphides said to be 250 mV with a negative polarity to the surface. A young and enthusiastic mining engineer was required to sink an exploration shaft on a similar peak and could not conceal his dismay.

The copper-flower also was not reliable for it appeared to depend upon a high level of copper, about 0.1% in the soil, a content that was toxic to all other vegetation. The flower was found well south of the Copper-Belt, for example on the Chongwe River east of Lusaka, and on shallow sandy soils at Chalimbana (fig. 2), either close to, or under the present Airport. But in Zimbabwe the flower was found only at the old Cedric Mine, where malachite was worked by the ancients. Malachite was produced also from the argillite at Alaska and the Copper Queen, and elsewhere, but the flower was not found<sup>(7)</sup>.

For these reasons, the relatively new science of Geochemistry appeared to offer a real advantage, at first in the zone of weathering and later for blind deposits hidden deep in the bedrock. Some



*Figure 2: Chalimbana copper clearing, Zambia*

of the early research by John Webb at the Royal School of Mines had resulted in a series of studies in Zambia; two on the dispersion of copper, and others on cobalt and vanadium. In Zimbabwe, the first study was of arsenic and antimony as pathfinders to gold, and others for beryllium and chromium. The results were published as circulars, later as papers in *Economic Geology* and the *Institution of Mining and Metallurgy* (now IMM, or IOM3), and eventually as a text in 1963<sup>(10)</sup>. Applied Geochemistry was not taught as a subject for at least a decade, and then only as a short course to undergraduates, first at the Royal School of Mines and later by former students at Vancouver, Queens in Kingston, Delft, Kalgoorlie, Rhodes in South Africa, and elsewhere.

Industry had implemented geochemical surveys in Zimbabwe over large tracts of country by 1958 where the search was mainly for copper in the Deweras Arkose of the Lomagundi, and for nickel sulphides in ultramafics. Deposits of sufficient size to be mined were expected by many to reach the sub-surface and have a clear chemical expression in soils and drainage sediments. The techniques in sampling and analysis were vague and the methods used in interpretation of the data were not adequate. The test at the time was simply to obtain sufficient samples to establish a background value, and reflect anomalous results. Eventually, the concept was refined to first isolate the populations according to the geology and pedology, and then to determine the ratio of the anomalous data to the background. We spoke always of the 'contrast'.

### **The mystery of chemical analysis**

The Arc-Emission optical spectrographs in the old Colonial Geological Surveys (including the ZGS), had provided rapid, semi-quantitative analysis, mainly to identify minerals (fig. 3). The sample mass of 100 mg was tiny, but adequate and the multi-element element capability was a clear advantage. Most instruments used photographic plates to estimate the content of major and minor elements, often by visual comparison with standards. The response of the film was logarithmic; sensitive at low contents and insensitive for high, and Fred Cornwall with Anglo American in Zambia, had preferred 35 mm film to a large plate camera for rapid handling. There remained always the problems of bias due to major element effects, and the sample error due to very small samples. The reproducibility of the results varied for the elements, but for 50 samples/day, the range was from 35 % to 45% of the reported value, and even 55% for lead.

A dreadful truth was revealed in samples from the Namwala Concession, Zambia, where variations in the proportion of silica sand in the (sieved) samples was reflected by enhanced results for the metal content. The analysts called it the Matrix Effect, and it was not a serious problem. Anomalous results in silica-rich samples were enhanced, whereas those in iron-rich samples the metal contents were depressed!



*Figure 3: Ian Green with his arc-emission optical spectrograph tended at the ZGS from 1956 to 1986*  
You had to be careful, and to wonder at the ubiquitous use of the minus 80-mesh fraction of stream sediment and soil samples. That fraction was believed to be most representative of the mix of relatively coarse and fine particles, whether the search was for dispersed copper bonded to the clay fraction, or for nickel in leached and mechanically dispersed fragments of gossan.

There were many traps for the unwary but by 1960 classic colorimetric methods were adapted and tested in the field for most of the elements of interest. Simple laboratories in the bush were

devised to analyse 100 samples/man-day, and even as a personal kit in a shoulder bag <sup>(11)</sup>. In general the samples were sieved, weighed to 200 mg and fused on a Primus stove, followed by an acid-leach and a buffer of specific pH to extract the metal. Estimation was by the depth of colour in an organic agent dissolved in benzene. The reproducibility of the results was improved significantly, to about 30% in the range from 50 to 100ppm. By contrast, a gold fire-assay from a sample of 2 kg, but reduced to 31g, had a reproducibility from 14.5 to 16%, in the range from about 10 to 15 ppm depending upon the laboratory.

Fusion by flux and Primus was believed to be a total attack until Geoffrey Harden determined the fact, and another advantage of the colorimetric methods became clear when he had recovered his voice. These methods were very sensitive and simple, weak acid attack, say by citric acid, or even by contact with water could reveal metals loosely bonded to soils and sediments, released perhaps from oxidized sulphides. Now it was convenient to express results as the ratio (hx), between total attack on grains of a silicate host-rock, and a gentle attack on a sulphide phase (cx). A small field laboratory under a tarpaulin and two semi-skilled assistants could produce 200 determinations of cx-arsenic/day, and provide results the day after collection! That was a huge advantage to morale and to progress in the bush, and the torsion balance, test tubes and reagents were not expensive.

The methods varied and some, for example arsenic, did not rely upon nasty chemicals, but time and experience revealed the dangers to health of chloroform, carbon tetrachloride and benzene. This hazard was recognised in WWII, but not widely known until the Dry Cleaners began to suffer. The problem of exposure faded when the principle of Flame-Atomic Absorption was re-discovered in Australia and the first commercial instruments were available, about 1963. Those superb AAS instruments, efficient laboratories and elegant technicians rapidly became the norm and the reproducibility of the results improved to 10%, and often better. The excitement and flexibility of the incredibly simple and inexpensive field laboratories was soon forgotten and at last there was a good reason to spend a few days in town.

During 1963, the normal fusion on a Primus gave way to the incredibly dangerous sample attack by perchloric acid, held also to be total. Some of those elegant technicians were very lucky to avoid sheets of flying glass from explosions in wood-framed fume cupboards.

By 1985, the software for trace-element analysis by X-Ray Fluorescence was developed and at last the methods became total, and even more accurate and flexible. The concept of multi-element geochemical mapping was real and there was no need to identify a statistical pattern amongst unreliable data that had to be re-investigated subsequently. For example, in the Sierra Leone studies of 1960, and the Geochemical Atlas of England and Wales, 1978. 'Whole-rock' analysis for almost all of the elements in silicate rocks was soon available for a modest cost, but only if you had found an analyst who really knew.

Major elements in furnace products were the norm with Siemens in Karlsruhe, ARL and Phillips all apparently vague, but there was interest in Bristol University. 'Why not talk to Dr-- at the ICI research labs in Cheshire?' Cheshire knew lots of things; a life-size bronze of Ludvig Mond and another (Carl Langer?), who remain famous for nickel, gazed at visitors over the lawn. A discrete tablet in a narrow corridor to nowhere recorded; 'Polythene was discovered here, (about) 1936'.

There were two in the team at the University of Nottingham and Dr Peter Harvey and his colleague were generous with their trace-element software in the very best academic tradition <sup>(12)</sup>. Later, some of the elements less sensitive by XRF were resolved by plasma-arc spectroscopy at

Shurugwe, Eiffel Flats, and Kamativi. Samples in solution were diluted by  $\times 100$ , the brilliant blue light from calcium flooded the spectra, and what sort of other arithmetic was used to obtain the result?

### **The Juche Idea**

C.A.U. Craven was inspired to develop an effective form of control in the assay of gold and the principles incorporated in his methods were applied by to trace-element analysis to the profound satisfaction of many <sup>(13)</sup>. Fortunately, other unsung heroes revealed the mysteries of sampling in terms that we could understand and rotary splitters and agate swing mills became available. There were few enthusiasts, but eventually the Laboratory Managers could be challenged.

Again the focus shifted, now to the accuracy and precision of the results. The analysts were proud of their work, the white coats were worn with aplomb and the statistical controls were reported on the results sheets for all to see. Peter Harvey and friend, responsible for XRF analyses to the universities in the NE England Group, knew from experience; 'Give them the statistical results, but they (customers) have no idea what is implied and will give you endless trouble as you explain the New Idea'.

The age-old idea was that a duplicate assay from the same sample provided an analytical control, but the occasional lack of concentration on a Monday morning remained hidden. Anomalies at the time were accepted as sample-results of greater than  $2 \times$  the standard deviation of the background value. This was a somewhat hit and miss approach to isolate the vagaries of nature and recognise the chemical dispersion from hidden deposits of valuable metals.

The SD of the sample set was calculated by hand, and even with a mechanical Facit calculator the job took about 25 minutes for the skilled, and 40 minutes for the unskilled.

Were anomalous results identified at greater than  $1 \times$  SD, or was it  $2 \times$  SD? The experts were condescending, and why not  $1.5 \times$  SD? No reason, then? Was it just an arbitrary choice? The answer was dragged out with some hesitation, nobody had really thought about it and was simply not good enough. There had to be a better way and fruitless hours were spent with a early computer programmers, but they, poor fellows, could not determine analytical bias, either positive or negative in the data set.

It was back to basics, using the simple graph paper favoured by Craven that took less than ten minutes to interpret! There were only twelve results to plot and these should be within the upper and lower warning limits expressed at say 10% and 15% of the mean value. Bias was glaringly evident and you could demonstrate the results to all. But most took comfort in the saw-tooth profile that was so easily plotted by off-set scales on the traverse line, but disastrous to interpret.

Statistical control samples were unknown unless you had studied the problem and somebody had pointed the way. For most it was too much bother; pity was that shame-faced, we had to repeat 2500 arsenic determinations for the Canadians! But the bother was real at Shangani where soil-sample traverses had detected a nickel gossan on a small hill. There was no control on the analyses, and that example was used for years to illustrate another lucky discovery <sup>(14)</sup>.

What was needed, the frequency histogram and probability diagram, came at last from Fisheries Research, and 'la Droite du Henri' added a touch of magic that was accepted with glee (logarithmic-probability paper). Louis Ahrens at Cape Town had set the scene and now the populations in the data could be recognised, threshold became a certainty and anomalous samples were without question <sup>(15)</sup>.

**The New Arithmetik**

Mutli-element chemical analysis became the rage; wads of data, major and trace elements too, say 15 to 20 results per sample. What did they mean and who knew how to isolate the threshold and anomalous results from such a massive data-set? The answers came from the Social Sciences, from Medical Statistics, and from those who studied the complex habitat of the malarial mosquito.

Cluster analysis was adopted with enthusiasm; it was simple to group those elements of characteristic association and to identify anomalous samples within the group. For example, basalts were characterised by high contents of iron, calcium and titanium; serpentine by high magnesium and chromium, but low titanium. Arenites, argillites and carbonates were diluted to characteristically different levels for different elements. Well, we knew that.

The key to the new enthusiasm was that no special training was needed, you simply bought the software, entered the data, and pressed the button on a powerful computer of the time, and the New Arithmetik identified the anomalous data in any geological environment. These ideas were a huge advantage, and now you had complete confidence in the interpretation of the results and why bother with geochemistry? The low contrast and single-sample anomalies were obscured and lost, no problem. It was tea-time for all.

**Why minus 80-mesh in the sand, Dr ?**

Down at Golden Valley, the Deweras Arkose slopes gently towards the Sakurgwe stream and somewhere on a hot day in 1960 a narrow outcrop of grey argillite blocked the traverse. This was only a metre thick and less than a metre high, surrounded by clean washed sandy soil on either flank. The search was for copper and the soil samples were spaced at 61 m apart. A casual swipe from the hammer as we passed by, revealed a faint but discernable wash of malachite. But under the lens, were sparsely disseminated grains of greasy-black chalcocite. None of the results, even from soil samples at the base of the outcrop reflected the discovery for all were at background level!

When you thought about it, why should dispersed copper bond to grains of silica and feldspar? Surely the fraction to search and analyse should be in the silt and clay, say minus 150-200-mesh?

That very simple concept, always too much trouble for industry, was tested eventually at Chibaluma Copper-Cobalt Mine where also there was no response from the soil traverses. Chibaluma was found by routine drilling along the strike of the Series des Mines, to the west of Nkana.

The problem was that the Chibaluma deposit was disseminated in arkose rather than argillite that is so common elsewhere in Zambia. The traverse revealed a gentle rise in the background content of copper from the basement conglomerate to the mineralized arkose above that could never be taken as anomalous. The only significant increase in copper was from the (barren) argillite in the hanging-wall. The dip was intermediate, the ground flat and forested, the soil cover thick, the contrast was low and the search moved on.

**Why minus 80-mesh in the streams, Dr ?**

Another fair question. And why do we select a stream and sample at 30 m apart all of the way down? Will we detect a mineral source cut by the stream, and trace it down in the style of an old-time prospector, pan and donkey *et al*? Have we no interest in dispersed-phase mineralization hidden in the minor tributaries?

The answers by those interested were to define the target. The British Geological Survey took very large samples in the streams, selected a sensitive size fraction for metals expected to be chemically dispersed, and made a concentrate in a very large, concave, and smooth wooden prospecting pan for the rest. The researchers in Scotland and Zimbabwe preferred minus 100-mesh <sup>(16)</sup>, and in South Africa, minus 200-mesh, depending upon the sand. It was really a problem of the supposed targets, speed, and the tools available for analysis.

The sample collection remained; you could either select a traverse along a stream bed or wetland drainage, or pre-select sample sites from air-photographs. In well-drained areas each site could represent the products of erosion from say 1.0 to 0.5 km<sup>2</sup> of catchment, and provided the pedology was consistent and poorly sorted samples were obtained, then the results should be compatible. 'Poorly sorted samples' leave much to the imagination, but the sample set should contain similar proportions of silt and clay fractions. Similarly, the analytical control samples should be from natural material from a similar environment. The idea that chemically pure elements could be mixed together (spiked), as control samples was simply a delusion and the results had no meaning.

### **The measure of contrast**

The reconnaissance soil exploration in Zimbabwe was concerned first with the Deweras Arkose, host to Mangula Copper Mine. Traverses were spaced at 305m apart, directed across the strike, and samples at about 20-23 cm depth were collected at intervals of 61m. The B-soil horizon was expected at that depth below a surface dominated by a grass-covered plain that obscured an extensive anticline beneath. The drainage was gentle with occasional areas of wetland that reflected enhanced contents of copper in the minus 80-mesh fraction. These anomalies were due to an increase in the proportion of silt and clay and to the accumulation of copper with the enhanced organic content of the soil; shame.

The exploration moved on towards Alaska and the headwaters of the Angwa River to find copper anomalies of different sorts. Many of these were ancient copper-smelter sites, several were on the river bank hidden in long grass with the advantage of water for those who worked the bellows. Others were in unlikely spots in the forest, long abandoned. In each case, the copper anomalies were characterised by high contrast and narrow spread. Some bothered to test the ground below the smelter sites, but others did not.

The Angwa Copper Mine was discovered from a smelter site in the alluvium of the west bank of the stream. George Woodward had never left any stone unturned, and a shallow pit sunk beneath the debris of wood-ash, smelter shards and charcoal, exposed arkose with abundant malachite. Bravo!

The same philosophy led to the relatively rich Shackelton Mine, about 2.65% Cu. The terrain was flat, there was no outcrop of arkose; just grass. The traverse line revealed one sample of 90ppm Cu as compared to the others at the background of 50ppm. There was no threshold to the anomaly, and the wagon drill holes, inclined against the assumed dip, defined a strike of only 60m!

In due course the stones were turned again and the minus 200-mesh fraction of that sandy soil revealed a peak of 72ppm as compared to a background of 6ppm, a contrast of x 12. Now nine consecutive samples on the traverse were anomalous. The sample attack was weak and devised to extract copper from a loose bond on the clay fraction. And how many other mines had we missed?

Years later and with the benefit of Shackleton well remembered, the traverses on the arkose at Alaska South were certainly anomalous. A wide stretch of grass in a semi-wetland, about 225m, was skirted by trees on each flank. The traverses over the grassland were anomalous as expected, but the soils from the bush beyond had a greater contrast than the grassland between! The rules were reversed. The wagon drill with a reach of 15m revealed a residual concentration of copper over the entire width of the traverse, slightly inclined up-dip at the eastern flank in the bush, flat in the central grass-covered zone, and an intermediate down-dip at the western end.

The resource was about 8 mT containing about 0.5% Cu. This was a form of residual anomaly, analogous to quartz rubble in the overburden that eventually dips to become the vein below; unusual and remarkable.

The new rules were to consider each set of results on their own merit and not to reject the single sample low-contrast anomaly. Employ the Arithmetik by all means, but as a final step in the interpretation. In no circumstances to leave any stone unturned!

**To be continued**

### **The Centennial Field Excursion to the Belingwe Greenstone Belt and the Great Dyke, 23<sup>rd</sup> – 25<sup>th</sup> October 2010 Led by Dr Tony Martin**

A group of some 34 eager participants assembled outside the Crown Plaza Hotel early on the morning of Saturday 23<sup>rd</sup> October, the day following closure of the two-day symposium that celebrated the hundred years of the Zimbabwe Geological Survey. Separating into a fleet of locally provided motor vehicles, in which our visitors were evenly spread, the object was to reconvene at the Nilton Hotel in Zvishavane in good time to draw breath and head for the field. See the team in the front-page photograph.

This was achieved, and we headed south out of town, past the Shabanie asbestos mine and the Sabi gold mine, to arrive at the famous, much visited Type-Section for the Manjeri Formation at the unconformity exposure of these Upper Greenstone or Bulawayan rocks over a granitoid basement of the Shabani Gneiss. The writer had first visited here in 1975 with Professor Preston Cloud and the full Belingwe Team comprising Tony Martin, Mike Bickle, Euan Nisbet and John Orpen, and again in September 1980 with the post-Independence excursion that included such visitors as Carl Annhaeuser, Richard Viljoen, Jay Barton, Maarten de Wit, Matt du Toit and Clive Barton, as well as Jim Wilson. Since then Tony Martin has led some hundreds of visitors on visits to the Belingwe Belt, and each time he says he learns more based on the animated discussions the various exposures provoke, sometimes controversially. On this occasion our Centennial group included in its ranks Euan Nisbet on a passionate re-acquaintance with his rocks, Mike Watkeys from UKZN, Sharad Master and Allan Wilson from Wits, Jan Kramer from Johannesburg University, Paul Mason from Utrecht, a goodly and necessary contingent from the ZGS and fine representation from our own society membership, a collection that left little doubt as to the caliber of discussion that was to ensue.

The group then proceeded to the Reliance Formation Type-Section, a tributary exposure of komatiitic lithologies that was traversed up from the Ngezi River confluence, where today no hippo reside. Missing out exposures of the Cheshire Formation conglomerate, the final stop of the day in the south-east of the greenstone belt involved a drive along the railway line before intercepting the Ngezi River upstream of our previous encounter. Here the group was treated to

superb exposures of basaltic pillow lavas, tuffs and breccias within the intervening Zeederbergs Formation. The renowned stromatolite exposures of the Cheshire Formation could not be visited on this trip due to their remoteness and our time constraint. The group returned to the Nilton in the gloaming for a well-earned beer and their memorable chicken or beef cuisine.

On day two the convoy proceeded west from Zvishavane across the Zeederburgs to the Mtshingwe Dyke cutting, which commands a view south to the Lower or Belingwean greenstone succession centred on the iron-formation of Belingwe Peak and the komatiitic Bend Formation deformed by the prominent and steeply NE-plunging syncline in that area. On and to the west exposures of the Lower Greenstones reveal a perceived volcanic vent within the intermediate Hokonui Formation, bearing the name of the farm that hosts Dadaya Mission and the former home of Garfield Todd, one-time Prime Minister of Southern Rhodesia. Then in the bed of the Dohwe River, right-bank tributary to the Mtshingwe, some superb exposures Hokonui pyroclastic flows were examined, and some members were distracted by the sight of gold tails in the pans of local *maporakosa* who work the gravels trapped between the rough rocky protuberances.

Perhaps the sequence that caught the imagination of most was that known as 'Hall's Flow' through the komatiitic Reliance Formation, particularly the columnar jointing and both olivine and pyroxene spinifex textures.



*Columnar jointing in a peridotite sill in the "Hall's Flow" exposure of the Reliance Formation, Belingwe Greenstone Belt, and Forbes for scale. Photo: TJB*

The final stop of the day was also to view komatiitic flows and tuffs of the Reliance Formation exposed in the Mtshingwe river bed close to the old NA antimony mine. Another stimulating day.

Breakfast on the 25<sup>th</sup> witnessed a few small presentations and thank you's, as some members were per force on their way. The group then departed east on the Masvingo road, across the Runde bridge before doubling back to the old low-level bridge where pavements of the banded Shabani Gneiss in the ancient Tokwe Segment are magnificently exposed, and have been viewed on innumerable occasions since the Granite'71 field excursion. Returning, a cutting on the main road exposes quartz gabbro of the East Dyke, satellite to the Great Dyke.



*Shabani Gneiss – AM explains with his upside-down map. Tony upon the MSZ at Bougai.*



Our return towards Harare along the road to Shurugwi and Gweru took us up the southern extent of the Shurugwi Sub-Chamber past active chrome mining and through cyclic units of Great Dyke pyroxenite and hartzburgite to the new Bougai platinum exploration camp south of Unki Mine. Here Tony Martin has been consulting and Allan Wilson was now in his element. With welcome drinks in hand the concluding remarks were expounded with Tony sitting on the actual exposure of the MSZ, perhaps uninspiring if one was not in the know. A fitting conclusion for our celebrations, and a wonderful, inspiring time was had by all. Thanks to Tony and all who put their effort into the trip's success.

*Tim Broderick*

## News



### Geology Department, University of Zimbabwe

*Maideyi Meck*

The Department is still struggling to come to life following the very dark three years that have seen it at its lowest ebb. Our fortunes have definitely risen from depth but we still have a long way to go. After taking an intake of students in January 2010, the Department did not manage to absorb another stream in August as expected. This was as a result of the fact that most people who were helping did not have their contract renewed or else they resigned for various reasons, which were as follows:

- Ms Danda to finish her PhD
- William Moyce to finish his M Phil
- N. Madari to study in the Netherlands
- M. Dzimba to join the mining Industry

The Department is currently trying to recruit graduate teaching assistants who will register for M Phil degrees and then help in teaching. If the Department registers at least 5 such students, we will be recruiting another stream of students to start in August 2011. Most of those students repeating from previous years graduated in October 2010. The Department has now managed to clear the backlog in teaching service courses to Engineering students. However, with the current staff the Department cannot re-introduce the Honours or Masters postgraduate programmes, which were last run in 2007 and 2006 respectively.

The remuneration to staff at the institute has improved and research money is now starting to become available. However, we in the Department will still need to pull together resources for the various mandatory field trips. The University and the students will share the costs for these trips, but we are making an appeal to industry for donations in cash or kind (food, fuel and manpower) to make the trips a success.

The Department received a year's tuition fee to support 5 students from Global TS mining company. Another mining house has promised to sponsor another 4 students. We in the Department wish to acknowledge this support from industry.

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DG Direct line/Fax:	263-4-303557			

**Note:** DG – Department of Geology; MRC – Mineral Resources Centre; GLF – Geology Lecture Fund.

## *Geological Survey Department*



**ZIMBABWE**

#### **A Century of Existence**

The year 2010 marked the attainment of 100 years since the establishment of the Geological Survey. The Department was founded in September 1910 in Bulawayo. Celebrations to mark this important milestone were held in October 2010. The celebrations included the vastly successful international symposium, organized by the Geological Society of Zimbabwe, which attracted earth scientists from many parts of the world to discuss various aspects of the geology of Zimbabwe. Many thanks go to the Geology Society committee, especially Andrew du Toit, for organizing the symposium. We wish to thank all those who attended both the technical sessions and the field trips, and helped to celebrate our centennial attainment.

To kick-start the proceedings a cocktail party was organized by the Ministry of Mines and Mining Development and was attended by several people including government ministers, captains of the mining industry, senior government officials and geoscientists. The Geological

Survey produced a review magazine, and printed T-shirts, hats and mugs to celebrate the event. Free copies of the magazine are available at Maufe Building for those who are interested whilst T-shirts, hats and mugs are on sale at nominal prices.

### **Staffing matters**

The Department announces the retirement of **Mr Dennis Bob**, Senior Laboratory Assistant, who joined the Geological Survey in 1973. He is the longest serving member of staff and his retirement is with effect from 31<sup>st</sup> January 2011. Dennis is still very fit, and companies may wish to consider to take advantage of his hard-won experience in rock cutting, slide making, rock polishing and sample preparation and panning.

The Department has been fortunate in that several short courses in mineral exploration, remote sensing and Geographical Information Systems were sponsored by certain international organizations during the year. These courses are proving to be important in enhancing the technical capacity of staff in the Department. Two geologists are currently in India attending a training course in mineral exploration and remote sensing.

The Geological Survey has entered into Memoranda of Understanding with international organizations that include the China Geological Survey, the Geological Survey of Iran, the Korea Institute of Geosciences and Mineral Resources, and the Japan Oil Gas and Metal Corporation. The most important aspect of these MOU's is in the training and exchange of professional and technical staff.

Since October last the Director, **Temba Hawadi** attended the Mining Indaba and the Africa Mining Partnerships meetings in Pretoria, South Africa, and he was in China as a board member for Anjin to attend meetings in Anhui.

**Forbes Mugumbate**, Deputy Director, is a member of a committee assembled to advise on indigenization in the mining industry. He attended the China Mining 2010 Conference in Tianjin and visited the Anhui Province. He also attended the African Caribbean and Pacific country Conference for Ministers responsible for mining that was held in Brussels, and he was a delegate at the Global Commodities Forum in Geneva.

**Fadzanai Mupaya**, Chief Geologist, attended meetings of the Pan African Mining Development Company as a Board Member in South Africa and at Victoria Falls.

**Ernest Mugandani**, Senior Geologist attended a mineral exploration and remote sensing training course in Seoul, South Korea and was accompanied by geologist, **Mukai Mangezi**.

Senior Geologist, **Sibongubuhle Mpindiwa**, attended a training course on radiation protection in Kampala, Uganda and, with **Mitchell Maisera**, Geologist, was also at a GIS training course in India. Mitchell was also a delegate at the SADC Mineral Database Workshop in Namibia.

Geophysicists **Mathias Ngoro** and **L. Shawarira** and Geologist, **Tendai Kashiri** attended a mineral exploration and remote sensing course in India.

*Forbes Mugumbate and Bornwell Mupaya*

## MINING INDUSTRY NEWS

*Mitchell Maisera*

With stabilization of the Zimbabwe economy, there has been some positive growth in our mining sector. However, this has been more to do with the global increase in metal prices than to the development of new mineral discoveries. In general, the Great Dyke platinum companies have been very busy with exploration of the MSZ in all the sub-chambers. Events that transpired during the period October 2010 to January 2011 are summarized below.

### **The Mining Indaba**

UTHO Capital facilitated the second Mining Indaba, which was held from the 15<sup>th</sup>-16<sup>th</sup> September in Harare. The event attracted about 800 stakeholders and served as a valuable channel for the global mining industry and investors to cultivate long-term relationships with Zimbabwe's mining interest groups. There were more small-scale miners at the Indaba than at the previous meeting, many of them seeking investment partners. Such positive interaction could lead to the development of more mines, provided the mine owners are able to present soundly evaluated projects.

### **Platinum**

**Zimplats'** recent investment and expansion programme demonstrates the company's confidence in Zimbabwe, and their example should send strong signals to other investors who are sitting on the fence.

Zimplats has invested more than US\$100 million in a number of social projects in their development of the Turf Growth Point. The company has built several houses for its employees, funded a 132 KV ZESA power line, a US\$25 million substation at Selous, a fibre optic line, access roads to areas linking Turf and surrounding villages, a weir and water reticulation, as well as upgrading the nearby council schools and clinic.

**Mimosa** also contributes towards community empowerment and has over the years presided over a number of corporate social investment programmes in the areas of education, health, institutional and infrastructure development, social welfare and housing.

Mimosa Mine recorded a 10% decline in revenue to US\$69 million during the quarter October to December 2010. It also registered a 14% drop in overall ore production, which declined to 560,142 tonnes. It is hoped that the situation will improve.

**Zimari Platinum** at Selous had almost gone half way through its first phase of drilling by end of year. On social responsibilities it has made a difference to Saruwe Secondary School in Chegutu. In co-operation with the school staff and the parents, Zimari renovated the classrooms. They also supplied teaching materials and 700 textbooks, and helped Chegutu Rural District Council Clinic with funding for the renovation of the children's and maternity wards.

### **Gold Mining**

**Mwana Africa** announced that it had placed new ordinary shares to raise US\$8 million for the second phase of an expansion programme at its Zimbabwean gold mining concern, the Freda-Rebecca Mine. The company reported that it had reached the first phase target rate of 30,000 ounces per annum after producing 11,920 ounces between March and September to generate US\$14,8 million in revenue.

**Blanket Mine** managed to meet its annual target of 40,000 ounces in 2010, with production accelerating after the commissioning of the number 4 Shaft expansion project in September.

**The Chamber of Mines** has emphasized that the gold sector will need at least US\$3,5 billion in fresh capital injections to finance capital expenditure in order to double gold production in the next five years.

**New Dawn** signed a continuous power supply contract with ZESA in November. This is to ensure uninterrupted power to the Turk and Angelus gold mines in a move to ramp up their production. They hope to increase output from the mines to around 100,000 ounces in the next five years, up from the current annual output of 50,000 ounces. The company now claims both the gold resource and mining capability to support a consolidated annual production of 50,000 to 60,000 ounces within the next 18-24 months. They doubled their Zimbabwe gold resource quoting a total measured and indicated mineral reserve of 1,558,400 ounces of gold grading 2,3 g/t. The Corporation registered a 48,8% increase in its gold output during the quarter ending in December as production improved at Turk Mine and on the central African Gold properties.

### **Diamond Mining**

Zimbabwe received Kimberley Process authorization to conduct additional sales of diamonds mined from Marange between 2006 and 2009. The Minerals Marketing Cooperation of Zimbabwe is to handle the operational modalities of the sales. In 2010 diamond exports grew by 73% (to US\$110 million). In 2010 **Murowa Diamonds** increased its output by 69% to 178,000 carats as Rio Tinto's share of Murowa's total production during the period topped 139,000 carats up from 97,000 in 2009. A total of 384,000 tonnes of ore were processed compared to 267,000 tonnes in 2009.

### **Coal**

There has not been much exploration on the eight coal Special Grants that have been granted, despite the huge demand for coking coal. The coal reserves for Hwange's dragline pit, which feed the country's largest power station, are running out. However, Chaba and 3-Main Underground mines have significant resources of metallurgical grade coal.

### **Chrome**

Recently there has been an outcry over certain companies that have been mining chrome along the Great Dyke without applying proper rehabilitation strategies. Government mine inspectors and those from the Environmental Management Agency moved in quickly to shut these operations down. These poor mining practices could be curtailed if the government does not extend the window for the export of alluvial/eluvial chrome concentrates, set to expire in March 2011.

### **Indigenisation Policy**

The government is working on the statutory instruments to give effect to its policy on the state's participation in all mining ventures. The policy provides for the government or indigenous Zimbabweans to hold at least a 51% interest in all mining ventures and 100% stake in all new alluvial diamond projects. Hopefully, this issue will be finalized soon so that investors are clear on the modalities of how the 51% stake is attained.

## News about Zim Geoscientists

We hear that **Ellah Muchemwa** has been transferred to Namibia on promotion and has had to resign her position as Second Vice President to the Chamber of Mines. We congratulate her on what must be a well-considered career move. Makorokoto!

We can confirm that **Paul Dirks** and **Tom Blenkinsop** survived the recent floods and then the mammoth cyclone that affected Queensland recently. All were battened down and holed up in their bathrooms, but miraculously the eye of 'Yasi' passed between Townsville and Cairns. Remarkably little damage was caused aside from numerous trees being uprooted and a few roofs blow off. Paul and Tom lost their power but **Eric Roberts'** did not, so they all ended up at Eric's, over a bottle of Shiraz no doubt.

We would like to offer our sincere condolences to **John Orpen** and his family over the recent passing of their daughter, Judy, following an operation to her foot.

**Please provide us with news about yourself or other geologists. We need to keep in touch with all of you out there. E-mail [dchatora@gmail.com](mailto:dchatora@gmail.com) or [makari@zol.co.zw](mailto:makari@zol.co.zw)**



## GSZ Research and Development Fund

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

## Conferences

**GeoSynthesis 2011**, 28 August – 2 September, 2011, Cape Town International Convention Centre, South Africa. Integrating the Earth Sciences – Africa's Crust & Mantle, Mineral & Hydrocarbon Resources, Energy, Geoheritage and Geofuture. [www.geosynthesis.org.za](http://www.geosynthesis.org.za)

**10<sup>th</sup> International Kimberlite Conference**, 6 – 11 February, 2012, Bangalore, India.  
[10ikcbangalore.com](http://10ikcbangalore.com)

**The 23<sup>rd</sup> International Geological Congress**, Cape Town, South Africa – 2016.

**GEOLOGICAL SOCIETY OF ZIMBABWE:  
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Ashanti Gold  
Canister Resources  
Casmyn Mining (Pvt) Ltd  
Chamber of Mines  
Duration Gold Zimbabwe (Pvt) Ltd  
Goldsearch Technical Services  
Metallon  
Mineral Resources Centre, UZ  
Pan African Mining  
Platinum Exploration Ventures (Pvt) Limited  
Rio Zim  
Samrec Vermiculite Zimbabwe (Pvt) Limited  
Sandvik  
SMC  
Trojan Nickel Mine  
Zimari Holdings  
Zimbabwe Mining Investments  
Zimbabwe Platinum Mines Limited