UNIVERSITY OF CAPE TOWN
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minerals to metals

9TH ANNUAL MINERALS TO METALS RESEARCH SYMPOSIUM

2016

"Building a platform in Africa for sustainable development through minerals and metals"

Foreword

The Minerals to Metals Initiative (MtM) was established at the University of Cape Town (UCT) as one of five 'Signature Themes' in 2007. The aim was to build on the existing strengths in the different research groups in the Department of Chemical Engineering, and address the challenges facing the minerals industry in an integrated, comprehensive and holistic manner. With Professor J-P Franzidis at the helm of the team, and boosted by his award of an NRF SARChI chair in Mineral Beneficiation, MtM has been distinguished by its inclusive culture and far-reaching connections. MtM has established a multifaceted research approach that has linked fundamental understanding to systemic analysis; generated an ability to support new, often unanticipated, initiatives; and produced high-quality graduates who are already impacting the industry.

Of the many exciting achievements documented in this report, the Master of Philosophy (MPhil) programme specializing in Sustainable Mineral Resource Development, which commenced in 2014, stands as the flagship: the MPhil encapsulates the synergies between education, research and engagement, pioneering the new frontiers of trans-disciplinary research for the industry that were sought by the Signature Theme initiative. In three years since 2014, fifty-four students from six countries have registered for the MPhil, with courses delivered at four university campuses in southern Africa. The recent award of ZAR 4.2 million from the African Development Bank demonstrates the recognition and support it is attracting.

With our planet facing an increasingly complex future as we engage with the '4th Industrial Revolution', the sustainable provision of minerals and metals becomes increasingly critical, with no carbon-neutral economy possible without mining. This gives us our 'raison d'etre', in the face of a society that no longer tolerates the behaviour of the past, with 'business as usual' becoming a diminishing option. For companies to thrive in the 21st century, they will need to be resilient and adaptive, incorporating sustainable principles into the way that they do business. They will need people with new skills, particularly 'T' shaped professionals who are able to contribute technical excellence into inter-disciplinary teams. The MtM initiative is unique in that it integrates a deep technical and often fundamental understanding with systemic thinking and holistic approaches. It is positioned to play a pivotal role for UCT, South Africa, Africa and the world.

I am excited to be part of this journey - 'building a platform for sustainable development in Africa through minerals and metals'.

Professor Dee Bradshaw
November 2016

Welcome to the 9th Annual Minerals to Metals Research Symposium

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FRIDAY 25th NOVEMBER:

MtM Research Forum








The WEF Resource Development and Management Initiative

Corey has just returned from an internship at the World Economic Forum in Geneva, where he was working on their flagship Responsible Mineral Development Initiative (RMDI). The RMDI is a multi-stakeholder tool that provides practical mechanisms to measure and communicate the needs and expectations of different stakeholders in the mining industry.

Corey was tasked with updating and reviewing the RMDI survey in accordance with the 17 Sustainable Development Goals. He provided supporting consultation with key mining and metals companies, governments and civil society organisations on the RMDI process.

This afforded him the opportunity to get first-hand experience in the implementation the RMDI in Guinea. He was also involved in the development of an 'off the shelf' version of the RMDI that will make the tool more accessible to all stakeholders.

Corey Beavon

MPhil in Sustainable Mineral Development

Corey is a cricket playing, contentious debate seeking, rambunctiously pragmatic engineering graduate, who is on a journey to tackle wicked problems of a sustainable nature, while maintaining the answer to all problems is the second law of thermodynamics.

Towards developing an integrated geometallurgical modelling framework of the minerals beneficiation chain

Early integration of sustainability decisions into the design of the minerals beneficiation flowsheet offers greater potential for reducing environmental impacts at mining and processing sites. The objective of this study is to demonstrate how integration of sustainability indicators and mineralogical attributes can be achieved in minerals processing flowsheet modelling.

A methodology for achieving this integration is proposed in this study. An existing integrated mineral processing unit model that incorporates parameters that capture the effect of variation in process feed stream mineralogical attributes on model outputs, is developed to output sustainability indicators. The effect of ore variability on overall process performance indicators is determined and a set of potential environmental outputs is identified. A set of sustainability indicators that vary with changes in feed ore mineralogy is defined and rated, based on the model outputs.

Edson Charikiya

Postdoctoral Fellow

Dr Edson Charikinya completed his PhD degree from Stellenbosch University in 2015. He is currently a Post-Doctoral Research Fellow at the University of Cape Town, Chemical Engineering Department under Minerals to Metals beneficiation signature theme. His current and future research interests are focused around the area of sustainable mining practices.

An Integrated Modelling Framework

As the mining industry is shifting to more complex operation conditions to accommodate the growing demand for their product and increasing pressure from the more environmentally aware public, new ways of solving these issues will arise from a different angle. A common way to view the mining industry is as an extractive process for a defined timespan. But new technology and modern views on economy introduces us to concepts like circular economy. Here the Mining industry plays a role as a key stakeholder. And new opportunities for mining is on the rise, such as urban mining. Where the mining is a more integrated part of society and have to exist in a more continuous fashion.

The work aims to provide insight in the beneficiation process of a specific plant, to do this a model of the comminution circuit is constructed which contains mineral data such as particle size distribution(PSD) and grindability of the feed, this will run through the model and later be incorporated into the flotation circuits. Where more parameters can be applied and incorporated. This will provide expandability and flexibility where more parts of the beneficiation process is accounted for. This computer model of the beneficiation chain shows the results from a helicopter perspective and can be used for broader understanding and as a wider base for decision making.

Fredrik Axelsson

Visiting Student

I am born and raised in Sweden. Ever since I started my studies in Luleå I wanted to do part of it abroad to get the opportunities to meet and share with people from different countries and cultures. To my great surprise I landed in South Africa.

Towards the development of an integrated modelling framework using mineralogy

The minerals industry is currently facing numerous multifaceted challenges spanning the techno-economic, environmental and social spheres. The adoption of sustainability thinking is a holistic approach to addressing these challenges and their relative interactions, rather than just focusing on individual issues. The ability to do so requires an integrated modelling framework that incorporates mineralogy, so that the effect of ore complexity and variability on one or more of these factors can be simultaneously evaluated and optimised.

The objective of this study is to demonstrate how an integrated modelling framework can contribute in achieving some of the sustainability principles. A case study of a poly-metallic sulfide ore is presented in terms of predicting both metallurgical performance (flotation grade and recovery) and selected environmental indicators (acid rock drainage potential). The framework uses a combination of simple flotation models, theoretical mineralogical predictions, and the element to mineral conversion (EMC) methodology. The framework provides a conceptual starting point for a new approach to traditional process mineralogy studies.

Sithembiso Ntlhabane

MSc Chemical Engineering

"It is not the critic who counts; not the man who points out how the strong man stumbles, credit belongs to the man who is actually in the arena, who actually strive to do the deeds, who comes short again and again, because there is no effort without shortcoming."- Theodore Roosevelt

Using X-ray computed tomography for the 3D textural analysis of drill core in Geometallurgy

Managing ore variability remains an on-going challenge. This study will focus on further developing the method for the quantitative 3D textural analysis of drill core samples scanned by XCT (Jardine, 2016). Here, the robustness of the GLCM will be established in terms of (i) the sensitivity to differently textured ore types displayed by various rock types, as a result of different ore forming processes and (ii) the minimum number of unique 3D pixel-pair relationships that need to be determined to quantify ore texture. Thereafter the focus is on the geometallurgical correlation between quantitative ore texture and comminution and breakage characteristics, by considering (i) which of the textural outputs of the GLCM show the best correlations for ore hardness, comminution product grain and particle size distribution, liberation, and mineral association and, (ii) Are the correlations defined ore specific or can they be generalized for other ores?

The focus of this study will be to use this textural information and correlate it with breakage characteristics, measured from the Short Impact Load Cell (SILC) and JKRBT (Julius Kruttschnitt Rotary Breakage Tester) tests.

Marcelene Voigt

PhD Chemical Engineering

Marcelene juggles between her full-time job as an Economic Geologist at the Council for Geoscience, and her part-time studies. She has mastered the skill of chronic multitasking, and her focus now is to master the skill of perseverance. She hopes to someday transform from a PhD candidate into a PhD survivor.

Can minerals industry cluster contribute to sustainable development in South Africa? Case study in Richards Bay

The economic development of Richards Bay has started with a national strategy to develop a deep-water port for exporting coal, the most important natural resource of South Africa in 1970's. This infrastructure development, together with the overcapacity of coal-fired electricity supply at the time had fostered capital intensive minerals industry to form an industrial cluster around Richards Bay.

However, the recent electricity price surge in the country has raised public outcry over the long-term preferential contract used to attract the investment and there are urgent needs to review the sustainability of the industry, not only its economic sustainability but also social and environmental sustainability.

In this study, as knowledgeable and responsible people are the most important resource for sustainable development, historical contributions of the minerals industry cluster to human and social capital development in the region are examined for future development.

Shuhei Kato

MPhil in Sustainable Mineral Development

"Every man must decide whether he will walk in the light of creative altruism or in the darkness of destructive selfishness."
-Martin Luther King

Characterisation of Rare Earth Elements in Ion-adsorption clays

With increasing advancements in technology and demand for cleaner alternatives for energy, rare earth elements (REEs) have gained significant prominence as critical elements for future generations. The unique chemical and physical properties of REEs make them challenging to process and beneficiate with much conjecture on the optimal separation of REEs. *In-situ* leaching of these elements from low grade (0.05 – 0.3 wt. %) clay deposits is a promising alternative due to its low cost and limited infrastructure. The REEs are associated with clay mineral structures, formed from subtropical weathering of rare-earth rich host rocks (granite).

In this study, an ion-adsorption clay sample from Madagascar is characterised using a combination of process mineralogy techniques enabling the characterisation of the REE within complex, inter-layered kaolinite and muscovite. Based on the understanding of the REE deportment to the clay microstructure, suitable processing routes can be designed and optimised to effectively recover the REEs.

Cody Owen Burcher-Jones

MSc Chemical Engineering

"Victoria Concordia Crescit – Victory Through Harmony" Before we bring peace to the world, we must first find peace within ourselves, and to do that we must find balance and harmony. With that, we can achieve inner happiness, peace between people and harmony with our environment. I strive for this in my work.

Modelling in-situ leaching of rare earth elements

As the grades of ore, containing precious metals, decline leaching can under certain circumstances present a potentially more economically viable and environmentally friendly process option compared with traditional pyro-metallurgical processes.

As experimental investigations of leaching processes are often time consuming and lack scalability, the development of models to simulate these processes has become of increasing importance. However, as the modelling of leaching systems has been approached from various perspectives, there has been an inconsistent approach to their calibration and validation. This has called into question their reliability in predicting full scale leaching operations. Further systematic modelling investigations are therefore required to address these shortcomings.

As models should always be calibrated and validated against experimental data a case study is required. With the demand for Rare Earth Elements (REEs) rising due to their increasingly ubiquitous use in technology, coupled with the fact that they have not been extensively modelled, extracting REEs using in-situ leaching was chosen as a case study.

Nicole Uys

MSc Chemical Engineering

Completed a BSc (Hons) in Chem Eng (2014), a Postgraduate Diploma in Management, specialising in Entrepreneurship (2015) and currently working towards a MSc within MtM at UCT. Passionate about renewable energy, water purification and waste minimisation and would like to identify new opportunities by exploring the lifecycles of materials from an engineering and entrepreneurship perspective

The influence of diffusion pathways on the solution potential in mineral leach systems

High grade ores resources continue to decline and therefore the mineral processing industry is compelled to process lower grade ore resources which are metallurgically more complex. The processing of lower grade ores necessitates the use of less energy intensive processes in order make extraction economically viable. Heap leaching gained popularity as it is most applicable to the leaching of lower grade ores as it only requires size reduction to relatively coarse particle size, typically in the range of 12 – 25 mm, and is resultantly less energy intensive.

However, heap leaching is still characterized by slow leaching times and low recoveries, which have been linked to using these coarser particle sizes whereby desired mineral grains may not be fully liberated. This is due to that leaching occurs on the surface of surface-exposed or subsurface mineral grains exposed to the lixiviant via cracks/ pores induced during crushing. Once the cracks/pores are fully saturated with solution, dissolved reagents n diffuse through to the mineral surface and products out to the bulk solution, resulting in concentration profiles within the pores. Therefore, a fundamental and experimental investigative study was undertaken in order to elucidate the extent to which concentration profiles within diffusion cracks/pores affect the leaching of encapsulated mineral grains.

Buhle Manana

MSc Chemical Engineering

"I am the master of my fate, I am the captain of my soul" - William Ernest Henley (Invictus)

Dry processing: Developing innovative technologies for improved sustainability in mining

Due to current technologies being exploited in the mining industry, access to high grade ores is becoming difficult due to the depths of mining shafts. As a result, most ores that are being mined currently are low grade ores or complex ores. Ore processing is an energy intensive process; energy intensity is increased when processing low grade ores or high grade complex ores in order to attain desired liberation of valuable minerals. For most ores both low grade and high grade ores, grinding is required to expose the surface area of valuable minerals. Conventional mills (tumbling mills) are energy intensive when it comes to grinding and with the global energy crisis, the use of tumbling mills is not sustainable.

The project aims to investigate the use of a high pressure grinding roll (HPGR) followed by air classifiers for the processing of kimberlite and platinum ores; the overall objective of the project is to save comminution energy, save water in comminution and use the air classifier to separate clay minerals and find the economic value of the clay minerals. Clay minerals are problematic in minerals processing as their undesirable effects are observed in comminution through to tailings dams' construction.

Gilbert Ncube

MSc Chemical Engineering

"Courage is not something that you already have that makes you brave when the tough times start. Courage is what you earn when you've been through the tough times and you discover they aren't so tough after all" - Malcom Gladwell (David and Goliath)

The Impact of Mine Waste on the Environment and Community Quality of Life: A Case Study Investigation of the impacts and conflicts associated with Coal Mining in the Mpumalanga Province, South Africa

Coal is one of the world's most used resources and the main energy source in South Africa. However, coal-based power generation industries produce large tonnages of solid waste which pose a significant and irreversible risk to the surrounding environment, and frequently also represent a long-term economic burden and loss of valuable resources. The current emphasis on land disposal and end-of-pipe rehabilitation and reclamation of mine waste by the mining industry has done little to improve its reputation or relieve the continued tensions between mining operations and surrounding communities. The aim of the project is to investigate the relationship between mine waste, environmental degradation and community quality of life to develop a more detailed understanding of the inter-relationship between mine waste, environmental degradation and community impacts, in terms of health and livelihoods. The knowledge and evidence generated is expected to facilitate the development and implementation of integrated and sustainable approaches to the management of mine waste in the South African context.

Bonisile Shongwe

MPhil in Sustainable Mineral Development

"Until purpose is realized, life is meaningless"
Bonisile has development at heart; her work focuses on enterprise development and other livelihood issues with a strong emphasis on empowering rural people and addressing poverty. The Swazi born introvert keeps a small circle of friends, loves family, and enjoys travelling and sport.

The impacts and conflicts associated with waste generated by gold mining in South Africa, with specific emphasis on heavy metal contamination - a case study of Davidsonville (Roodepoort)

Large amounts of gold tailings dams were produced in Witwatersrand area which covers enormous densely populated areas. Often the gold tailings dams contain elevated levels of uranium and other toxic heavy metals that pose a health risk to communities. A lot of newspaper articles and documentaries have emerged where society has associated their health problems to mine waste. Therefore, the aim of the research is to determine the impacts and conflicts associated with gold mine waste, with specific emphasis on heavy metal contamination. The aim will be achieved by, (i) conducting a temporal analysis of incidents of environmental pollution by gold mining with specific emphasis to heavy metals, sources and origins and impacts that this has had on surrounding communities and other activities in the area and the actions taken/repercussions; (ii) establishing current perceptions and understandings amongst the Davidsonville community, the implications that this may/does have on their quality of life and resilience, as well as their legal rights; (iii) analysing the extent of which current community concerns are/have been addressed by the mining industry and/or government, and are supported by scientific evidence and information; and (iv) identifying any gaps and shortcomings with regards to (ii) and make recommendations accordingly.

Phumzile Nwaila

MPhil in Sustainable Mineral Development

Versatile, GIS analyst and Environmental Scientist with multi-disciplinary experience in GIS, Office Administration, Environmental due diligence and Project Management. I hold a BSc in Geology and Geography (UJ); BSc honours degree in Geography (UJ); and currently busy with an MPhil degree in Sustainable Mineral Resource Development (UCT).

Assessment of pollution in the Munkukungwe stream after the closure of the Bwana Mkubwa Mine

Water pollution induced by mining activities is the major environmental challenges on the Zambian Copperbelt. The study was conducted to investigate the pollution situation in Munkulungwe stream located on the Copperbelt. Water samples from four sampling points on Munkulungwe stream near Bwana Mkubwa Mine were analyzed to assess the pollution load. The study assessed the variation of Physical parameters, Heavy Metals and Macro Invertebrates of the stream. Physical parameters and concentration of heavy metals in water samples were determined. pH and Total Dissolved Solids were found to be within the acceptable limits of the Zambia Bureau of Standards (ZABS) at all sampling points. All sampling points recorded high turbidity values above the acceptable limits, while Dissolved Oxygen was below the acceptable limit. Cu was within the acceptable limits while Co, Pb, Fe and Mn were above the acceptable limits. Macro Invertebrates sensitive to pollution were not found in the stream and the average stream rating from the biotic index score was fair. The Results determined, show that the water quality of Munkulungwe stream is polluted. It is recommended that close monitoring of the stream be done.

Lee Mudenda

MPhil in Sustainable Mineral Development

Lee Mudenda is a post graduate student at the University of Cape Town. He enjoys spending time out with his wife Precious, watching football and educating the community on the benefit of environmental stewardship. Grateful for an amazing group of friends that have had a positive impact in his life.

Mine Dust- Implications, Detection and Management

Dust consists of particles in the atmosphere that come from various sources such as soil, dust lifted by weather, volcanic eruptions, and pollution. Although there are numerous natural and anthropogenic sources of atmospheric particulates, mining operations pose the greatest potential risk to human health and the environment. A major problem, especially in the arid and semi-arid areas of Africa, appears to be the contamination by dust fallout from mining operations, from flotation tailing ponds and from smelters.

Dust and aerosol emissions associated with mining operations are commonly associated with significantly elevated levels of hazardous contaminants and are a source of occupational health hazard through direct exposure via inhalation, ingestion and other contamination routes. The changing nature of dust prevalence has led to increased amounts of ultrafine atmospheric particulates with varying elemental compositions. Their subsequent toxicity is also subject to modification. The current work will characterise the changing composition of dust particulates in order to review the present classification system for dusts, using a case study of a fine and ultra-fine process stream coal material generated from a South African colliery.

Rahul Ram

Postdoctoral Fellow

"Be the change you want to see in the world" - Mahatma Ghandi

"Everybody is a genius. But if you judge a fish, by its ability to climb a tree, it will forever live its life believing it is stupid" - Albert Einstein

The Development of an Integrated Approach for Acid Rock Drainage (ARD) Prediction from Waste Rock

World-wide, acid rock drainage (ARD) is one of the largest environmental challenges facing locations with current or previously active mining activities. Formed from the exposure of sulphide minerals to both water and air, and catalysed by naturally occurring iron- and sulphur-oxidizing micro-organisms, ARD is predominantly associated with the mining of sulphidic ores. The effective management of this pollution requires accurate characterisation and prediction of the potential for long term ARD generation.

The aim of this project is to improve ARD characterisation and prediction through the development of an integrated protocol to assess ARD generation. In conjunction with standard ARD tests, the development of improved test methodologies will be used to obtain more reliable estimates for the rates ARD generation at the laboratory-scale under both chemical and microbially-mediated conditions. Integration of these results with a detailed mineralogical and geochemical study of the mine waste will enable a better understanding of the potential for pollution formation. Refinement of a simple mass transport model with results from the aforementioned laboratory-scale tests, and validated with mine-site field tests, will allow for the more reliable prediction of ARD generation.

Alex Opitz

PhD Chemical Engineering

Alexander holds an undergraduate and masters degrees in Chemical Engineering, and is currently completing his PhD in the characterisation and prediction of ARD risks from mine wastes. He has seven years research experience working on industry-related projects across multi-disciplinary fields including mineral leaching, bioprocess engineering and mineral geochemistry.

Characterizing the Environmental Risk Potential of South African Coal Processing Waste

The processing of coal to meet the consumers' specifications produces large volumes of coal waste that impose environmental risks including water contamination, mainly due to acid rock drainage (ARD) and the subsequent mobilization of metals and salts. Another adverse impact is air pollution from spontaneous combustion of coal processing wastes disposed in dumps. The environmental impacts are related to geochemical and physical compositions of the waste.

Previous work at University of Cape Town to characterise the potential environmental risks of the waste was challenged by inadequate characterisation techniques and insufficient evaluation tools. This project aims to optimise the toolbox for characterising the potential environmental risks associated with coal waste through enhancing, validating and evaluating mineralogical, elemental, geochemical ARD and metal risk assessment tools. The characterisation will be done at laboratory scale on a number of coarse - fine coal wastes from different coal fields and operations in South Africa. The optimised characterisation toolbox will provide reliable data for assessment of human health and environmental risk potential of coal processing wastes. Furthermore, the data is useful in the justification and implementation of environmental impact mitigation measures and also providing a basis for value recovery of these wastes.

Annah Moyo

MSc Chemical Engineering

I am an individual who is not satisfied by mediocre when excellence is there, therefore I made it an obligation to do my best to achieve excellence. If we all do our best with sustainability and development as the set goals then the world will be a better place!!

Kinetics of lime dissolution in neutralisation of acid mine drainage

Acid mine drainage (AMD) contains high concentrations of dissolved heavy metals and sulphates, with pH values as low as 2.5. This can be toxic to plant and aquatic life, it is thefore important to treat acidic effluents before being discharged to the environment. AMD treatment involves neutralisation process, where AMD is reacted with alkaline solution to adjust pH to acceptable environmental standards. During neutralisation process, iron and other metals are removed or recovered in a form of oxides or oxyhydroxide precipitates.

Lime is a prefered neutralising agent because of it's reactivity and accessibility. Beside lime's potential benefits, it's neutralisation fuction is reported as a very complicated task especially when high efficiency is targeted. This study therefore seeks to establish a rigorous analysis on lime dissolution kinetics in the context of South African AMD neutralisation. This is to be achieved through emperical models or established mathematical based models, labolatory studies such as the effect of dissolution of lime in a stirred tank under different conditions such as temperature, pH and concentration of different cations are to be explored. This will then provide more value for the successive studies on the formation of iron precipitates and other metal recovery during lime neutralisation.

Senzo Mgabhi

MSc Chemical Engineering

Other than deeper interest in water treatment, hydrometallurgy and chemical engineering science, Senzo is passionate about environment, nature conservation and sustainable development. As a Chemical Engineer, with attained analytical skills and growing aptitude in critical thinking, he seeks to pitch the sustainable solutions that are ethical, safe and environmental friendly.

Two stage separation process for the management of sulfide wastes and associated ARD risks

The beneficiation of coal for down-stream use generates large quantities of solid waste, including overburden, discard and ultra-fine tailings. These wastes contain sulfide minerals, particularly pyrite, which oxidize and give rise to acid rock drainage (ARD), a major source of ground and surface water pollution. Current attempts are focused on end-of-pipe technologies such as carbon capture and storage, clean coal combustion technologies, mining operations and control of pollution. Very little emphasis has been placed on opportunities related to use or recycling of downstream wastes. Sustainability through resource conservation and recycling is a growing field of research and development in which recent researchers have demonstrated the benefits of the principles of sustainability in contrast to the current end-of-pipe approaches. Previous studies at the University of Cape Town in South Africa have demonstrated the technical feasibility of using froth flotation for separating pyritic sulphur from coal ultrafines in a two-stage process, which is aimed at simultaneously eliminating ARD risks and recovering valuable coal. In all case studies investigated to date, desulfurization flotation of base metal sulfide and coal processing wastes resulted in a sulfide-lean tailings which is non-acid generating thus effectively eliminating long-term ARD risks.

Juarez Amaral Filho

Postdoctoral Fellow

Environmental engineer with PhD in Mineral and Environmental Technology at UFRGS – Brazil. Currently researching under the supervision of Prof. Harrison and Prof. Broadhurst, as a post-doctoral fellow. His research interests are environmental issues related to characterization, processing, discard and disposal of minerals wastes and effluents; mineral waste recycling and water reuse; and, ARD prediction, minimization and mitigation.

UCT urban mine-understanding the local context to e-waste processing

Printed circuit boards (PCB's) from end of life electronic waste (e-waste) contain significant quantities of metals. Some of these can be recovered profitably (extracting positive value) while others can become a hazard to the environment and humans if not disposed of appropriately (reducing negative value). High grade PCB's are attractive to e-waste exporters, who because of the nature of the local industry, have the option to cherry pick these leaving behind low grade PCB's with a low positive value or even negative value. There is a need to develop and test process flow sheets that lead to optimal extraction of positive value and the responsible disposal of benign waste streams in the treatment of low and mixed grade PCB's. The process flow sheets must be suitable for adaptation by emerging economies where energy costs, and availability of infrastructure, as would be required for a blast furnace operation, are a primary consideration. A multi-stage hydrometallurgical treatment process, in which whole and cut up unpopulated PCB's are processed is to be developed and tested. In this proposed process, low grade PCB's (usually not multi-layered) go into sequential chemical baths, dissolving different groups of metals at each stage. The remaining substrate can then be sent out for further recycling. Economic and feasibility studies of the processes flow sheets at small to medium scale plants will be investigated.

Thandazile Moyo

Postdoctoral Fellow

"To laugh often and love much; to win the respect of intelligent persons and the affection of children; to earn the approbation of honest citizens and endure the betrayal of false friends; to know even one life has breathed easier because you have lived—this is to have succeeded."- Ralph Waldo Emerson

Development of a process flow sheet for selective metal recovery from waste printed circuit boards and its evaluation using a techno-environmental and socio-economic framework

Waste printed circuit boards (PCBs) from end-of-use Waste Electrical and Electronic Equipment (WEEE) contain significant quantities of metals. Some of these metals are of economic value while others are hazardous to the environment and humans if not disposed of appropriately. An industry has emerged globally for the collection, dismantling and separation of high value components from WEEE. The South African WEEE industry comprises of collection, dismantling and initial separation of components, however, the high value fraction is exported to these centralised operations in Europe, thus leaving the low value fraction and potentially hazardous residue behind. This project aims to develop and evaluate hydrometallurgical process flow sheet options that lead to optimal recovery of value and hazardous metals along with minimisation and sustainable management of waste streams in the treatment of PCBs. The process design will be evaluated within a cluster of small-to-medium-scale industries that contain collection, dismantling and separation units to provide the feed. The evaluation will be based on both, a techno-economic comparison to the established centralised, commercial-scale processing of PCBs, and a socio-economic evaluation of such an industry cluster in terms of job opportunities, skills development and the existing legal and regulatory framework.

Zaynab Sadan

MSc Chemical Engineering

"No man can reveal to you aught but that which already lies half asleep in the dawning of your knowledge. The teacher who walks in the shadow of the temple, among his followers, gives not of his wisdom but rather of his faith and his lovingness. If he is indeed wise he does not bid you enter the house of his wisdom, but rather leads you to the threshold of your own mind." – Kahlil Gibran

Potential Value Recovery from Waste Tyres via Aqueous Phase Reforming

Human population growth and the industrial era has brought about an increase in waste generation. Recycling of waste is becoming increasingly important due to the emphasis placed on environmental sustainability of our planet. Polymeric waste, particularly tyres, are difficult to dispose of and the stockpiles attract mosquitoes, vermin and dangerous reptiles, and is a fire hazard. Burning tyres release hazardous pollutants, are difficult to extinguish and expensive to clean- up. The bulky nature of tyres does not allow for it to be compressed or folded, creating space problems at landfill sites. To mitigate these challenges, waste tyres has the potential to be used as a resource if further recovery of value can be extracted. Tyres are composed of a mixture of synthetic and natural rubber and other compounds, which together form a highly complex structure. The complexity derives from the three dimensional network, formed between polymers, sulphur and a variety of other compounds created via the irreversible vulcanization reaction. This reaction creates transverse bonds that connect the polymer chains to form the cross-linked structure of rubber which result in a product that is elastic, insoluble and which cannot be reprocessed. Current technologies for fuel recovery from waste tyres are energy intensive. An alternative method of Aqueous Phase Reforming (APR), a low energy cost method that uses water as reaction medium, on amphiphilic tyre particles are proposed.

Alvira Mentoor

PhD Chemical Engineering

Dreams are messages God sends us about the future
Dreams light up my path and allow me to see clearly what lies ahead
Dreams calm my soul, lift my spirit and strengthen my bond with God
Without dreams I am a lost soul

Introducing Loop-closure for Phosphates into a Provincial Development Strategy: An analysis of Overlaps of Primary and Secondary Phosphate Processing Technologies

Almost 90% of the global phosphoric acid demand is primarily attributed to fertiliser production for use in the agricultural industry. South Africa primarily relies on the processing of limited igneous phosphate ore deposits found in Phalaborwa, Limpopo for the supply of phosphates; but this is not sustainable as the worldwide phosphate ore reserves are expected to last approximately 100 years (Smil, 2000) due to rising demands and declining ore grades. The work proposed work herein investigates the following: (i) The possibility of using source-separated human urine (or its derivatives) as a raw material at an existing phosphate processing plant, (ii) the socio-economic impacts of operating a small business enterprise that would be involved in the supply of 'raw' or pre-treated urine. To fulfil the abovementioned aim (i), flowsheet analyses, including process simulations on ASPEN Plus will be done to study common phosphoric acid production processes. Urine, and its derivatives will be added at several selected stages of the chemical process and the effects on costs, product flow & yield, resource intensity and eco-efficiency monitored. The second aim of this research will be fulfilled by predicting and assessing the success of a business enterprise such as this through comparison with the already operational REDISA model for waste tyres.

Sizwe Vidima

MPhil in Sustainable Mineral Development

Sizwe Vidima was born in a small township called Clermont, located on the west of Durban and moved to Cape Town for tertiary studies in Chemical engineering. Sizwe is currently a candidate in the Minerals to Metals programme: MPhil in Sustainable Mineral Resource Development and is passionate about inclusive economic development. Words Sizwe lives by: Carpe Diem.

Fabricated soils from ultrafine coal waste

The use of fabricated soils from processing coal waste in mine reclamation projects is an innovative part of the solution for a more sustainable coal mining production. It enables the reduction of the direct environmental, social and economic impact related to current (end-of-pipe) waste disposal approaches and rehabilitation of mine sites.

Trough separation of the acid-generating sulphide fraction as well as further coal production from the fine coal waste using two-stage flotation or an equivalent separation process, a largely benign waste fraction results.

The re-purposing of this waste particulate material into a fabricated soil will be investigated through the addition of amendments such as algae, anaerobic digested sludge and organic compost.

The chemical, physical and biological aspects of the fabricated soil will be defined, including its drainage, nutrient profile and absence of toxic components. Its potential use in mine-site rehabilitation also will be considered.

Juarez Amaral Filho

Postdoctoral Fellow

"Se os senhores da guerra
Mateassem ao pé do fogo
Deixando o ódio pra trás,
Antes de lavar a erva
O mundo estaria em paz!"

Chimarrão, nectar of life and peace **by João Chagas Leite**

Recycling and utilization of mine waste: A gold case study

The discovery of world-class gold deposits in the late 19th century led to the transformation of South Africa's economy from an agricultural to a modern industrial economy. Despite its significant contribution to the economy, the mining industry has been plagued by labour disputes and is widely criticized for its negative environmental impacts. Of particular concern is that fact that the beneficiation of gold results in the production of large quantities of solid waste (including overburden, waste rock and tailings), which accounts for approximately 42% of all waste generated in South Africa. This waste material is typically discarded in tailing deposits, which cover approximately 400km^2 in surface area. These tailings dam pose a significant environmental risk as they can lead to the formation of acid rock drainage (ARD) generation, water pollution, soil contamination, flooding resulting from burst tailings dams and respiratory health impacts to surrounding communities. To minimize the impacts of conventional disposal on the environment date, three main approaches to mineral waste management have been adopted in South Africa. These are namely rehabilitation, recovery, and reuse. While these approaches have been implemented, the reuse option still remains constrained in South Africa. The research findings suggest that the reuse of mine waste is influenced by different parameters such as technology, legislation, material suitability and economics. These parameters can either facilitate or hinder the reuse of mine waste.

Lesley Sibanda

MPhil in Sustainable Mineral Development

"You only live once, but if you do it right, once is enough." - Mae West




FRIDAY 25th NOVEMBER:

4th Year Student Projects





P1- Sulphur Speciation and Associated Acid Rock Drainage Risks in Coal Wastes

Olga Guseva

Thabiso Matlakala

P2- Characterising the Properties and Behaviour of Coal Dust

David Viljoen

James De Beer

P3- Operationalizing the Sustainable Development Goals for mining

Ruvarashe Ndoora

Sinovuyo Zipete

P4- Leaching of Metals from Waste/Reject Printed Circuit Boards

Priyashnie Govender

Kristin Johnson

P6- Developing a water accounting approach for water management of a mining and minerals operations: A Glenover Phosphate Mine Case Study

De Waal Hugo

Olivia Venter

P8- Green Mining

Blessing Chirume

Matimba Mabonda

P9- The influence of anion choice on the kinetics of the ammoniacal leaching of chalcopyrite

Thapelo Selekane

Thakani Ramaru

P10- A Review of Surface Deposit Effects in the Amine and Sulphate Leaching of Chalcopyrite ($CuFeS_2$)

Anderson Chimphango

Benjamin Hall

P51- The role of by-product heat in co-located industrial symbiosis

Winnie Sebopa

Thuso Bulala






SATURDAY 26th NOVEMBER:

MtM & ESDA Sustainable Development Workshop




Impacts of mine waste on post-mining land use- a case (study) of Luanshya town, Zambia

Mining and mineral extraction in Zambia has had long lasting and transformative effects on the country's economy and landscape. Since the first commercial copper production in 1928 in Luanshya, a town located 337km north of the capital Lusaka, its landscapes have been drastically altered. To determine the extent of this alteration, spatial land use data will be collected and used to generate maps. Furthermore, map-based interviews will be held with some local stakeholders in the town to document the diversity of their memories, experiences and perceptions about mining in the town. Analyses of these data will help demonstrate how the physical and socio-economic transformations associated with industrial development have shaped land use in this mining town. Past works on the Copperbelt have concentrated on the types and extent of pollution in the concerned mining towns. This study employs a livelihoods approach to assess the current situation in Luanshya, as well as examines the effects of land changes that have been caused by mining activities. The study will also determine how these mining activities have affected the environment and land use patterns. This work is important because mine waste is a sustainability challenge that needs to be addressed. The study will conclude by exploring land use opportunities that can help improve the environmental sustainability of this once mining-dependent town.

Sakuwaha Grace Kabang'u

MPhil in Sustainable Mineral Development

Kabang'u is a geoscientist working for Rio Tinto Zambia in mineral exploration. When she is not camping in the bush searching for the next copper mine, she spends time studying, reading novels, or learning dance. Growing up in a big family taught her that there is no substitute for hard work.

Prospects for Sustainable Land Use of Rehabilitated Opencast Mines in the Witbank and Highveld Coalfields

Coal is still South Africa's primary source of energy. South Africa is ranked seventh in global coal production and is the sixth largest coal exporter. The extraction of coal, whether through underground or opencast mining, is often associated with serious environmental implications. Opencast mining is particularly of a destructive nature and compromises highly potential agricultural lands, ecologically sensitive environments and development in surrounding areas. The Witbank and Highveld coalfields lie within the critically endangered grassland biome. Approximately 46% of South Africa's total high potential arable soils are found in Mpumalanga. About 12% of these soils have been altered by coal mining activities; with a further 14% subject to coal prospecting applications. Post-mining land rehabilitation and the understanding of the process is therefore vital in order to ensure that land destroyed by mining is put to sustainable use such as agricultural or grazing purposes. The purpose of the research project is to investigate the prospects of sustainably using previously poorly rehabilitated opencast mined areas in the Emalahleni and Middelburg areas. The aim is to review the level of the initial rehabilitation carried out, particularly looking at the soils. As well as establish the potential and benefits of using the land.

Nontobeko Gule

MPhil in Sustainable Mineral Development

"I've learned that no matter what happens, or how bad it seems today, life does go on. I've learned that I still have a lot to learn. I've learned that people will forget what you said, people will forget what you did, but people will never forget how you made them feel."- Maya Angelou

Rehabilitation of Abandoned Asbestos Mines in South Africa

The South African mining history is over a centuries and half old; however, legislature that seeks to uphold the integrity of the environment and societal wellbeing from mining impacts, is only in its third decade. The South African government has embarked on a rehabilitation programme, and abandoned asbestos mines are at the top of the priority list. This work aims to draw out lessons learnt in South Africa's rehabilitation of asbestos mines from the government rehabilitation programme over the past 10 years by: conducting desktop studies, and environmental inspections of the rehabilitated sites in the past decade; presenting best practices and alternative practices from around the global; assessing the environmental footprint of the rehabilitation plans implemented; and investigating the actual post-rehabilitation land use compared to the planned land use. This will be to determine the effectiveness of rehabilitation plans implemented, assess their sustainability based on environmental footprint and social impact, and recommend improvements implementable to the South African rehabilitation practice.

Mpho Phalwane

MPhil in Sustainable Mineral Development

I'm a first year MPhil student and i have seven years minerals processing experience. I believe that mining is a good vehicle for development in Africa, and I'm excited about our role in ensuring that it's of a sustainable kind. But as Mary-Ann Evans said, "The important work of moving the world forward does not wait to be done by perfect men"; in that's spirit we should then not be afraid to keep trying.

An exploration of lived experiences of resettled families in Mazabuka district, Zambia. The case of 12 resettled families by a Nickel mine project

Given the negative impacts associated with resettlement projects and considering it is now close to a decade since the families at Munali Nickel Mine were resettled, the main research question for this proposal is to explore and find out what the experiences of the resettled families at Munali Mine have been?

The aim of the proposal is to explore the lived experiences of the individual males and females comprising resettled families with regards to the coping strategies.

The proposal therefore aims to fill the existing knowledge gap and lack of adequate qualitative, empirical and perceptual baseline data by exploring on the "**lived experiences of resettled families".**

The thesis will be informed by an intersection of constructivism paradigm and phenomenology and will predominantly adopt a qualitative research design and will mainly focus on the 12 purposively sampled families.

Lewis Tumbama

MPhil in Sustainable Mineral Development

Living in two worlds: Lewis is a Social Scientist by training and is working as a Senior Involuntary Resettlement Specialist on a Donor funded Project in Lusaka, Zambia.
Off professional duties, Lewis is watching movies or is actively helping to resolve community developmental needs and leadership matters in his village.

The impact of surface lease agreement pay-outs on socio economic development: A case study of inclusion or exclusion of women in host mining communities near Mokopane

In South Africa most land ownership in the rural areas, where the majority of the mines are found, falls under the leadership of traditional authorities. The purpose of this research is to outline the importance of including women from host mining communities when surface lease agreements are negotiated by the traditional authorities. Women are traditionally excluded from such negotiations because of customary law practices that are applicable to most mineral-rich communities. The research will include a review of communal land rights which include aspects of tenure, customary law, how the Interim Protection of Informal Land Rights Act (IPILRA) is applied in these areas, as well as the economics and benefits arising from mining, and the living conditions around mining areas including resettlement as an alternative. The research will be conducted in an area where mining is already operational and where surface mining rights are already awarded, so that a clear understanding is attained. Questionnaires and focus group discussions will be used to collect real stories and experiences from members of the community chosen for the study.

Mandisi Petane

MPhil in Sustainable Mineral Development

Mandisi Petane is a project officer at the Department of Rural Development and Land Reform. He is currently pursuing his MPhil specializing in Sustainable Mineral Development at the University of Cape Town, focussing on the inclusion of women in Mine Surface Lease Agreement negotiations.

Impact of Copper Mining on the Zambian Copperbelt Province: A case study of Mopani and KCM Mines

Copper mining is the economic mainstay in Zambia, dating as far back as independence. It is also recognised as a force that has fostered urban development on the Copperbelt province. However, the declined economic performance of the Zambian mining sector around the 1980's and 1990's led to inadequate handling of environmental issues emanating from mining activities. These environmental liabilities, in addition to solid waste mismanagement, have led to conflicts between mining houses and the community emanating from numerous issues. The objective of this project is to assess the impacts and conflicts associated with the copper mining sector of the Copperbelt province of Zambia, with a specific focus on the Mopani and KCM mines. This will be achieved through an investigation of the published information and perceptions amongst communities, civil society organizations and government with respect to the 'mine-environment-community cause-effect chain'. From this study, it is expected that the gaps and shortcomings with respect to documented data and factual information will be identified. It is also envisaged that the knowledge generated through this study will assist the Zambian government in policy-making with respect to reducing the socio-economic and environmental impacts of mining, and avoiding mine-community conflicts.

Harrison Sampa Ng'andu

MPhil in Sustainable Mineral Development

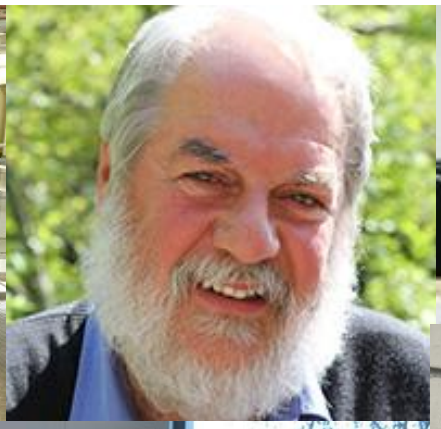
Sampa Harrison Ng'andu joined the Copperbelt University as a Senior Mining Technician/Researcher/Lecturer in September 2013, where he gained his undergrad degree. Currently he is pursuing an MPhil specializing in Sustainable Mineral Resource Development at UCT. He has participated in a number of research works, including; Engineering Education in Zambia, Mining and Sustainable Development: An Expose of the Zambian Mining Industry.





Minerals to Metals

Executive Committee



Professor Dee Bradshaw

SA Research Chair in Minerals Beneficiation
Director, Minerals to Metals Initiative
Department of Chemical Engineering

Dee Bradshaw's focus in on 'adding value' from minerals resources by developing technical levers that incorporate sustainability principles to contribute to the provision of minerals and metals to a sustainable world. With over 30 years of experience, Dee's background is in Flotation Chemistry and Process Mineralogy with her interests expanding into other aspects of the field as she continues to work towards the 'Development of an Integrated Mineralogical Framework for Mineral Processing from ore deposit, including the effects of texture on liberation, of valuable from unwanted minerals to disposal of waste and tailings' (first articulated in 2005). She has been responsible for initiating, setting up and participating in post graduate courses in flotation chemistry, process mineralogy, geometallurgy and building research capacity in general at the UCT, UQ, U of Tasmania and HU. She has participated in JKTech's MetSkills program for Metallurgical Training as well as many professional development courses for industry in South Africa, Australia, Canada and Turkey. This includes her participation as a visiting scholar (2014/ 2015) for the European Master in Georesources Engineering in activities at the University of Liege, Belgium and the Lulea Technical University, Sweden. She delivered a 2 day course 'Sustainability in mining' in Oct 2014 at the Universidad Católica del Norte, Antofagasta Chile. She has supervised over 40 post graduate research students and co-authored over 150 journal and conference papers. In 2013 she was recognised by the University of Queensland as a leader who nurtures and develops her graduate students, a concept she calls 'Living Gold' (http://vimeo.com/73666824).

Associate Professor Jenny Broadhurst

Deputy Director, Minerals to Metals Initiative
Department of Chemical Engineering

Assoc.Prof. Broadhurst has 30 years research and development experience in the field of mineral's beneficiation within various industry and academic organisations. Since joining the Department of Chemical Engineering at UCT in July 2001, Dr Broadhurst has been involved in a number of research and capacity development activities relating to the environmental and other sustainability issues of relevance to the coal-based power generation and primary metal production industry sectors. Such activities include project management of the Minerals to Metals Signature Theme, and co-supervision of under-graduate, post-graduate and contractual research projects. Dr Broadhurst is also involved in the development and presentation of under-graduate (4th year) and post-graduate (MSc) courses pertaining to acid rock drainage and environmental issues in hydrometallurgy. Dr Broadhurst is also currently actively involved in developing inter and trans-disciplinary research capacity and has been actively involved in the establishment and application of a new trans-disciplinary and multi-institutional masters course in the Management of Mineral Resources for Sustainable Development in Africa, as part of the Education for Sustainable Development in Africa initiative under the auspices of the United Nations University.

Professor Sue Harrison

SA Research Chair in Bioprocess Engineering
Director, Centre for Bioprocess Engineering Research (CeBER)
Department of Chemical Engineering University of Cape Town

Sue has some 30 years' experience in research in bioprocess engineering, gained in the industrial and academic arenas. She joined the academic staff of the Department of Chemical Engineering at the University of Cape Town in 1991. Since then 95 MSc and PhD students have been awarded research degrees under her supervision. She regularly authors peer reviewed scientific papers (50 peer-reviewed journal papers over the review period 2011 - 2016) and presents research at international and national conferences (62 at international conferences from 2011 to 2016). Her research in biohydrometallurgy centres on metal extraction from sulphidic minerals through tank and heap bioleaching of low grade and complex ores and electronic waste, biological sulphate reduction for AMD treatment, AMD prevention and value from waste through the circular economy, industrial ecology and maximizing of resource productivity approaches. She collaborates actively with researchers at the University of Mumbai, Cambridge University, Berkeley, Exeter and Imperial College London and with companies in South Africa and abroad. Sue has taught actively into the chemical engineering and biotechnology programmes at undergraduate and postgraduate levels at the Universities of Cape Town and Cambridge. She was awarded the South African DST Research Chair in Bioprocess Engineering, with effect from 2008. She received the DST's "Distinguished Woman Scientist" award in 2008.

Professor Harro von Blottnitz

Director, Environmental & Process Systems Engineering (EPSE)
Department of Chemical Engineering

Enjoying a settled academic position in a highly dynamic and successful department, I define my research and teaching interests by the multiple challenges of sustainable development in developing country settings, esp. as these pertain to resource flows. My interests span topics in the fields of Environmental Systems Analysis, Renewable Fuels Processing (biogas, biodiesel and bio-ethanol), Waste Management and Sustainable Consumption. Since joining the University of Cape Town in 1998, 42 Masters and 4 PhD students have completed their theses under my supervision, and we have published some 45 papers in peer-reviewed journals. I have taught in 7 different courses in the undergraduate curriculum and have introduced sustainability into the curriculum at both the undergraduate and postgraduate level. In 2009, I led a team that hosted the 4th international Life Cycle Management conference in Cape Town. I currently chair the Voluntary Advisory Forum of South Africa's Chemical and Allied Industries Association. From 1995 until May 1998 I was employed at the Chair for Mineral Processing, Beneficiation and Waste Treatment at the Aachen University of Technology in Germany. There, I also completed my doctoral dissertation, in which, I developed an extension of the sampling theory of particulate solids for applications in recycling operations. The doctorate in engineering was awarded summa cum laude in 1999. With my roots in South Africa's Eastern Cape and in Namibia, I commenced my academic career with a BSc in Chemical Engineering (first class honours) from the University of Cape Town in 1990. After two years as a process engineer on a PVC production plant, I returned to UCT in 1993, obtaining an MSc.Eng. in 1994.

Professor David Deglon

Director, Centre for Minerals Research
Department of Chemical Engineering

Professor David Deglon graduated with a BSc Chem Eng in 1989. He worked for some years within the Rand Mines group as a metallurgist on coal, gold and platinum operations. He left Rand Mines in 1992 and joined UCT as a part-time research officer in the Department of Chemical Engineering. The following year he was appointed as a technical officer of the Western Cape Mineral Processing Facility, a collaborative educational venture with the University of Stellenbosch and the Cape Technikon.

In 1998 he was appointed as a senior lecturer within the Department of Chemical Engineering and was promoted to associate professor in 2006 and professor in 2010. He was awarded a PhD degree in 1998 and an MBA in 2002.

He currently holds the Anglo American Platinum Chair in Minerals Processing and is Director of the Centre for Minerals Research, a large multi-disciplinary research centre. His research areas include computational fluid dynamics, flotation and metallurgical accounting.

Professor Alison Lewis

Dean of the Faculty of Engineering and the Built Environment
Director, Crystallization and Precipitation Unit (CPU)
Department of Chemical Engineering

Alison Lewis graduated with a BSc (Chem Eng), MSc (Chem Eng) and PhD, all from UCT, and is a registered Professional Engineer. She is the Dean of the Faculty of Engineering and the Built Environment at the University of Cape Town, and still maintains her position as Director of the Crystallization and Precipitation Unit in the Chemical Engineering Department.

The Research Unit is one of the accredited research units at UCT. The Research Unit has national and international recognition as specialists in the field of Industrial Crystallization and Precipitation, especially in hydrometallurgical applications. Water and brine treatment have become an increasingly important focus of the Unit's activities.

The Research Unit is funded by a range of national and international mineral and chemical processing companies and consists of four staff members and 4 postgraduate students. The outputs of the research unit include 43 postgraduate degrees, 62 international peer-reviewed journal publications, one patent, eight books and chapters in books, and 57 international conference presentations.

Professor Jochen Petersen

Director, Hydrometallurgy Group
Department of Chemical Engineering

Originating from my PhD, which was focussed on assessment and modelling of chromium release from stainless steel smelter wastes, my research interest has always followed a dual approach using extensive experimental characterisation of reaction and transport phenomena during the leaching of minerals and the mathematical modelling of these phenomena with a view to optimising the reaction conditions for most efficient extraction. For many years this was focussed on heap leach processes especially the bioleaching of sulphide minerals. During my post-doctoral years at the University of British Columbia I developed, together with Prof David Dixon, the HeapSim modelling tool in parallel with an extensive assessment strategy to characterise bioleaching from a particular ore sample. This foundation informed further research for many years, expanding the approach to copper, zinc and nickel sulphide bioleaching as well as Au and PGM cyanide leaching in terms of mineral types, accompanied with more fundamental studies on , bioleaching kinetics, gas-liquid mass transfer and inner particle diffusion-reaction phenomena in the heap context. More recently my focus has expanded to non-biological leaching, especially ammonia for copper and nickel leaching, as well as cyanide, thiocyanate and iodine for gold and PGM leaching. The focus on heap leaching and the associated modelling has expanded to include in-situ leaching and tools for predicting non-ideal solution flow phenomena. A recent new direction includes modelling of ion-exchange processes, both in resins and REE adsorption clays, again through a combination of reaction and transport phenomena. I believe as an engineer it is imperative to not lose touch with the industrial application of the fundamental knowledge generated through research. Continued interest exists to use heap and in-situ leach processes for treating low-grade ores (especial of chalcopyrite), waste and tailings materials and even electronic waste. I am also putting a stronger emphasis on evaluating extractive technology in the broader socio-economic context, both locally and globally in terms of commodity cycles.

Dr Megan Becker

Senior Research Officer, Centre for Minerals Research
Department of Chemical Engineering

Megan Becker is a Senior Research Officer leading the process mineralogy initiative in the Centre for Minerals Research in the Department of Chemical Engineering at the University of Cape Town. She has a background in geology (BSc Hons, MSc - University of Cape Town) and a PhD in process mineralogy from the University of Pretoria (2009). Her research interests focus on understanding both the effect mineralogy has on the beneficiation process and the effect of the beneficiation process on the mineralogy, and how one can best use mineralogy information.

She has a keen interest in teaching mineralogy and in mineralogical analysis techniques, and currently manages the QEMSCAN facility in the CMR. She has supervised close to 20 postgraduate students and has over 50 peer reviewed publications in international journals and conference proceedings in the area of minerals beneficiation (including comminution, flotation, hydrometallurgy and environmental aspects such as acid rock drainage).

Professor Aubrey Mainza

Centre for Minerals Research
Department of Chemical Engineering

Prof Aubrey Mainza graduated with a Bachelor of Science (majoring in Metallurgy and Mineral Processing) from the University of Zambia in 1998. He completed his PhD in Mechanical Engineering (specializing in the areas of comminution and classification in mineral processing) at UCT in 2006. He joined the Centre for Minerals Research as a Research Officer in 2002, then became a Senior Research Officer and in 2007 he took up the role of Head of Comminution Research in the Centre for Minerals Research. In 2008 Aubrey was appointed as Senior Lecturer and took an active role in undergraduate teaching core Chemical Engineering and Minerals Elective Courses within the Department of Chemical Engineering. Aubrey become an Associate Professor in 2013 and a Professor at the beginning of 2016. Aubrey is the currently the Deputy Director and Heads of Comminution research for the CMR, and participates extensively in collaborative research with international universities, mining companies, and comminution and classification equipment manufacturers.

Emeritus Professor J-P Franzidis

Minerals to Metals Iniative
Department of Chemical Engineering

Prof J-P Franzidis was the founding Director of UCT's Minerals to Metals Signature Theme (2007–2014) and UCT's inaugural SARChI Chair in Mineral Beneficiation (2008–2014). He joined UCT's Chemical Engineering Department in 1983, and was involved in flotation research for over 30 years. In 1996, he joined the Julius Kruttschnitt Mineral Research Centre (JKMRC) at the University of Queensland, Australia, to lead the AMIRA P9 project, a major research collaboration between the JKMRC and UCT, McGill University, the University of Newcastle (Australia) and Hacettepe University in Turkey. He returned to UCT in 2007 to direct the newly-formed Minerals to Metals Signature Theme, and was instrumental in establishing the Master of Philosophy degree specializing in Sustainable Mineral Resource Development. He retired from UCT at the end of 2014, and now lives in Australia. He continues to participate in the MPhil, as part of the teaching team of the *Research Methodology and Communication* course

Eunice Jacobs

Administrative & Finance Officer, Minerals to Metals Initiative
Department of Chemical Engineering

Eunice has an academic background in accounting, finance and business management. She has gained many skills within finance, human resources and administration through her 6 years at UCT. She also wishes to further her studies in the near future.

Guest Speakers

Professor Hanri Mostert

Prof Mostert's original interests in property law matured into specialisations in Land Law and Mineral Law. In these fields, she has contributed to the most authoritative sources on South African Law, addressing issues of constitutional property protection, landlessness, tenure security, restitution, nationalisation, land governance and mineral resource regulation. Her work on mineral law has been cited with approval by both the Supreme Court of Appeal and the Constitutional Court in South Africa. She emphasizes the state's duties to achieve better living standards and ensure responsible individual autonomy. She defends the notion of engaged citizenship in the enhancement of freedom and quality of life for individuals and the community and comments on the role of the judiciary in building a society subscribing to principles of accountability and trust in property law. Prof Mostert is rated by the National Research Foundation (NRF) as an internationally renowned researcher. She also held fellowships of the Commonwealth Programme, the Max Planck Foundation, the German Academic Exchange Service and the Alexander Von Humboldt Foundation. The South African Department of Science and Technology nominated her as a finalist for the Young Women in Science Award 2012.

Emeritus Professor Don McKee

Prof McKee is the founding director of Sustainable Minerals Institute, UQ, Australia. After completing a BE (Met) and M Eng., he completed his PhD in 1972 at The University of Queensland. After working as a metallurgist working in operations in Australia and USA, he joined JKMRC in 1981 and was the Director from 1989-1996. He was Head, Department of Mining, Minerals and Materials Engineering at UQ and Director of Sir James Foots Institute of Mineral Resources from 1997-2000. He was instrumental in establishing The Sustainable Minerals Institute in 2001, and was appointed inaugural Director, before retiring in 2008. This involved establishing the three additional Centres in SMI (Minerals Industry Safety and Health Centre, Centre for Social Responsibility in Mining and Centre for Water in the Minerals Industry).

Ms Michelle Lawrence

Michelle Lawrence is the Technical Director at Kropz, responsible for the design and development of all mineral processing, related infrastructure and operations. Michelle has been involved with Kropz's Elandsfontein project since the company obtained its prospecting license in July 2013. Michelle has been instrumental in ensuring that socially and environmentally responsible design decisions have been taken and she is driven by her desire to ensure that Kropz becomes a world-class model of responsible mining and processing of fertilizer minerals. Prior to joining Kropz, Michelle held various roles in the mining industry including Operations Manager at Impala Platinum; Design Engineer at DRA International and Ausenco and a Minerals Analyst at Qinisele Resources. Michelle holds an Honours Degree in Chemical Engineering from the University of Cape Town.

Ms Chihiro Kiyonaga- Research

Chihiro is the Research Director in the Economic and Development Section at the Embassy of Japan in the Republic of South Africa. Her master's research study, which she conducted under the auspices of the Programme in Sustainability Science at the University of Tokyo, focused on community perspectives on sustainable development in mining areas in South Africa.

Adjunct Professor Caroline Digby

Caroline Digby is the Director of the Centre for Sustainability in Mining and Industry (CSMI), at the University of the Witwatersrand. The centre focuses on promoting responsible mining across Africa through research, training and dialogue. Its main research areas are health and safety, environment and socioeconomic development. A development economist by training, Caroline has worked in the field of mining, sustainability, education and regeneration for over twenty years. Prior to joining the University of the Witwatersrand, she was Sustainability Director at the Eden Project in the UK, where she also ran the Post- Mining Alliance promoting better practice in post-mining regeneration. She has held posts at the International Council on Mining and Metals, the International Institute for Environment and Development (IIED) and the consulting group CRU International.

Adjunct Professor Mike Solomon

Mike Solomon is a mining engineer of 36 years of experience and an expert on mining investment risk. He is the Chairman of its Mineral Economics Division of the Southern African Institute of Mining and Metallurgy. As a member of the Global Agenda Council for the Future of Mining and Metals of the World Economic Forum he has championed UCT's engagement with the Global Sustainability Goals. He is participating in the project operationalizing the United Nations (SDGs).

Adjunct Professor Jeremy Mann

Jeremy Mann spent most of his career working for Anglo American in various roles in operating and managing positions in metal production, as lead process design engineer on projects involved in numerous global base metal feasibility studies and engineering projects, including project management of capital projects. He was General Manager of the Anglo American Research facility, and before his retirement was Head of Geosciences, Process and S&SD Technology development for the Group. In that role he represented the company on a number of global collaborative research organisations, advisory boards and industry research institutions. Currently he is an adjunct professor at the Department of Chemical Engineering at the University of Cape Town, and is the technology manager for SAMMRI and an independent project manager for AMIRA International, a global broker, facilitator and overseer of syndicated collaborative projects. His engagement with MtM has been as mentor and supervisor in projects that specifically explore mining projects as a joint venture partnership between industry, the regulator and the community and all stakeholders that will realise shared value accruing to all the joint venture participants.

Adjunct Professor Robert Schouwstra

Robert Schouwstra is a mineralogical consultant with over 30 years of experience on the mineralogical aspects of various commodities and mining and processing operations. Involved in investigations on numerous ore bodies he obtained a comprehensive knowledge of the impact of mineralogy on the concentrators, the behaviour of minerals in concentrators, smelting processes and hydrometallurgical operations. Combining his experience in geology, processing and process mineralogy he shaped and managed the Process and Mineralogical Research Department for Anglo American. He brings expertise in mineralogical technique development, process mineralogy and geometallurgy.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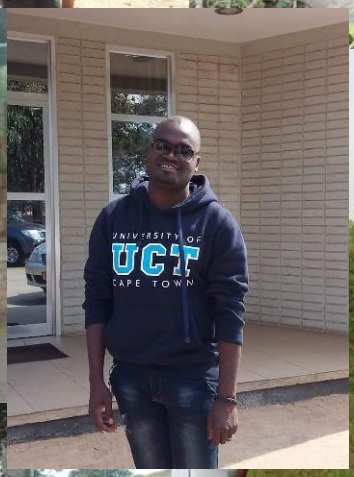
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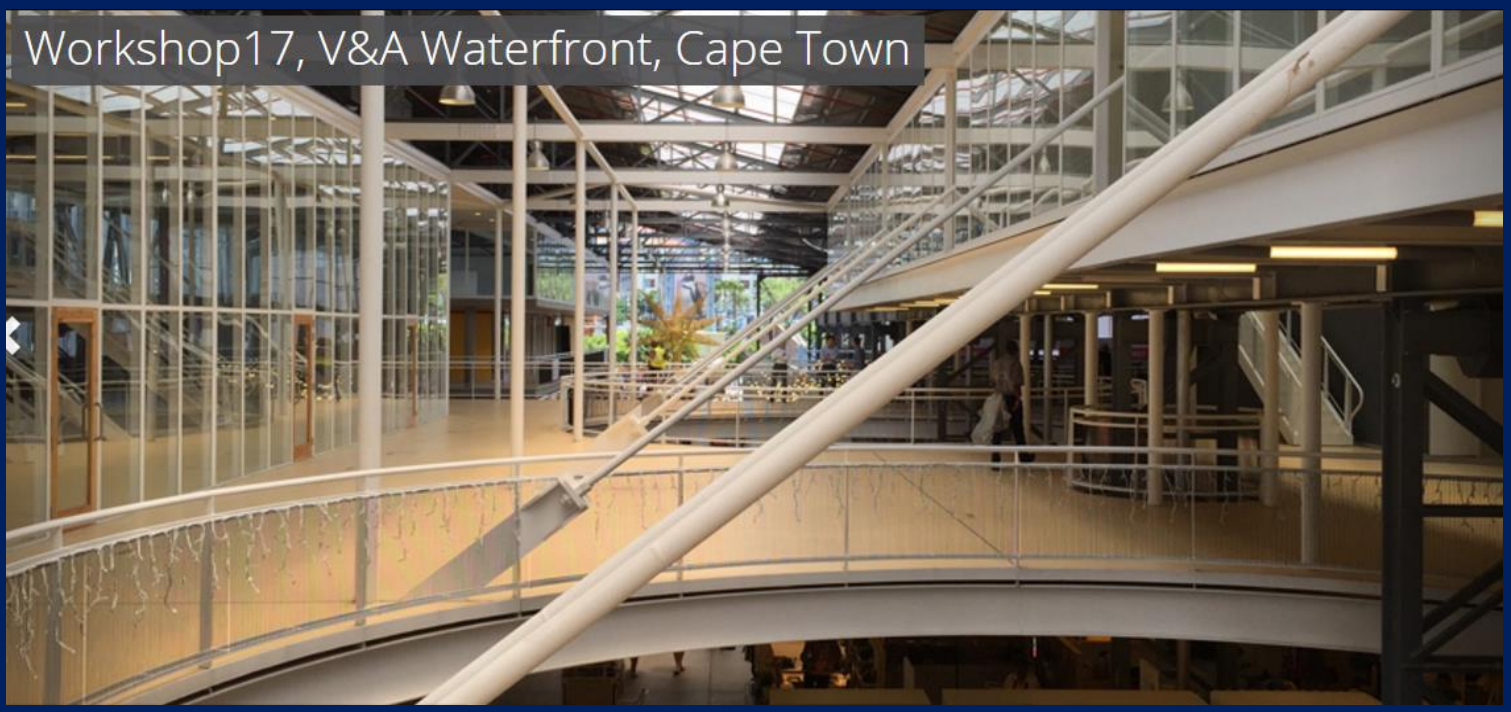

Thank you

MtM Organising Committee

Dr. Rahul Ram, Dr. Juarez Amaral Filho, Ms Nicole Uys,
Ms Zaynab Sadan, Ms Buhle Manana; Mr Cody Burcher-Jones