

SAIMM Limpopo Branch Technical Event

Theme:

Managing Technology for Inclusive and Sustainable Growth in the Mining Industry

Date: 31 July 2026

Venue: Zebula Golf Estate & Spa, Farm 534 KQ,
Bela-Bela, Limpopo



SAIMM
THE SOUTHERN AFRICAN INSTITUTE
OF MINING AND METALLURGY
LIMPOPO BRANCH

Abstract Book

31 JULY 2026

Zebula Golf Estate & Spa, Farm 534 KQ, Bela Bela Limpopo

THE SOUTHERN AFRICAN INSTITUTE OF MINING AND
METALLURGY JOHANNESBURG 2026

SAIMM Limpopo Branch Technical Event 2026

Managing Technology for Inclusive and Sustainable Growth in the Mining Industry

31 July 2026
Zebula Golf Estate & Spa, Farm 534 KQ, Bela-Bela, Limpopo

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

- SP1 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. Delpont 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. Spearing
- SP7 Rock Engineering for underground coal mining**
(2002) J. Nielen van der Merwe and Bernard J. Madden
- SP8 Second Edition: Rock Engineering for underground coal mining**
(2010) J. Nielen van der Merwe and Bernard J. Madden
- SP9 Theoretical Rock Mechanics for Professional Practice**
(2016) M. Handley
- SP10 Johannesburg and its Holey Mining Heritage 2021**
(2021) T.R. Stacey
- SP11 Mineral and Metal Extraction – An Overview**
(2021) L.C. Woollacott and R.H. Eric
- SP12 The Fall of a Giant: The story of the disintegration of the South African Mining - Industry (2022/2023) Dr I. Robinsoin**
- SP13 COMRO's Legacy: Research and Development of Stopping Mining Machinery and Technologies (2023) B. Protheroe**

SUPPLEMENT TO THE SAIMM JOURNAL

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) | S11 | Infacon 6 (Incorporating Incsac)(1992)
Edited by H.W. Glen |
| S2 | Planning Open Pit Mines (1970)
(4th imp.) Edited by P.W.J. van Rensburg | S12 | Massmin 92
Edited by H.W. Glen (out of print) |
| S3 | Application of Computer Methods in the Mineral Industry (APCOM 1973)
Edited by M.D.G. Salamon | S13 | Minefill 93
Edited by H.W. Glen |
| S4 | Infacon 1974
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 |
| S5 | Proceedings of the 12TH CMMI Congress 2
volumes (1982) Edited by H.W. Glen | S15 | Surface Mining 1996
Edited by H.W. Glen |
| S6 | Rockbursts and Seismicity in Mines (1984)
Edited by N.C. Gay and E.H. Wainwright | S16 | Hidden Wealth (1996)
Edited by H.W. Glen |
| S7 | The Planning and Operation of Open Pit and Strip Mines (1986)
Edited by J.P. Deetlefs | S17 | Heavy Minerals 1997
Edited by R.E. Robinson |
| 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 | S18 | The 8TH International Platinum Symposium (1998) |
| 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 | S19 | Mining in Africa '98 |
| S10 | International Deep Mining Conference (1990)
Volume 1: Innovations in Metallurgical Plant
Edited by G.A. Brown and P. Smith
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 | 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 |
| | | S31 | 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	S58	Hard Rock Safe—Safety Conference 2009
S33	ISRM—Technology Roadmap for Rock Mechanics	S59	Sampling and Blending 2009
S34	Heavy Minerals Conference 2003	S60	World Gold 2009 Conference
S35	Safety in Mines Research Institutes (2003)	S61	Physical Beneficiation Conference 2010
S36	VII International Conference on Molten Slags, Fluxes & Salts (2004) Tenth International Ferroalloys Congress INFACONX 2004	S62	Second Hardrock Safe—Safety Conference 2010
S37	Deep and high stress mining 2004	S63	Platinum in Transition ‘Boom or Bust’ 2010
S38	‘Platinum adding value’ 2004	S64	South African Pyrometallurgy 2011 International Conference
S39	Base Metals—Southern Africa’s response to changing global base metals market dynamics 2005	S65	Minefill 2011 (10TH International Symposium on Mining with Backfill)
S40	Strategic versus Tactical approaches in mining 2005	S66	Base Metals Conference 2011
S41	Best practices in rock engineering SARES 2005	S67	MineSafe 2011 Conference
S42	IFSA 2005, Industrial Fluidization South Africa	S68	Iron Ore and Manganese Ore Metallurgy 2011
S43	Southern African Pyrometallurgy 2006 International Conference	S69	Percolation leaching: The status globally and in Southern Africa 2011
S44	Stability of rock slopes in open pit mining and civil engineering situations	S70	IFSA 2011, Industrial Fluidization South Africa
S45	‘Platinum Surges Ahead’ 2006	S71	Southern Hemisphere International Rock Mechanics Symposium 2012
S46	Hydraulic Transport of Solids - Hydrotransport 17 (2007)	S72	Platinum Conference ‘A catalyst for change’ 2012
S47	Fourth Southern African Base Metals Conference ‘Africa’s base metals resurgence’	S73	Ferrous 2012—Ferrous and Base Metals Development Network Conference
S48	Heavy Minerals Conference, 2007	S74	Diamonds - Source to use 2013
S49	Cave Mining Conference, 2007	S75	Sampling and analysis: Best-practice in African mining 2013
S50	International Symposium on Lead and Zinc processing - Lead & Zinc 2008	S76	Base Metals Conference 2013
S51	Surface Mining 2008	S77	Precious Metals 2013 Conference—The Precious Metals Development Network (PMDN)
S52	Platinum in transformation 2008	S78	Physical Beneficiation 2013 Conference
S53	IFSA 2008, Industrial Fluidization South Africa	S79	21st Century challenges to the southern African coal sector 2014
S54	Hydrometallurgy Conference 2009	S80	Furnace Tapping Conference 2014
S55	Shotcrete for Africa 2009	S81	Platinum Conference ‘Platinum—Metal for the Future’ 2014
S56	Base Metals Conference 2009	S82	IFSA 2014, Industrial Fluidization South Africa
S57	Heavy Minerals Conference, 2009	S83	Copper Cobalt Africa 2015
		S84	The Danie Krige Geostatistical Conference 2015 - Vol. 1 The Danie Krige Geostatistical Conference 2015 - Vol. 2

S85	World Gold Conference 2015	S111	7TH International Platinum Conference 2017
S86	Slope Stability 2015	S112	Infacon XV: International Ferro-Alloys Congress 2018
S87	2nd Annual Young Professionals Conference 2015	S113	SOMP–Society of Mining Professors 6TH Regional Conference 2018
S88	AMI–Nuclear Materials Development Network 2015	S114	Digitalization in Mining Conference 2018
S89	MPES–23rd International Symposium on Mine Planning & Equipment Selection 2015	S115	Diamonds – Source to Use 2018 Conference 2018
S90	Diamonds still Sparkling Conference 2016	S116	The 9TH Southern African Base Metals Conference 2018
S91	The SAMREC/SAMVAL Companion Volume Conference 2016	S117	Geometallurgy Conference 2018
S92	New Technology and Innovation in the Minerals Industry Colloquium 2016	S118	Mine Safe Technical Conference and Industry Day 2018
S93	Theoretical Rock Mechanics for Professional Practice (Special Publications Series 9) by M. Handley - 2016	S119	ASM Conference 2018
S94	Hydrometallurgy Conference 2016	S120	4TH Young Professionals Conference 2018
S95	10TH Heavy Minerals Conference 2016	S121	Furnace Tapping 2018 Conference 2018
S96	MineSafe Conference 2016	S122	7TH Sulphur and Sulphuric Acid Conference 2019
S97	AMI–Ferrous and Base Metals Development Conference 2016	S123	Mine Planner’s Colloquium 2019
S98	3rd Young Professionals Conference 2017	S124	9TH International Conference on Deep & High Stress Mining 2019
S99	Proximity Detection and Collision Avoidance Systems in Mining Colloquium 2017	S125	New Technology Conference and Trade Show 2019
S100	6TH Sulphur and Sulphuric Acid Conference 2017	S126	Smart Mining Smart Environment Smart Society Conference 2019
S101	Mine Planning Colloquium 2017	S127	The Eleventh International Heavy Minerals Conference 2019
S102	Chrome Colloquium 2017	S128	Surface Mining Masterclass 2019
S103	4TH Mineral Project Valuation Colloquium 2017	S129	International Mine Health and Safety Conference 2019
S104	Water Conference 2017	S130	Tailings Storage Conference 2020
S105	Rapid Underground Mine and Civil Access Engineering 2017	S131	IMPC2020 XXX International Mineral Processing Congress
S106	MineSafe Conference 2017	S132	Johannesburg and its Holey Mining Heritage (Special Publications Series 10) by T.R. Stacey - 2021
S107	Uranium 2017 International Conference 2017	S133	Mineral and Metal Extraction – An Overview (Special Publications Series 11) by L.C. Woollacott and R.H. Eric - 2021
S108	IFSA 2017–Industrial Fluidization Conference 2017	S134	Diamonds – Source to Use – 2021 Online Conference 2021
S109	AfriRock 2017–ISRM International Symposium 2017		
S110	AMI Precious Metals 2017–The Precious Metals Development Network (PMDN) Symposium		

S135	WorldGold Online Conference 2021	S155	12TH International Heavy Minerals Conference 2023
S136	APCOM 2021 Minerals Industry4.0-The next digital transformation in mining	S156	Geometallurgy Conference 2023
S137	5TH Young Professionals Online Conference 2021	S157	Next Generation Tailings Opportunitiy or Risk? Conference 2023
S138	Southern African Rare Earths International Online Conference 2021	S158	6TH Young Professionals Conference 2023
S139	SAMCODES Conference 2021	S159	Southern African Pyrometallurgy 2024 International Conference
S140	Global Tailings Standards and Opportunities For the Mine of the Future Conference 2022	S160	The 11TH World Conference of Sampling and Blending 2024
S141	The Fall of a Giant: The story of the disintegration of the South African Mining Industry (Special Publications Series 12) by I. Robinson - 2022/2023	S161	SANIRE Symposium 2024 Technical Applications in Rock Engineering
S142	Battery Materials Conference 2022	S162	2ND International Conference 2024 Southern African Rare Earths
S143	32ND SOMP Annual Meeting and Conference 2022	S163	2ND Battery Materials Conference 2024
S144	SDIMI (Sustainable Development in the Minerals Industry) 10TH International Conference 2022	S164	Hydrometallurgy Conference 2024
S145	THANOS International Conference 2022	S165	Environmental Social Governance Sustainability Conference 2024
S146	Mine Impacted Water Online Conference 2022 (Abstract Book Only)	S166	MineSafe Mine Health and Safety Conference 2024
S147	8TH International PGM Conference 2022	S167	Mintek@90 Conference 2024
S148	SANCOT Symposium 2022	S168	Mine Closure Conference 2025
S149	8TH Sulphur and Sulphuric Acid Conference 2023	S169	2ND Southern African Hydrogen and Fuel Cell Conference 2025
S150	Southern African Hydrogen and Fuel Cell Conference 2023	S170	9TH Sulphur and Sulphuric Acid Conference 2025
S151	COMRO's Legacy: Research and Development of Stoping Mining Machinery and Technologies (Special Publications Series 13) by B. Protheroe - 2023	S171	4TH Digital Transformation in Mining Conference 2025
S152	Copper Cobalt Africa in Association with The 10TH Southern African Base Metals Conferenc 2023	S172	AfriRock 2025 Pioneering Progress Conference
S153	Digital Transformation in Mining Conference 2023	S173	Thirteen International Heavy Minerals Conference 2025
S154	Diamonds Source to Use 2023 Online Conference	S174	International Mineral Asset Valuation Conference 2025
		S175	Geometallurgy Conference 2025
		S176	9TH International PGM Conference 2025
		S177	MineSafe Conference 2025
		S178	Tailings Conference 2026 - Where to Now?
		S179	SANCOT SYMPOSIUM Conference 2026
		S180	Pyrometallurgy International Conference 2026
		S190	SANIRE SYMPOSIUM 2026

Published by The Southern African Institute of Mining and Metallurgy
Minerals Council South Africa, 7th Floor, Rosebank Towers, 19 Biermann Avenue,
Rosebank, 2196, Republic of South Africa

© The Southern African Institute of Mining and Metallurgy, 2026

The abstracts in this volume have been for the most part prepared from Word documents supplied by the authors, with additional typesetting and formatting by The Southern African Institute of Mining and Metallurgy.

Organising Committee

S. Zulu - Chairperson
T. Kgarabjang
Z. Masibigiri
L. Masutha
E. Mualusi
M.Nkwanyana
N. Tsajoa

FOREWORD

Dear Participants and Guests,

It is a great pleasure to welcome you to the SAIMM Limpopo Branch Technical Conference of July 2026, to be held again in Zebula Lodge, at Bela-Bela.

SAIMM Limpopo Branch technical conference has become a flagship event of the SAIMM. Originating from a strong foundation in concurrent mining related issues, the conference has grown to embrace the broader organization of mining industry, their integration within corporations and networks, and their impact on society. Most importantly, this technical conference stands to represent the Mining industry community in its unit as well as its diversity. The SAIMM Limpopo branch is committed to disseminating, to all discipline of the Mining industry, information on the most recent and relevant research, theories and practices in the mining industry. It is our belief that good research and technical achievements deserve to be heard, widely read and published. SAIMM Limpopo Branch conferences link researchers and practitioners from different disciplines of mining industry from around the country. The theme for the July 2026 Technical Conference is – “Managing Technology for Inclusive and Sustainable Growth in the Mining Industry.” This theme offers a unique platform for participants to engage in cutting-edge discussions on technological innovations and strategies, technology management, innovation and

socio-economic associated practices. Furthermore, this theme is meant to assist in disseminating, to all branches of the mining industry, information on the most recent and relevant research, theories and practices in technological innovations.

The mining industry, in general, continues to evolve with the fast-paced changes in technology and global priorities and it is critical to decipher how digital tools,

methods and technologies are reshaping organizations and driving sustainable, user-centered, and economically viable solutions. Please take this opportunity to listen to a talk and imagine your contribution to the future on mining and related industries. Wishing each of you a successful technical conference to catch up on the latest developments in the mining industry, expand your network and seek inspiration to use your technical knowledge towards the solution of mining challenges.

Kind Regards
Steven Zulu
SAIMM Limpopo Branch Chair
31 July 2026

Contents

Page No

Conference Chairperson's CV	1
Keynote Presenters CVs	2
Microbes at work: Turning acid mine drainage into clean water	
S. Mbedla, P.M. Pale	5
The importance of sustainable herd management for mining communities after mine closure	
C. Hudson, J. Browne, D. Viljoen	6
Mining sector research and development projects resulting in sustainable and inclusive growth	
K. Magagane, G. Baloi, E. Mualusi and R.B. Khumalo	8
Unlocking a competitive pyrometallurgy industry in south africa: challenges, opportunities and the role of mintek as a national research and technology organisation	
E. Matinde	11
Alternative energy sources for smelting: a hybrid biomass-derived syngas route for decarbonising ferrochrome production	
M. J. Mvita, N.P. Baloyi, W. Nheta	13
Responsible artificial intelligence adoption in flotation at palabora mining company	
K. Machaba, T. Ramakobya, M. Moumakwe and K. Mashilo	16
Design of experiments-based optimization of baseline rougher flotation conditions for palabora copper lift ii ore	
F.M. Facela, L.E. Mualusi and K. Machaba	17
Recovery of rare earth elements from coal fly ash by sodium carbonate roasting, wet magnetic separation and acid leaching	
M. J. Mvita, N.P. Baloyi, W. Nheta	19
Evaluation of the metallurgical performance of a pilot-scale Jameson flotation cell on the final flotation concentrate streams at the Modikwa concentrator	
C. Maleka, H. Mphahlele and P. Makuwa	22
Investigation of equipment and structural failures as an opportunity for growth	
P.G.H. Pistorius	24
Managing technology for inclusive and sustainable growth in the mining industry: A mine surveying perspective at Palabora Mining Company, South Africa	
D.R. Khumela, G. Mtileni, D. Ntuli, R.B. Khumalo, T. Chauke, F.K. Mulenga	26

Contents

Page No

Managing critical ventilation infrastructure for operational resilience: Lessons from fan relocation and flood recovery in an underground block cave mine
N. Mkhondo and M. Ramaano 27

Tokenised fractional ownership as a capital access mechanism for junior and small-scale mining operations in South Africa
Z. Masibigiri 30

The organizers of the event wish to thank the following sponsors for their support



Conference Chairperson



Steven Zulu

Metallurgical Technical Manager
Siyanda Bakgatla Platinum Mine

Steven Zulu is an accomplished Metallurgical Technical Manager with extensive expertise in Extraction Metallurgy and Technology Management. He holds a National Diploma and a B.Tech. in Extraction Metallurgy from the University of Johannesburg, BSc (Hons) and M.Sc. in Technology and Innovation Management from the University of Pretoria, B.Com Economics and B.Com Economics (Hons) from Unisa. Currently, he is pursuing a Ph.D. in Management of Technology & Innovation with University of Pretoria.

Steven's career is marked by significant contributions to the mining and metallurgical sectors. His roles has included but not limited to legal appointee for Safety, Health, and Environmental compliance, he has overseen critical operations including production, metal accounting, budgeting, human capital, tailings dam management and cost reduction initiatives. His leadership in metallurgical optimisation and recovery improvement projects has yielded substantial results, including the successful design and commissioning of the MIG and Chrome Recovery Plants at various operations.

In academia, Steven is deeply involved in mentoring and supervising graduate students, chairing career development panels, and collaborating with various academic institutions. He has organised multiple colloquia and symposia for professionals in the mining and metallurgy fields.

His research interests have culminated in several published papers, focusing on the strategic competitiveness of the South African mining industry in the context of the Fourth Industrial Revolution and digital transformation technological innovations. Steven's publications highlight the importance of organisational capabilities in adopting new technologies and advancing the sector.

A member of multiple professional organisations, including the South African Institute of Mining and Metallurgy and the Mine Metallurgical Managers Association, he currently serves as the Chair of the SAIMM Limpopo Branch. Steven's commitment to professional development is evident in his active participation in workshops, courses, and conferences.

With a strong foundation in metallurgy and a keen understanding of technology management, Steven Zulu continues to be a leading figure in his field, dedicated to innovation and excellence in metallurgical practices.

Keynote Presenters



Kathy Sole

Sole Consulting

Kathy holds a PhD from the University of Arizona. She has been providing independent hydrometallurgical consulting services since 2011, with clients on six continents. She has worked across a wide range of commodities, including base metals, uranium, titanium, vanadium, and precious metals. She received the 2019 Milton E. Wadsworth award from SME (USA) and has twice been awarded a Silver Medal of the SAIMM. Kathy is a Fellow of SAIMM and the South African Academy of Engineers.



Malibongwe Manono

University of Cape Town

Dr Malibongwe Manono is an Associate Professor in the Department of Chemical Engineering and the Deputy Dean of Undergraduate Studies in the Faculty of Engineering and the Built Environment at the University of Cape Town. He holds a PhD in Chemical Engineering specialising in Minerals Processing. His research interests are in the areas of froth flotation, water within flotation, dewatering of flotation products and value recovery from minerals and metallurgical processing waste. He has supervised many final-year Chemical Engineering research projects, 16 MSc(Eng) students and 2 PhD candidates to completion. He is currently supervising 11 MSc(Eng) students and 2 PhD candidates. His publication record boasts over 30 articles in globally recognised journals and significant participation in international and local conferences such as the International Mineral Processing Congress (IMPC), International Mine Water Association (IMWA) Congress, SAIMM-PGM conference series, to name a few. He also stands as a reviewer for esteemed journals in his research field and has lent his expertise to conference organising committees for international conferences as a scientific committee member

Microbes at work: Turning acid mine drainage into clean water

S. Mbedla, P.M. Pale

University of Johannesburg, South Africa

Rapid urbanisation, industrialisation, and mining activities have significantly increased water consumption and wastewater generation, creating major environmental challenges. Among the most damaging forms of wastewater is acid mine drainage (AMD), which is formed through the oxidation of sulfide minerals and is characterised by high acidity and toxic metal contamination. AMD not only contaminates water resources but also poses serious environmental, social, and economic risks.

Conventional AMD treatment methods, such as lime neutralisation and chemical precipitation, are often costly, inefficient, and generate secondary waste, making them unsustainable for long-term use. Micro-organisms and seaweed offer a promising eco-friendly alternative by transforming AMD into cleaner water through natural biochemical processes. Iron-oxidising and iron-reducing micro-organisms such as *Ferroplasma* and *Geoplasma*, together with sulfate-reducing bacteria, can neutralise acidity, precipitate metals, and support resource recovery.

These microbial strategies align with sustainability frameworks such as the circular economy and waste-to-resource approaches, offering opportunities not only for water purification but also for the recovery of value-added materials. Keywords: Flotation, co-collector, primary collector, cost, flotation recovery

The importance of sustainable herd management for mining communities after mine closure

C. Hudson, J. Browne, D. Viljoen

MineCare Evolution (Pty) Ltd, South Africa

Herd management can play a pivotal role in strengthening mine communities after mine closure by providing a practical pathway to food security, household income, land stewardship, and local enterprise development. In many mining-dependent areas, closure leads to job losses, declining local economies, and heightened social vulnerability; therefore, resilient livelihood options are essential to a just transition. Well-structured herd management programmes can help communities convert available land, local knowledge, and labour into productive assets through improved animal health, breeding, grazing management, traceability, and market access. Beyond direct economic returns, these systems can support rangeland rehabilitation, build climate resilience, and create a foundation for community-led development that endures beyond the mining life cycle. As part of broader post-mining planning, herd management should be positioned not only as an agricultural intervention, but as a strategic mechanism for socio-economic recovery and long-term resilience.



Carla Hudson

CEO

MineCare Evolution (Pty) Ltd

Carla is a geologist and environmental management specialist with wide-ranging experience across mining, exploration, consulting, and sustainability programmes in Africa. She began her career as one of the first female underground mining geologists at JCI's South Deep Shaft and later worked as a Senior Exploration Geochemist on projects across multiple countries. She went on to specialise in EIA and mine closure work, held environmental leadership roles including Environmental Manager at South Deep, and completed a Master's in Sustainable Development (Environmental Management and Climate Change) at SOAS, University of London. She has since led initiatives in mine water management, sustainable mine closure and the just energy transition, and is currently CEO of MineCare Evolution, focused on economic diversification for mining communities.

Mining sector research and development projects resulting in sustainable and inclusive growth

K. Magagane, G. Baloi, E. Mualusi, R.B. Khumalo

Palabora Mining Company, South Africa

Research and development (R&D) projects in the mining sector can make an important contribution to sustainable and inclusive growth. In a sector that faces ongoing pressure to improve productivity, protect workers, manage environmental impacts, and remain financially viable, R&D offers practical solutions that support both present needs and long-term development. By introducing new technologies, better processes, and more effective systems, R&D helps mining operations work more efficiently and respond more effectively to everyday challenges. One of the clearest benefits of R&D is its ability to improve operational performance. New ideas and innovations can help mines increase efficiency, make better use of resources, and reduce delays or unnecessary costs. At the same time, these improvements often support safer and healthier working conditions. For example, better equipment, monitoring systems, and work practices can reduce employees' exposure to hazards and strengthen occupational health and safety standards. In this sense, R&D does more than improve production outcomes; it also contributes to the wellbeing of the workforce and supports more responsible mining practices. R&D also adds value by growing the body of knowledge within the mining industry. The findings from research can give researchers, engineers, finance managers, logistics managers and mining managers a better understanding of what works, what needs improvement, and how challenges can be addressed in more effective ways. When this knowledge is shared across different mines and

organisations, the benefits extend beyond one operation and contribute to inclusive growth across the sector. In addition, R&D can improve financial performance by lowering operating costs, increasing productivity, reducing downtime, and supporting stronger profit margins. In some cases, it may also provide tax benefits or incentives that encourage continued investment in innovation. Overall, R&D projects help the mining sector become more efficient, safer, more informed, and more financially resilient, making them an important part of sustainable and inclusive growth. The next steps will be to conduct research to evaluate R&D impact to the mining sector using Palabora Mining Company (PMC) as a case study.

Keywords: Research and Development, innovation, mining sector, technologies, sustainable growth



Katekile Shawn Magagane

Taxation Superintendent
Palabora Mining Company

Katekile Shawn Magagane CA(SA), MCom (Taxation),
Registered Tax Practitioner

Katekile is a seasoned taxation and accounting professional with close to a decade of experience across tax, audit, compliance, and financial governance. He currently serves as Taxation Superintendent at Palabora Mining Company, where he leads complex taxation matters, supports compliance, manages tax risk, and provides practical tax guidance that helps the business make informed decisions.

He holds a BCom in Accounting and a Postgraduate Diploma in Accounting from the University of Cape Town, as well as a Master of Commerce in Taxation from the University of Pretoria. Katekile is a Chartered Accountant (SA), registered with the South African Institute of Chartered Accountants, and is also a Registered Tax Practitioner. These qualifications reflect both his technical depth and his commitment to professional excellence.

Before joining Palabora Mining Company, Katekile worked at the South African Revenue Service in a range of specialist roles within the Large Business and International Division. This gave him broad exposure to both domestic and international tax matters and a solid understanding of the regulatory landscape. His experience was further strengthened through a secondment to the Auditor-General of South Africa, where he gained valuable exposure to audit work under the Public Finance Management Act (PFMA). This experience deepened his understanding of public sector auditing, accountability, and governance, and added an important dimension to his broader tax and financial reporting expertise.

Beyond his day-to-day responsibilities, Katekile is deeply committed to developing future finance professionals. He serves as a mentor and marker for the University of Cape Town Board Course, where he supports candidates preparing for the final CA board examination. With advanced academic credentials, meaningful experience in both the public and private sectors, and a strong commitment to professional development, Katekile brings a well-rounded and credible perspective to the fields of taxation, accounting, and governance. He remains committed to promoting sound tax compliance, strengthening governance, and creating sustainable value through responsible financial stewardship. He has further developed skills of Research and Development in the mining sector and that is what he will tell us more about in his presentation.

Unlocking a competitive pyrometallurgy industry in South Africa: Challenges, opportunities and the role of Mintek as a national research and technology organisation

E. Matinde^{1,2}

¹Mintek, South Africa

²University of the Witwatersrand, South Africa

South Africa hosts some of the world's unparalleled resources for industrial commodities such as chromite, manganese ores, platinum group metals, iron ores, vanadiferous titanomagnetite ores, rare earth metals, coal, among others. These critical minerals are fundamental to global economic growth due to their irreplaceable applications in industrial, transportation, energy generation and storage, communication and manufacturing, among other critical applications. The demand for precursors for industrial and structural alloys (e.g., Cr, Mn, Ti, Fe, Si, Ni, REEs, etc.) and battery and energy metals (e.g., Cu, Ni, Co, Mn, etc.) will naturally increase to satisfy the increased demand for infrastructure, clean energy, agriculture, industrial machinery, among other pressing human needs. Most critical metals and engineering alloys, however, can only be economically extracted and refined at scale via pyrometallurgical approaches. Although most the primary metal production processes have matured and operate optimised flowsheets and technologies, they rely extensively on cheap and abundant carbonaceous reductants, utilise energy-intensive processes to smelt and refine the metals, generate huge amounts of residual hazardous waste streams (such as slags and dusts) and produce toxic and greenhouse gas emissions. These industry-wide challenges therefore present research and technology development opportunities to reduce the environmental footprint of pyrometallurgical processes. The need to increase the ecological footprint and sustainability of pyrometallurgical processes also increases the impetus to develop energy efficient flowsheets with low

carbon and effluent emissions, including demonstrating flowsheets incorporating alternative and low-carbon reductants, coupled with the ability to process both primary and secondary feed materials. This paper highlights the role of Mintek as South Africa's national research and technology organisation in providing world-class, integrated research, development and innovation infrastructure to facilitate the testing and demonstration of fit-for-purpose flowsheets and technologies.



Elias Matinde

Manager, Pyrometallurgy Division
Mintek

Elias holds a PhD in Metallurgical Engineering from Tohoku University in Japan, an MBA and a Bachelor of Science degree Metallurgical Engineering from the University of Zimbabwe. Elias has over 25 years of experience in applied research in extractive metallurgy, specialising in the development of sustainable pyrometallurgical processes and technologies. He is a Fellow and Past president of the SDAIMM (2024-2025). Elias is currently employed as the Manager of the Pyrometallurgy Division at MINTEK. The Division specializes in applied pyrometallurgy research and technology demonstration, with unique capabilities to demonstrate electric arc furnace smelting processes continuously at scale up to 3MW design capacity, with or without preheating. These capabilities are fully supported by thermochemical and computational modelling capabilities using a variety of modelling and simulation software tools to ensure process decisions.

Alternative energy sources for smelting: A hybrid biomass-derived syngas route for decarbonising ferrochrome production

M. J. Mvita¹, N.P. Baloyi^{1,2} W. Nheta^{1,2}

¹University of Johannesburg, South Africa

²Mineral Processing and Technology Research Centre,
South Africa

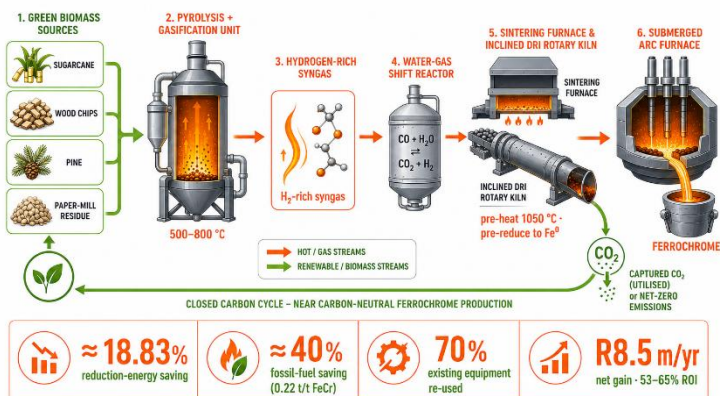
The South African ferrochrome (FeCr) industry is among the most energy-intensive metallurgical sectors in the country, with modern submerged arc furnace (SAF) operations consuming of the order of 3.1–3.5 MWh of electrical energy and 0.50–0.55 t of carbonaceous reductant per tonne of alloy produced. Rising electricity tariffs, a national carbon tax, ageing furnace technology and mounting community and regulatory pressure over emissions have eroded the global competitiveness of local smelters. This paper presents a hybrid process concept that substitutes fossil-derived thermal energy and part of the reductant demand with biomass-derived syngas produced on-site through integrated pyrolysis and gasification. The syngas is enriched in hydrogen through a high-temperature iron–chromium water-gas shift stage and is used to fire the sintering section and to drive a direct-iron-reduction rotary kiln that simultaneously pre-heats and pre-reduces chromite pellets before they enter the SAF. A first-principles energy and mass balance, built on standard thermochemical data, indicates that pre-reduction and pre-heating of the burden to 1050°C delivers an electrical energy saving of approximately 18.83% in the reduction step, while the fossil-reductant demand at the furnace falls from about 0.55 t/t FeCr to 0.145 t/t FeCr — an effective fossil-fuel saving of roughly 40%, equivalent to 0.22 t/t FeCr. Because the concept re-uses about 70% of existing plant equipment and requires only about 30% new units, the estimated capital outlay of R7.6–10.5 million is modest; combined fossil-fuel and carbon-tax savings yield an annual net gain of about R8.5 million and a

projected return on investment of 53–65% per annum. The route offers a technically credible and near carbon-neutral pathway to decarbonise FeCr smelting using feedstocks readily available from South Africa's paper and sugar industries.

Keywords: ferrochrome, biomass gasification, syngas, water-gas shift, direct iron reduction, decarbonisation, carbon-neutral smelting, energy optimisation

Graphical abstract

A Hybrid Biomass-Derived Syngas Route for Decarbonising Ferrochrome Production





Meta Jonathan Mvita

Researcher and Part-time lecturer
University of Johannesburg

Meta Jonathan Mvita is a dedicated PhD candidate in Chemical Engineering at the University of Johannesburg, expected to complete the program in 2026. Before this, he pursued a Master of Engineering (MEng) in Extraction Metallurgy from 2023 to 2024. He holds a Bachelor Honours degree in Metallurgy, also from the same institution, completed in 2022. Since 2023, Jonathan has served as a research assistant, contributing to significant advancements in the field of engineering. Over the years, he lectured on modules including Coal Processing, Nonferrous metallurgy, Metallurgy Practice, Refractory Technology, Advanced Reaction Engineering, Process Control, and Multi-Stage Operations, demonstrating a strong commitment to education. Jonathan has authored 19 peer-reviewed journals and conference proceedings, showcasing his research contributions and expertise in metallurgy and chemical engineering. The work focuses on sustainable practices and innovative solutions within the field, positioning him as a promising researcher and educator. Fascinated by Artificial intelligence concepts, programming, and statistics, MVITA believes in imparting the skills developed in relation to the use of intelligent systems.

Responsible artificial intelligence adoption in flotation at Palabora mining company

K. Machaba, T. Ramakobya, M. Moumakwe, K. Mashilo

Palabora Mining Company, South Africa

Palabora Mining Company has adopted froth sensors and advanced process control (APC) as part of its digital transformation journey in flotation. This work examines how these technologies are being used to enhance process control for recovery improvement, circuit stability and more consistent metallurgical decision-making, while also addressing the human and ethical dimensions of artificial intelligence (AI) adoption in mining.

In the flotation circuit, operator experience and visual froth interpretation remain central to effective control. Froth sensors strengthen this knowledge by converting froth behaviour into measurable information, including bubble size, bubble count, froth coverage, froth velocity and froth state. When combined with APC control of key variables such as air addition rate and froth depth, these measurements provide a stronger basis for identifying operating constraints, improving recovery response and reducing copper losses to tails.

However, the value of AI-enabled control depends not only on technical performance, but also on operator trust, data quality, explainability, accountability and skills development. This paper argues that AI in flotation should not replace operator knowledge, but should make plant behaviour more visible, measurable and transferable. The Palabora case demonstrates that responsible AI adoption requires a human-centred approach, where froth sensors and APC are used as decision support tools that strengthen metallurgical judgement, improve operational consistency and contribute to inclusive, ethical and sustainable mining practice.

Keywords: AI adoption, froth sensors, Advanced Process Control, flotation, responsible AI, sustainable mining.

Design of experiments-based optimisation of baseline rougher flotation conditions for Palabora copper lift ii ore

F.M. Facela, L.E. Mualusi, K. Machaba

Palabora Mining Company, South Africa

Palabora Copper Mine is situated in the eastern part of Limpopo province, processing copper ore along the Palabora igneous complex. The copper is mainly hosted in primary sulfide minerals and is beneficiated through froth flotation. Flotation performance is influenced by the interaction of ore mineralogy, reagent chemistry, and flotation hydrodynamics, therefore establishing that representative baseline flotation conditions is essential for process enhancement and overall maximum production output. In this paper, Design of Experiments (DOE) was applied to optimise rougher flotation conditions for a composite Lift II ore sample comprising transgressive carbonatite, banded carbonatite, and foskorite. A Box-Behnken Design was used to investigate the effects of dithiocarbamate collector, dithiophosphate (DTP) collector, and frother dosage on copper recovery and concentrate grade. The experimental responses were evaluated using Response Surface Methodology, regression analysis, Analysis of Variance, and response optimisation techniques. The results indicated that frother dosage was the most influential variable affecting copper recovery, while DTP dosage exhibited a comparatively limited effect within the investigated operating range. Although the initial optimisation model showed limited predictive capability, response surface analysis revealed clear metallurgical trends and highlighted the importance of frother dosage in flotation performance. Confirmation tests produced lower responses than those predicted by the model, necessitating further optimisation using a Central Composite Design (CCD) to investigate the combined effects of air rate and frother dosage. The CCD results demonstrated that copper recovery improved at intermediate air rates, whereas excessive

air addition negatively impacted flotation performance. Overall, the DOE approach successfully established a metallurgically representative baseline flotation regime, providing a foundation for future studies on the influence of mineralogical variability on the flotation response of Palabora Copper Lift II ores.

Keywords: Copper flotation, Design of Experiments, Response Surface Methodology, Box-Behnken Design, Central Composite Design, Reagent Optimisation.



France Milton Facela

Graduate Metallurgist
Palabora Mining Company

Recovery of rare earth elements from coal fly ash by sodium carbonate roasting, wet magnetic separation and acid leaching

M. J. Mvita¹, N.P. Baloyi^{1,2}, W. Nheta^{1,2}

¹University of Johannesburg, South Africa

²Mineral Processing and Technology Research Centre,
South Africa

Rare earth elements are essential to permanent magnets, wind turbines, electric vehicles and a wide range of clean energy technologies; yet their supply rests on a narrow base of primary producers. Coal fly ash offers a large and largely untapped secondary source, particularly in South Africa where the material is generated in very large quantities and stockpiled with little reuse. This paper develops and evaluates an integrated route for recovering rare earths from Kendal Power Station fly ash by combining a roasting pretreatment, wet magnetic separation and acid leaching. The raw ash was characterised by X-ray fluorescence, X-ray diffraction, scanning electron microscopy with energy-dispersive spectroscopy and inductively coupled plasma mass spectrometry. It was found to be a Class F aluminosilicate carrying a total rare earth plus yttrium grade near 415 parts per million (ppm), dominated by the light rare earths and a strong cerium signal, with much of the inventory locked inside an amorphous glass. Sodium carbonate roasting between 400 and 900°C progressively broke down this glass, raised the sodium content of the solid to almost 30% as sodium oxide, and transformed the quartz framework into a high-temperature silica polymorph and sodium aluminosilicate phases, with an optimum roasting window near 600°C that opened the glass without recrystallising the products into refractory forms. Wet high-intensity magnetic separation was then applied to reject the iron-rich fraction and preconcentrate the rare earths, and a particle swarm optimisation of the operating variables

returned close to 92% recovery into the non-magnetic product at an enrichment ratio near three, with magnetic flux density and pulp density governing most of the response. The preconcentrate was leached in acid, and random forest and gradient boosting models trained on a structured leaching dataset predicted the efficiency accurately, identified the roasting temperature as the dominant control, and located an optimum that recovered close to 90% of the rare earths. A shrinking core analysis showed that the roasted material leaches under surface chemical reaction control with an apparent activation energy of 43.8 kilojoules per mole, well above the diffusion-controlled behaviour reported for raw ash, which confirms that roasting changes the rate-limiting step by removing the glass barrier. The combined roasting, magnetic separation and leaching route, supported by machine learning optimisation, provides an efficient and defensible flowsheet for turning coal fly ash into a rare earth resource.

Keywords: rare earth elements, coal fly ash; sodium carbonate roasting, wet magnetic separation, acid leaching, particle swarm optimisation, machine learning, leaching kinetics



Meta Jonathan Mvita

Researcher and Part-time lecturer
University of Johannesburg

Meta Jonathan Mvita is a dedicated PhD candidate in Chemical Engineering at the University of Johannesburg, expected to complete the program in 2026. Before this, he pursued a Master of Engineering (MEng) in Extraction Metallurgy from 2023 to 2024. He holds a Bachelor Honours degree in Metallurgy, also from the same institution, completed in 2022. Since 2023, Jonathan has served as a research assistant, contributing to significant advancements in the field of engineering. Over the years, he lectured on modules including Coal Processing,

Nonferrous metallurgy, Metallurgy Practice, Refractory Technology, Advanced Reaction Engineering, Process Control, and Multi-Stage Operations, demonstrating a strong commitment to education. Jonathan has authored 19 peer-reviewed journals and conference proceedings, showcasing his research contributions and expertise in metallurgy and chemical engineering. The work focuses on sustainable practices and innovative solutions within the field, positioning him as a promising researcher and educator. Fascinated by Artificial intelligence concepts, programming, and statistics, MVITA believes in imparting the skills developed in relation to the use of intelligent systems.

Evaluation of the metallurgical performance of a pilot-scale Jameson flotation cell on the final flotation concentrate streams at the Modikwa concentrator

C.Maleka, H. Mphahlele, P. Makuwa

Modikwa Platinum Mine, South Africa

The paper evaluates the metallurgical performance of a pilot-scale Jameson flotation cell (Z500 Jameson Cell) on final flotation concentrate streams at Modikwa concentrator, with the primary objective of reducing chromium oxide (Cr_2O_3) content below the smelter penalty threshold of 3% while maintaining PGM recovery and concentrate quality.

The study was conducted on Chrome Recleaner Float (CRF), Silicate Recleaner Float (SRF), and Main Recleaner Float (MRF) streams under varying operating conditions, including feed grade, airflow, and froth depth. Test work established an optimum froth depth of approximately 80% (200mm), achieving the highest recovery performance. Results indicate that the Jameson cell significantly reduced chromium oxide grade in CRF and SRF streams, with average feed chrome decreasing from 3.67% to 2.21% in the concentrate, thereby meeting smelter requirements and reducing potential penalties. In contrast, no meaningful chrome reduction was observed when treating the MRF stream, particularly at feed grades below 2%. In addition to the chrome reduction, the cell also demonstrated strong concentrate grade upgrading capability, achieving an average enrichment ratio of 1.8 and consistently increasing PGM concentrate grades, particularly on CRF and SRF streams. This aspect introduces a possible cost saving on mass pull by 25% when treating the chrome and silicate recleaner streams. A reduced mass pull of approximately 25% suggests significant potential for lowering concentrate tonnage and associated transportation costs.

PGM recovery remained good, exceeding 80% under most operating conditions, although variable and occasionally low recoveries were observed on the SRF stream. Overall, the findings demonstrate that the Jameson cell is an effective technology for chromium reduction and concentrate upgrading when applied to CRF and SRF streams. Its application to the MRF stream is not recommended due to limited metallurgical benefit. The paper highlights the potential of the Jameson cell to improve concentrate quality, reduce penalties, and enhance operational efficiency in PGM flotation circuits.

Keywords: Jameson cell, Cr_2O_3 reduction, PGM recovery, concentrate upgrade, enrichment ratio, mass pull reduction, smelter penalties, flotation performance



Cedric Maleka

Metallurgist
Modikwa

Cedric Maleka is a qualified Metallurgist with over seven years of experience in metallurgical plants. He holds a BTech Degree in Extractive Metallurgy from the University of Johannesburg. Throughout his career, Cedric has gained extensive exposure on mineral processing, precious metals refining, flotation, hydrometallurgy, metallurgical accounting, process optimization, and plant performance improvement. His professional experience includes roles with industry-leading organizations such as Rand Refinery, Sibanye Gold, Glencore Lion Smelter, AECL, and Modikwa Platinum Mine, where he currently serves as a Metallurgist. Cedric is recognized for his strong analytical skills, operational excellence, and commitment to safety, quality, and continuous improvement. Passionate about metallurgy and sustainable mining practices, he consistently delivers results with diligence, professionalism, and high ethical standards.

Investigation of equipment and structural failures as an opportunity for growth

P.G.H. Pistorius

University of Pretoria, South Africa

Failure of equipment and structures never occurs at a convenient time. Despite the inevitable disruption to production and maintenance schedules, a mechanical failure constitutes an opportunity for improvement. The systematic examination and recording of equipment failures therefore should be pursued. In this presentation, by way of background, the various categories of root causes of failure will be noted. The focus of the presentation will be a proposed approach to the initial visual inspection. It will be shown that careful visual inspection of failed equipment or structures, with detailed photography and sketches, showing the environment, the overall condition of the equipment and details of the fracture surface can be done quickly. Ideally, this inspection should be done before the wreckage is cleared. The first inspection can be supplemented by a workshop inspection, if possible. A record of the visual inspection can be placed context by retrieving equipment data (such as speed, loads, and video material) and the operational, maintenance and repair history. With this information, it is often possible to determine the root cause of failure with confidence. If it is necessary to involve an outside expert (possibly a mechanical or a metallurgical engineer), the record of the initial investigation will be valuable, or even essential. This approach will be demonstrated by three case studies of equipment failures in the mining industry, from outside the province of Limpopo.

Pieter Pistorius

Associate professor
University of Pretoria

Pieter Pistorius was born in Modimolle. He graduated from the University of Pretoria with a degree in metallurgical engineering in 1983. He has a PhD in Physical metallurgy from the same university. He started his career in the heavy engineering industry. He joined his old department in 1988, and spent about nine years, teaching and doing research in physical metallurgy and welding engineering. He re-joined industry in 1997 and spent some time in production and technical departments in the manufacturing industry before joining MegChem, a consulting firm in 2010. In 2015 he went back to the department of Materials Science and Metallurgical Engineering at the University of Pretoria. He teaches undergraduate and postgraduate courses in welding engineering, he has led the studies of five PhD and eleven masters students, and does consulting work to various industries.

Managing technology for inclusive and sustainable growth in the mining industry: A mine surveying perspective at Palabora mining company, South Africa

**D. Khumela, G. Mtileni, D. Ntuli, R.B. Khumalo, T. Chauke,
F.K. Mulenga**

Palabora Mining Company, South Africa

The mining industry is experiencing major transformations driven by fast technological progress and growing demands for sustainability, safety, and efficiency in its operations. Good management of technology is a key requirement for ensuring inclusive and sustainable growth in the mining sector. The paper looks into the developing technology that is currently available in the field of mine surveying and is currently being implemented at Palabora Mining Company. The paper also includes the application and integration of modern surveying technologies like the Global Navigation Satellite Systems, Robotic Total Stations, Geographic Information Systems, Unmanned Aerial Vehicles, Remote Sensing and Geomos Slope Automated Monitoring Systems. The paper focuses in particular on the contribution of these technologies towards operational productivity, environmental sustainability, worker safety and community development. The paper also looks at the difficulties in implementing such technology. These include lack of skills, lack of funds, problems of data management and resistance to change. Recommendations are presented to improve the adoption of technology for sustainable mining's long-term and inclusive economic development.

Keywords: Mine surveying, technology management, sustainable mining, inclusive growth, UAV, GeoMoS,

Managing critical ventilation infrastructure for operational resilience: Lessons from fan relocation and flood recovery in an underground block cave mine

N. Mkhondo, M. Ramaano

Palabora Mining Company, South Africa

Modern underground mining operations rely heavily on ventilation infrastructure to protect worker health, maintain safe working environments and provide for sustainable production. As mines become increasingly complicated, the ability to manage critical infrastructure during major business disruptions has emerged as a key component of operational resilience.

This paper presents a case study of two significant ventilation-related challenges encountered at an underground mining operation and demonstrates how proactive planning, adaptive engineering solutions, and effective management of ventilation technology contributed to business continuity, workforce protection and sustainable mining practices.

The first challenge involved the relocation of primary upcast fan infrastructure situated in an open pit. Ongoing geotechnical instability and progressive pit wall movement posed a significant risk of the long-term integrity of the ventilation installation. The potential loss of this infrastructure would have severely impacted the mine's ability to provide adequate ventilation to underground working, resulting in operation disruptions, production loss, and elevated occupational health and safety risks. A strategic decision was therefore taken to relocate the fans' installation to a more secure location. The project required careful planning, risk

assessment, engineering design, and execution to ensure uninterrupted ventilation service while safeguarding a critical component of the mine's ventilation network.

The second challenge occurred when flooding rendered a major return ventilation level inaccessible, significantly disrupting established airflow pathways within one of the mine's operating areas. The loss of the return airway threatened the mine's ability to maintain accessible ventilation conditions and delay access for recovery activities. In response, the ventilation team implemented an adaptive ventilation strategy by repurposing an existing fresh air pass to function as a temporary return airway. Although airflow quantities were reduced compared to normal operating conditions, the modified ventilation circuit provided sufficient airflow to support re-entry, recovery work, and subsequent rehabilitation activities. The intervention enabled continued ventilation of affected areas while facilitating the restoration of normal mining operations.

These events highlighted the importance of flexibility within ventilation system design and demonstrated the value of integrating ventilation management within broader emergency preparedness and business continuity objectives. The successful outcomes were achieved through collaboration between ventilation engineering, operational, and emergency response personnel, supported by continuous monitoring and risk-based decisions making.

The lessons derived from these experiences demonstrate that managing ventilation technology extends beyond compliance and routine operation. Effective stewardship of critical ventilation infrastructure can strengthen mine resilience, protect workers during disruptive events and support sustainable production. The case study provides practical insights for mining operations seeking to enhance their ability to anticipate, adapt, and recover from infrastructure and environmental challenges while maintaining safe and productive workplaces.



Nonjabulo Mkhondo

Ventilation Observer
Palabora Mining Company

Nonjabulo Mkhondo is an Environmental Health Practitioner and Mine Environmental Control Professional with experience spanning public health, agriculture, and the mining industry. She holds a Bachelor of Environmental Health from the University of Johannesburg and has further specialised in Mine Environmental Control, developing expertise in Occupational Hygiene and Mine Ventilation.

Prior to entering the mining sector, Nonjabulo served as an inspector within both the public health system and agricultural environments. These experiences provided a strong foundation in health risk management, regulatory compliance and the protection of public well-being.

Her transition into mining was driven by a growing interest in the practical application of environmental health principles within complex industrial settings. Since joining the mining industry, she has gained experience in underground mine ventilation, occupational hygiene, environmental monitoring and occupational health risk management. Her work focuses on creating safer working environments through the effective management of occupational health hazards and environmental conditions.

Nonjabulo is passionate about bridging the gap between public health principles and industrial health practice, with a particular interest in mine ventilation. She is committed to advancing practical, evidence-based solutions that contribute to safer and more sustainable mining operations.

Tokenised fractional ownership as a capital access mechanism for junior and small-scale mining operations in South Africa

Z. Masibigiri

Kovhani (Pty) Ltd, South Africa

South Africa's junior and small-scale mining sector is sitting on a funding problem that government grants and foreign capital have not fixed and are not going to fix. Exploration investment has fallen from 22% of Africa's total in 2007 to just 7% by 2024. Commercial banks pass on small-scale mining applications as a matter of routine. The Junior Mining Exploration Fund, while a genuine step forward, allocates less in its entire annual round than a single Canadian junior miner raises in one transaction on the Toronto Stock Exchange. What remains is a large number of permitted, geologically sound operations across Limpopo and beyond that cannot buy equipment, advance drilling, or scale production. Not, not because the ore is not there, but because the money has no way in.

This presentation looks at permissioned distributed ledger technology (DLT) and asset tokenisation as a practical answer to that problem. A permissioned blockchain like Hyperledger Besu is a private, access-controlled network where every participant is identified, verified, and operating under enforceable governance rules.

On this infrastructure, ownership of a mining asset through a royalty stream, a revenue share arrangement, or a stake in a producing shaft is issued as a security token and governed by smart contracts. Those contracts do the work that intermediaries usually do: they distribute royalty payments automatically when production thresholds are met, restrict transfers to verified investors, and keep an immutable record of every transaction from issuance to settlement. No manual reconciliation. No trust gap. No middleman taking margin that should belong to the operator or the investor. For small-scale

miners specifically, this opens a royalty-based equipment financing model where they raise capital against future production revenue, acquire the machine, repay through output.

The capital that enters through this mechanism is domestic retail investment. South Africans investing small amounts, aggregated across many participants into funding that actually moves projects forward. The presentation covers what regulatory conditions are required for this to work responsibly: FSCA licensing for crypto asset service providers, FICA compliance, and alignment with FATF standards governing digital asset platforms.

The growth case maps directly onto this conference's triple bottom line. Economically, domestic retail capital currently has no pathway into private mining assets – this creates one. Socially, communities that sit next to mine operations get a mechanism to own a piece of them, not just live next to them. Environmentally, when legitimate small-scale operators can access formal financing, the conditions that push people toward illegal and unregulated extraction begin to ease.

Attendees will leave with a clear understanding of how permissioned blockchain works in a mining finance context, what needs to be in place for it to be deployed responsibly, and why domestic retail capital – not foreign institutions, not government grants – may be the most practical source of funding the junior and small-scale sector has been overlooking.



Zwivhuya Masibigiri

BSc (Hons) Mining and Environmental
Geology student
Kovhani (Pty) Ltd

Zwivhuya Masibigiri is a final-year BSc (Hons) Mining and Environmental Geology student at the University of Venda, with hands-on experience in geotechnical site investigation, structural geology, and rock mass classification. He is currently a Strata Control Officer (Metal) Candidate through the Mineral Council South Africa, awaiting examination results. His practical fieldwork experience includes vacation work with Mukona Consulting Engineers, where he supported geotechnical site investigations, conducted soil and rock logging, and contributed to the compilation of formal engineering reports. He has undertaken two geological mapping field campaigns – a foundational programme in Tshipise, Limpopo and an advanced 10-day structural geology campaign in Barberton, Mpumalanga.

Zwivhuya is an active student in the South African mining sector. He serves on the Executive Committee of the SAIMM Limpopo Branch and YPC. He is also a Founding Committee Member and Stakeholder Engagements lead of the South African Mining Youth Association (SAMYA) UNIVEN Student Chapter, pioneering its establishment and building relationships with industry and academic stakeholders across Limpopo.

He previously served as Deputy Project Manager and Deputy Chairperson of the Geological Society of South Africa UNIVEN Branch, and has volunteered with the Vhembe Biosphere Reserve Youth Network and the UNIVEN Centre for Entrepreneurship and Rapid Incubation (UCfERI). He is also the founder of Kovhani (Pty) Ltd, a fintech company applying blockchain technology to fractional ownership of mineral and energy assets – an initiative aimed at bridging the gap between resource wealth and community benefit.

