doi: 10.1255/tosf.5

Sampling conferences in South Africa

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In response to the rising interest in sampling in the minerals industry and the consistent educational input from international experts such as Francis Pitard, Dominique Francois-Bongarcon, Geoff Lyman and Kim Esbensen, three sampling conferences, forums for the expression of interest and research, have been held in South Africa over the past eight years. This has been a somewhat slower pace than that set by the Australian Institute of Mining and Metallurgy (AusIMM) who have arranged biannual sampling conferences in Perth since 2006. The first of the South African sampling conferences was entitled "Exploration, Mine, Met and Environmental Sampling" (EMMES 2005), held at the Eskom Conference Centre on 3–4 November 2005. The conference was presented under the auspices of the SAIMM in conjunction with the Geostatistical Association of Southern Africa (GSSA) and the Geological Society of Southern Africa (GSSA). The second conference specifically dedicated to sampling was the World Conference on Sampling and Blending 2009 (WCSB4) held in Cape Town in October 2009, and organised through the SAIMM. However, only 4 of the 35 conference papers presented were by South African authors, indicating that participation was very strongly skewed to the international community, whose support for this conference, by the way, was greatly appreciated.

The paucity of contributions from the South African sampling fraternity at WCSB4 emphasised the need for a local sampling conference at which those involved in day-to-day sampling activities on mines, in milling plants, in coastal loading terminals and in laboratories could be drawn to present the good work in sampling that they are doing. On this basis a third conference dedicated to sampling and entitled "Sampling and Analysis: Best-practice in African mining", with the sub-title "Reducing operational risk using sampling and assay" (SAIMM, Symposium Series S75), was proposed and organised. The conference was held at Misty Hills in the Muldersdrift area from 4 to 6 June 2013 with over 150 delegates registered for the conference. Of the 45 papers presented only three were by international speakers, namely Isobel Clark, Ralph Holmes (Keynote address) and Dominique Francois-Bongarcon.

For both of the non-WCSB conferences, Mr Hugh Bartlett was the Chairman of the Organising Committees. The substance and content of topics and papers presented between 2005 and 2013, as well as the progression of the level of research as recorded in the forewords to the conference proceedings (2005 and 2013), is noteworthy. In the foreword to the first conference, Bartlett (2005) emphasised that the conference was to be seen as a forum in which industry standards (of sampling) for exploration, mining and metallurgical processes for all commodities including coal, iron ore, diamonds, base metals, gold and platinum, could be discussed. He also emphasised that the application of sampling as the basis for resource and reserve estimation and metallurgical accounting had to be underpinned by good statistics. Questions such as the correctness of samples, ensuring unbiasedness, sample mass and methods for appropriate sample recovery and preparation were mentioned as being of utmost importance, and the reliability of assays, the use of certified reference materials and the issues surrounding quality assurance and quality control in the laboratory occupied an important place in the conference (Bartlett, 2005). In the foreword to the second conference Bartlett (2013) widened and deepened the scope of issues to be covered. He noted that sampling and sample analysis are the foundation of the minerals industry being essential at all stages of the value chain, from exploration and face sampling, to blast-hole sampling, in-mine grade control, ore processing and handling, metallurgical sampling, sub-sampling in the laboratory, as well as the analysis of standards and duplicates in maintaining quality control in the laboratory. The importance of sampling in trade of commodities, concentrates and residues for toll treatment was also highlighted.

Table 1. Major topics, papers presented and authors at the EMMES Conference, 2005.

QA/QC topics	**Standards and laboratory monitoring: Two key components of best practice assay quality control in the gold mining industry.** K. Kenyon, *AngloGold Ashanti Ltd* **Manufacture and use of reference materials.** M. McWha, *AMIS Mineral Standards* **Best practice—Methodology for production and use of reference materials for the platinum industry.** R. Sheets and D. Grant, *Applied Geology Services* and G. Chunnett, *Anglo Platinum* **Why mine/matrix matched certified reference materials.** C.J. Oats, *Anglo American PLC* **QA/QC at the Mineral Resource Management section of Sishen Mine.** J.H. Sullivan, *Sishen Iron Ore Mine* **Assay quality assurance—Quality control procedures at Goldfields Ghana Limited, Tarkwa Gold Mine.** S.D. Woods and R.N. Boryor, *Gold Fields Ghana Limited* **A practical quality assurance and quality control procedure for gold estimation in a deep level South African mine.** V. Govindsammy, *AngloGold Ashanti Ltd* **Analytical uncertainty component: The role of the laboratory.** V. Anderson, L. Duggan, S.H. Dry and R. Holdsworth, *Anglo Research* **Practical due diligence in fire assay.** D. du Preez, *Assay Tech*	9
Theory of sampling issues	**The imperatives for sampling and evaluation in SA mining industry.** P. Charlesworth, *Guest Speaker* **Determination of correct sample size and preparation method.** G.P.L. van der Linde, *Hotazel Manganese Mines* **An empirical assessment of GYs sampling constants K and Alpha using a broken rock model.** R.C.A. Minnitt, *Wits University* **The economic benefits of good sampling practices.** F. Pitard, *Guest Speaker* **Sampling standards.** C. Spangenberg, *AngloGold Ashanti Ltd* **Separation of errors in sampling and analysis.** H.E. Bartlett, *Hugh Bartlett Consulting* **Chemical measurement system analysis for a manganese metal production process.** R.C.A. Minnitt, *Wits University*, T. Gluck, C. Bothma and P.V. Savage, *Manganese Metal Co. (Ply) Ltd*	7
Sampling equipment	**Sampling tool project at AngloGold Ashanti Ltd.** R. Barnard, *AngloGold Ashanti Ltd* **Development and conceptual evaluation of a methodology for sampling for diamonds in broken ore.** S.J. Coward and J. Ferreira, *De Beers Mineral Resource Research and Development Unit* **Isokinetic emission testing.** R. Bissett and A. Jansen (presenting), *ECOSERV Environmental Consulting Services* **The use of radio frequency transponders in density tracers to conduct densimetric analysis.** D. van der Merwe and P. Fouche, *Kumba Resources* **An innovative and practical approach to sampling of slurries for metallurgical accounting.** R. Boyd, *Thermo Gamma Metrics (Ply) Ltd* **Cross belt sampler versus cross stream sampler.** W.S. Hefer, *Kumba Resources* **Development of a RF tracer for use in the mining and minerals processing industry, for ore tracking and blending.** P. Fouche, *Kumba Resources* (PRESENTATION ONLY) **The bulk sample preparation plant at Driefontein.** A. Fouche, *Gold Fields West Wits Analytical Laboratory*	8
Coal industry	**Sampling in the coal industry.** G.J. de Korte, *CSIR*	1
Metallurgy	**Sampling for cyanide in metallurgical processes.** P.W. Lotz, *Mintek* **An innovative and practical approach to sampling of slurries for metallurgical accounting.** R. Boyd, *Thermo Gamma Metrics (Ply) Ltd* **Improvements in metal accounting at Black Mountain.** J. Taylor, *Black Mountain*	3
Platinum	**The analysis of sulphur in the South African PGM smelting industry.** A.D. McKenzie, *Mintek* **Slurry sampling of toll PGE concentrates at Impala Platinum Ltd.** D. Adams, Impala Platinum and H.E. Bartlett, *Hugh Bartlett Consulting* **Confidences in metallurgical balances estimated from the errors in mass measurement, sampling and analytical determinations.** H.E. Bartlett, *Hugh Bartlett Consulting*	3
Diamonds	**Application of conditional simulation to optimise sampling diamond placer deposits.** S. Duggan, *De Beers Group Services* **Sampling considerations for determination of process efficiency within a diamond processing flow sheet.** R. Machowski, *De Beers Group Services (Ply) Ltd* **Correlations in dilution within the process plant at Snap Lake, De Beers, Canada—A practical sampling approach.** R. Machowski, *De Beers Group Services (Ply) Ltd* **Use of enterprise architecture in sampling programmes.** R.M. Irvine, *De Beers Group Services*	4
Environmental	**Environmental assessment, monitoring and interpretation.** J. Perkins, *Biotrack (Botswana) (Pty) Ltd* and M. Dangerfield, *Biotrack (Australia) (Pty) Ltd*	1

Conference content

A comparison of the content at each of the conferences is enlightening and interesting. The titles and authors of papers presented at the 2005 conference are listed in Table 1, with those for the 2013 conference listed in Table 2. Perhaps the most obvious difference in the conferences is the number of papers presented at each, 35 for the EMMES (2005) and 45 for the "Sampling and Analysis: Best-practice in African mining" (2013).

A simple comparison of the information in Tables 1 and 2 indicates that there is a growing interest between 2005 and 2013 in the topic of the theory and practice of sampling in South Africa. It also reflects a growing body of sampling "champions" in the industry, and a new-found awareness of the importance of sampling in the minerals industry. The scope of topics covered is also

Table 2. Major topics, papers presented and authors at the Sampling and Analysis: Best Practice 2013.

QA/QC topics	**Between laboratory biases; same sample, different answers. Guidelines?** M. McWha **Current practices in analytical laboratory QAQC.** N. Mackenzie **Quality control and quality assurance case studies for the analysis of precious and base metals.** K. Lomberg and R. Mckinney **A new control chart for QA/QC analysis.** D. Francois-Bongarcon **Best practice in quality assurance: determination of the sampling fundamental error.** G. Lyman, E. van Tonder and R. Schoustra	5
Sampling practice	**The "simulated chip-sample model" as a method for quantifying error and bias in sampling thin carboniferous reef types.** D. Fourie and R.C.A. Minnitt **Quality control and assurance of underground chip sampling at Kopanang Mine, South Africa.** A. Pillay, T. Flitton and B. Freese **Keynote address: Kumba iron ore product quality management systems.** N. Hannweg **Practical application of Venmyn Variance Towers to define data density and the number of boreholes needed.** A.N. Clay, T.C. Orford and J.A. Myburgh **Improved sampling of concentrate dispatched to smelter.** K. Tshimanga **Sampling of lumpy ore and ferroalloys manually by thin layer method.** M. Turner	6
Theory of sampling issues	**Keynote address: Sampling in the South African minerals industry.** R.C.A. Minnitt **Keynote address: Critical importance of sampling in trading mineral commodities.** R. Holmes **An overview of sampling best practice in African mining.** I.C. Spangenberg and R.C.A. Minnitt	3
Reporting codes	**The understanding and importance of sampling in the SAMREC code.** K. Lomberg **International reporting standards for exploration results, mineral resources and mineral reserves with particular reference to sampling techniques and data.** R. Dixon **Sampling—a critical component in delivering accurate and representative test results as the basis of trade in commodities and the role of relevant international standards and conformity assessment procedures and infrastructure.** G. Visser **Sampling for mineral resource definition.** H.F.J. Theart	4
Sampling equipment and software applications	**An overview of SGS Minerals Services' global geochemical laboratory quality management system.** R. Galow, J. Bowden, S. Khan, M. Labuschagne and V. Murphy **The evaluation of sampling and assay data via customized IMP programs.** H. de Roos **Managing a fully automated robotic laboratory: experiences from Anglo American Platinum's EBRL.** J.P. Le Roux **Mechanical sampling-a manufacturer's perspective.** R.C. Steinhaus and R.C.A. Minnitt **Challenges of retrofitting sampling equipment into existing belt conveyor transfers.** D. Stevens and H. Mostert **Pitfalls in Vezin sampling for finely crushed materials.** C. Kruger and E. van Tonder **Automated sampling and analysis of iron ore for export from the Saldanha iron ore terminal in South Africa.** P. Hofmeyr and D. Pretorius	7
Analytical procedures	**The use of XRD analysis in the sampling and materials balance of low-grade iron ores and sinters.** J.P.R. de Villiers **Advances in automated wet chemistry technology to enhance process control.** A. van der Westhuizen **Comparison of laboratory sub-sampling methods.** P. Qeqe and E. van Tonder **Best practice for weighted compositing: Introducing the VSSD.** E. van Tonder and Z. Marais **Comparison of Carius tube and microwave digestion of PGM concentrate and ICP-OES analysis.** D. Surender	5
Coal industry	**Sampling the coal chain.** P.E. Hand **Practical considerations for bias testing of coal sampling systems.** A.R. Johns	2
Gold	**Sample support size and spacing determination for resource development of a marine placer gold deposit.** P. Saravanakumar, G.J. Brown and G. Van Eck	1
Base metals	**The trials and tribulations of sampling on a copper concentrator.** C.B. Kohler and T.C. Brink	1
Metal accounting and metallurgy	**Metal accounting and corporate governance.** P.G. Gaylard, N.G. Randolph and C.M.G. Wortley **From metal to money: the importance of reliable metallurgical accounting.** D. Seke **Perspective on grade and tonnage reconciliation at Kopanang Mine, Vaal River District, South Africa.** D. Francois-Bongarcon and A. Johnson **Mine to metal: a practical balance for a large platinum producer.** M.J. Liebenberg and H.E. Bartlett **The allocation of gold production from multiple shafts feeding a common treatment plant using run-of-mine sampling of ore deliveries.** L. Korff, H.E. Bartlett and R.C.A. Minnitt **Gold accounting across CIUCIP circuits.** D. Clemente and H.E. Bartlett	6
Platinum	**Platinum group metals: Best practice sampling methods, assay techniques and quality control.** K. Lomberg **Mogalakwena Platinum Mine: world-class sampling for a world-class PGE, Cu, Ni mine.** R. Brazier	2
Diamonds	**Determination of sampling configuration for diamondiferous gravel occurrence using geostatistical methods applied to a probe drill platform.** J. Jacob, C. Prins and A. Oelofsen	1
Environmental	**Keynote address: Environmental sampling—overview.** E.M. Cukrowska, H. Tutu and L.K. Chimuka	1
Uranium	**Uranium exploration analysis.** D.R. Young	1

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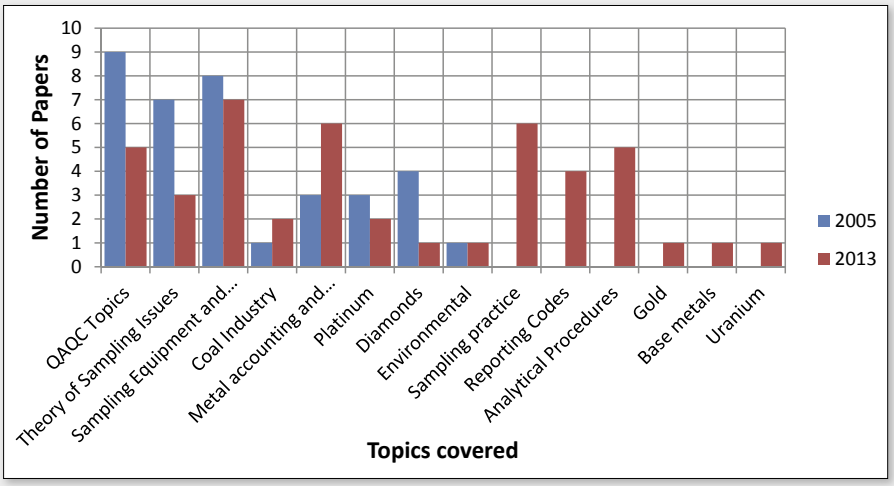

Figure 1. A histogram of the number of papers and the range of topics covered in the 2005 (blue) and 2013 (red) sampling conferences held in South Africa.

different from the 2005 conference to the one held in 2013, the numbers of papers and the topics presented being shown in Figure 1. This diagram is interesting in that QA/QC related topics (nine papers) were highest in 2005 with approximately half the number of papers on this topic in 2013 (five papers). Other issues that ranked high in 2005 were around the Theory of Sampling (seven papers) and sampling equipment and related software (eight papers). In 2013 sampling equipment topics were represented by the highest number of papers (seven), with metal accounting and sampling practice being covered by six papers each. Topics relating to QA/QC and analytical procedures were covered in five papers each, followed by issues around reporting codes (four papers) and the Theory of Sampling (three papers).

It is also interesting to note that commodity-specific papers on different sampling topics began to emerge in the 2013 conference, something that tended to be missing in the 2005 conference. In addition the topics on sampling practice, reporting codes and analytical procedures, not seen in the 2005 conference, were strongly represented in the 2013 gathering.

It should be noted that it was never the intention of the South African sampling conferences to become misaligned with what is happening globally through the WCSB and Australian conferences in trying to promote good sampling practice. Some unfortunately saw the South African conference as an attempt to upstage the WCSB conferences and the efforts being promoted in Australia. This was never the case. Instead we as organisers recognised that a lot of excellent work was being done in South Africa, but nowhere was there a forum for this cohort of sampling practitioners to express and showcase their sampling best practice. It was also felt that many South Africans were standing aside to look on as the show took place elsewhere in the world.

The very positive and ready response from the South African sampling fraternity and the strong support from sampling equipment manufacturers for the latest conference indicate that a vibrant community interested in promoting best sampling and analytical practice is alive and well in South Africa.