



The South African Institute of Mining and Metallurgy
Founded in 1894

SYMPOSIUM SERIES S39

The Third Southern African Conference on

Base Metals

*'Southern Africa's response to changing global
base metals market dynamics'*

CONTENTS

26-29 JUNE 2005

KITWE, ZAMBIA

THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY

SYMPOSIUM SERIES S39

The Third Southern African Conference on Base Metals

*'Southern Africa's response to changing global base
metals market dynamics'*

THE SOUTH AFRICAN INSTITUTE OF MINING AND METALLURGY
JOHANNESBURG 2005

SAIMM PUBLICATIONS

THE MONOGRAPH SERIES

- M1 **Lognormal-De Wijsian Geostatistics for Ore Evaluation**
(2nd ed. 1981) D.G. Krige
- M2 **An Introduction to Geostatistical Methods of Mineral Evaluation**
(2nd ed. 1981) J.-M.M. Rendu
- M3 **Principles of Flotation**
(1982) (3rd imp. 1986) Edited by R.P. King
- M4 **Increased Underground Extraction of Coal**
(1982) Edited by C.J. Fauconnier and R.W.O. Kersten
- M5 **Rock Mechanics in Mining Practice**
(1983) (3rd imp. 1986) Edited by S. Budavari
- M6 **Assay and Analytical Practice in the South African Mining Industry**
(1986) W.C. Lenahan and R. de L. Murray-Smith
- M7 **The Extractive Metallurgy of Gold in South Africa,**
2 volumes (1987) Edited by G.G Stanley
- M8 **Mineral and Metal Extraction — An Overview**
(1994) L.C. Woollacott and R.H. Eric
- M9 **Rock Fracture and Rockbursts—an illustrative study**
(1997) Edited by W.D. Ortlepp

THE SPECIAL PUBLICATIONS SERIES

- SPI **Proceedings, Underground Transport Symposium**
(1986) Edited by R.C.R. Edgar
- SP2 **Backfill in South African Mines** (1988)
- SP3 **Treatment and Re-use of Water in the Minerals Industry** (1989)
- SP4 **COREX Symposium 1990** (1990)
Edited by H.M.W. Delport and P.J. Holaschke
- SP5 **Measurement, Control, and Optimization in Mineral Processing**
(1994) Edited by H.W. Glen
- SP6 **Handbook on Hard-rock Strata Control**
(1994) A.J.S. Spearng
- SP7 **Rock Engineering for Underground Coal Mining**
(2002) J. Nielen van der Merwe and Bernard J. Madden
International Mineral Prcessing Congress (2003)

SUPPLEMENT TO THE SAIMM JOURNAL

- J1 **The Metals and Minerals Industry in South Africa—Part 1 (1989)**
Edited by H.W. Glen

THE SYMPOSIUM SERIES

- S1 **Mathematical Statistics and Computer Applications in Ore Valuation**
(1966)
- S2 **Planning Open Pit Mines**
(1970) (4th imp.) Edited by P.W.J. van Rensburg
- S3 **Application of Computer Methods in the Mineral Industry**
(APCOM 1973) Edited by M.D.G. Salamon
- S4 **Infacon 1974**
Edited by H.W. Glen
- S5 **Proceedings of the 12th CMMI Congress**
2 volumes (1982) Edited by H.W. Glen
- S6 **Rockbursts and Seismicity in Mines**
(1984) Edited by N.C. Gay and E.H. Wainwright
- S7 **The Planning and Operation of Open Pit and Strip Mines**
(1986) Edited by J.P. Deetlefs
- S8 **GOLD 100: Proceedings of the International Conference on Gold (1986)**
Volume 1: Gold Mining Technology
Edited by H. Wagner and R.P. King
Volume 2: Extractive Metallurgy of Gold
Edited by C.E. Fivaz and R.P. King
Volume 3: Industrial Uses of Gold
Edited by G. Gafner and R.P. King
- S9 **APCOM 87: Proceedings of the Twentieth International Symposium on the Application of Computers and Mathematics in the Mineral Industries (1987)**
Volume 1: Mining
Edited by L. Wade, R.W.O. Kersten and J.R. Cutland
Volume 2: Metallurgy
Edited by R.P. King and I.J. Barker
Volume 3: Geostatistics
Edited by I.C. Lemmer, H. Schaum and F.A.G.M. Camisani-Calzolari
- S10 **International Deep Mining Conference (1990)**
Volume 1: Innovations in Metallurgical Plant
Edited by G.A. Brown and P. Smith
and
Application of Materials Engineering in the Mining Industry
Edited by B. Metcalfe
Volume 2: Technical Challenges in Deep Level Mining
Edited by D.A.J. Ross-Watt and P.D.K. Robinson
- S11 **Infacon 6 (Incorporating Incasac) (1992)**
Edited by H.W. Glen
- S12 **Massmin 92**
Edited by H.W. Glen (out of print)
- S13 **Minefill 93**
Edited by H.W. Glen
- S14 **XVth CMMI Congress Publications (1994)**
Volume 1: Mining
Edited by H.W. Glen
Volume 2: Metals Technology and Extractive Metallurgy (1994)
Edited by H.W. Glen
- S15 **Surface Mining 1996**
Edited by H.W. Glen
- S16 **Hidden Wealth (1996)**
Edited by H.W. Glen
- S17 **Heavy Minerals 1997**
Edited by R.E. Robinson
- S18 **The 8th International Platinum Symposium (1998)**
- S19 **Mining in Africa '98**
- S20 **Extraction Metallurgy Africa '98**
- S21 **Sixth International Symposium for Rock Fragmentation by Blasting (1999)**
- S22 **Metallurgy Africa '99**
- S23 **Heavy Minerals 1999** Edited by R.G. Stimson
- S24 **Tunnels under Pressure** Technical Editor T.R. Stacey
- S25 **Mine Hoisting 2000**
- S26 **Coal-The Future (2000)**
- S27 **The Fifth International Symposium on Rockburst and Seismicity in Mines (RaSim 5) (2001)**
- S28 **6th International Symposium on Mine Mechanization and Automation (2001)**
- S29 **XIV International Coal Preparation Congress and Exhibition**
- S30 **Surface Mining 2002—Modern Developments for the New Millennium**
- S31 **IFSA 2002, Industrial Fluidization South Africa**
- S31A **APCOM 2003—Application of Computers and Operations Research in the Minerals Industries**
- S32 **ISSA/Chamber of Mines Conference—Mines and Quarries: Prevention of Occupational Injury and Disease**
- S33 **ISRM—Technology Roadmap for Rock Mechanics**
- S34 **Heavy Minerals Conference 2003**
- S35 **Safety in Mines Research Institutes (2003)**
- S36 **VII International Conference on Molten Slags, Fluxes & Salts (2004)**
- S37 **Tenth International Ferroalloys Congress INFACONX 2004**
- S38 **International Platinum Conference 'Platinum Adding Value'**

Published by The South African Institute of Mining and Metallurgy
Fifth Floor, Chamber of Mines Building, 5 Hollard Street, Johannesburg, 2107
Republic of South Africa

© The South African Institute of Mining and Metallurgy, 2005

ISBN 1-919783-74-1

All papers printed in this publication have been reproduced directly from copy supplied by the authors. The Institute therefore takes no responsibility for any errors or changes that may have occurred in the transferring of documents between systems.

Wherever possible, quality control checks have been exercised

Foreword

The Southern African Conference on Base Metals started out in 2001, as a modest concept to get the local base metals industry together. The first conference held in Zimbabwe in 2001, proved to be a huge success and was followed by the second conference in 2002 in South Africa.

After a bit of a lapse, the third conference is being held in Kitwe in Zambia. Because of the strong global demand experienced by all base metals, it is most appropriate to have this conference in the midst of the Copper Belt. Although the current climate is good for base metals, it was not too long ago that most of the base metals' experienced poor demand and very low prices. It is therefore extremely important that the base metals industry, separately and collectively, ensures that we add value for all stakeholders. This we can achieve by being cost-efficient, maximizing revenues, applying scientific and engineering principles innovatively, but above all, by sharing knowledge amongst each other.

Hence this conference is the ideal opportunity to share information, learn new things and establish networks.

It is therefore with great pleasure that I welcome all delegates, from Southern Africa, but also from further afield, to the 3rd Southern African Conference on Base Metals. I trust that you will find the proceedings valuable, will partake in all the deliberations and get maximum value from the conference.

I want to extend a big word of thanks to the members of the organising committee, the secretariat of the SAIMM, our sponsors and the hosts of our post-conference tours. Without your willingness and dedication, this event would not have been!

Finally, I want to dedicate these proceedings to Aubrey Mjacu, a member of the Organising Committee, who recently passed away after a short illness. Aubrey we will miss you dearly!

Willem van Niekerk
*Chairman,
Organising Committee*

Contents

Page No.

SESSION: PLENARY

Strategic outsourcing and the degree to which it may support the successful growth of the Zambian Copper Mining Industry C. Heili	1
A technical and operational audit of the first 10 years of the Teniente converter operations at Nkana smelter M. Syamujulu	43
Reducing/eliminating gas emissions from Pierce Smith converters H.J. Le Roux and W.B. Drummond	71
The explosive character of zinc dust: A case study W.H. van Niekerk, C. van Heerden, K. van Dyk, E.H.O. Meyer	87
Metals and alloys water solidification—A bridge from pyro-to hydro-metallurgy D. Norval	97
Development of a RF tracer for use in the mining and minerals processing industry J.A. Rabe, P.A.P. Fouche, K. O'Neill	107
Management of mining projects—The relationship between the client, clients project team and the EPCM project team and Why projects fail C.A.F. Sweet and L. Stilwell	127
An integrated approach of waste issues on metallurgical sites G. Devos	135

PARALLEL SESSION ONE: METALLURGY

The application of cyclic voltammetry coupled with Surface Plasmon Resonance measurements to thiol-collector interactions with gold surfaces D.R. Groot, S.H.M. Harkema, and M.K.G. Vermaak	149
The effect of mode of occurrence of galena and sphalerite on the selective flotation of ore samples from the Rosh Pinah Mine M.D. Seke and P.C. Pistorius	161
Recent developments in flotation reagents to improve base metal recovery W.A. Grobler, S. Sondashi, and F.J. Chidley	185
Some aspects of laboratory flotation of Co-Cu minerals from mixed oxide ores A.F. Mulaba-Bafubiandi, and D.T. Bell	191
Advancing comminution and flotation performance with advanced process control G.C. Smith, A. Singh, and V.C. Smith	201
Recent developments at Zincor J.P. van Dyk	217

PARALLEL SESSION ONE: MINING

Applications of fibre-reinforced shotcrete (fibrecrete) support in drifts at Nchanga underground mine S. Mundike and M. Lipalile	225
Geotechnical considerations in the design of the MOCB mining method at Konkola No. 3 Shaft M. Lipalile, A.W. Naismith, and A.B. Tunono	235

Ground conditions and support systems at 1 Shaft, Konkola Mine, Chililabombwe, Zambia C. Katongo	253
Refrigeration and ventilation design for the deepening of Mindola Copper Mine D.O. del Castillo, M. Biffi, M. Dawborn, and D. Noort	281
Mechanised mine development utilising rock cutting and boring through raise and blind boring techniques	297
P.H. Ferreira	
Electronic delay detonators—a unique solution to pertinent mining problems R. Banda and N. Rhodes	315

PARALLEL SESSION TWO: METALLURGY

Outokumpu SX EW Technology package R. Kuusisto, P. Pekkala, and G.J. Karcas	321
Development of a novel three-step SX process to recover copper from an acidic solution R. Minango, E. Bwalya, D. Bukunkwe, and B. Grinbaum	337
The use of selective ion exchange for the recovery of base metals from effluent streams J. Wyethe, M. Kotze, B. van Hege, and R. Bell	353
Contribution on nickel, zinc and sulphur co-deposition during cobalt electrowinning K. Kongolo, C.T. Mutale, and M.K. Kalenga	373
Process developments at tailings leach plant G.C. Chisakuta, M. Banda, and M. Chabinga	379

PARALLEL SESSION TWO: MINING

Management of a major slope failure at Nchanga Open Pit, Chingola, Zambia S.D.N. Wessels and W.A. Naismith	391
Mine operational planning as the driver for determining and managing energy demand D. Capstick, K. Garner, and J. Porter	407
The optimisation of mining method and equipment R.G.B. Pickering	423
Exploration of a mature copper mining license—A copperbelt case history T.P. Williams, M.B. Rydzewski, and B. Corner	435
Sinking contractor's close out presentation on completion of south deep shafts A. Douglas and K. McLeod	455

SESSION: PLENARY

A bacterial heap leaching approach for the treatment of low grade primary copper sulphide ore S.W. Robertson, A. Vercuil, P.J. van Staden, and P. Craven	471
Effects of microwave energy treatment on value liberation from Zn and Co-Cu ores A.F. Mulaba-Bafubiandi, and J.M.L. Lewis	485
Sulphur from smelter gases and sulphate-rich effluents J. Maree, D. Theron, R. Nengovhela, and P. Hlabela	515
Recent developments in the automation of mining analytical laboratories for base metal analysis P.K. Hofmeyr	523

**THE CONFERENCE ORGANISERS WISH TO THANK THE FOLLOWING
SPONSORS FOR THEIR SUPPORT**

ooOoo

SPONSORS

Bateman

Betachem

Eskom

Grinaker LTA

Kumba Resources

Larox

Mintek

Mopani Copper Mines, Zambia

Murray & Roberts Cementation

Outokumpu Technology

Sandvik Tamrock, Zambia

The Third Southern African Conference on Base Metals

*'Southern Africa's response to changing global base
metals market dynamics'*

Organising and Technical Programme Committee

W.H. van Niekerk (Chairman)

A.G. Elliot

N.M. O'Brien

N.C. Machingawuta

K.C. Owen

N.A. Mjacu*

V. Silwamba

D.S. Ngandu

*Deceased

CONFERENCE SECRETARIAT

The South African Institute of Mining and Metallurgy
P.O. Box 61127, Marshalltown, 2107, South Africa