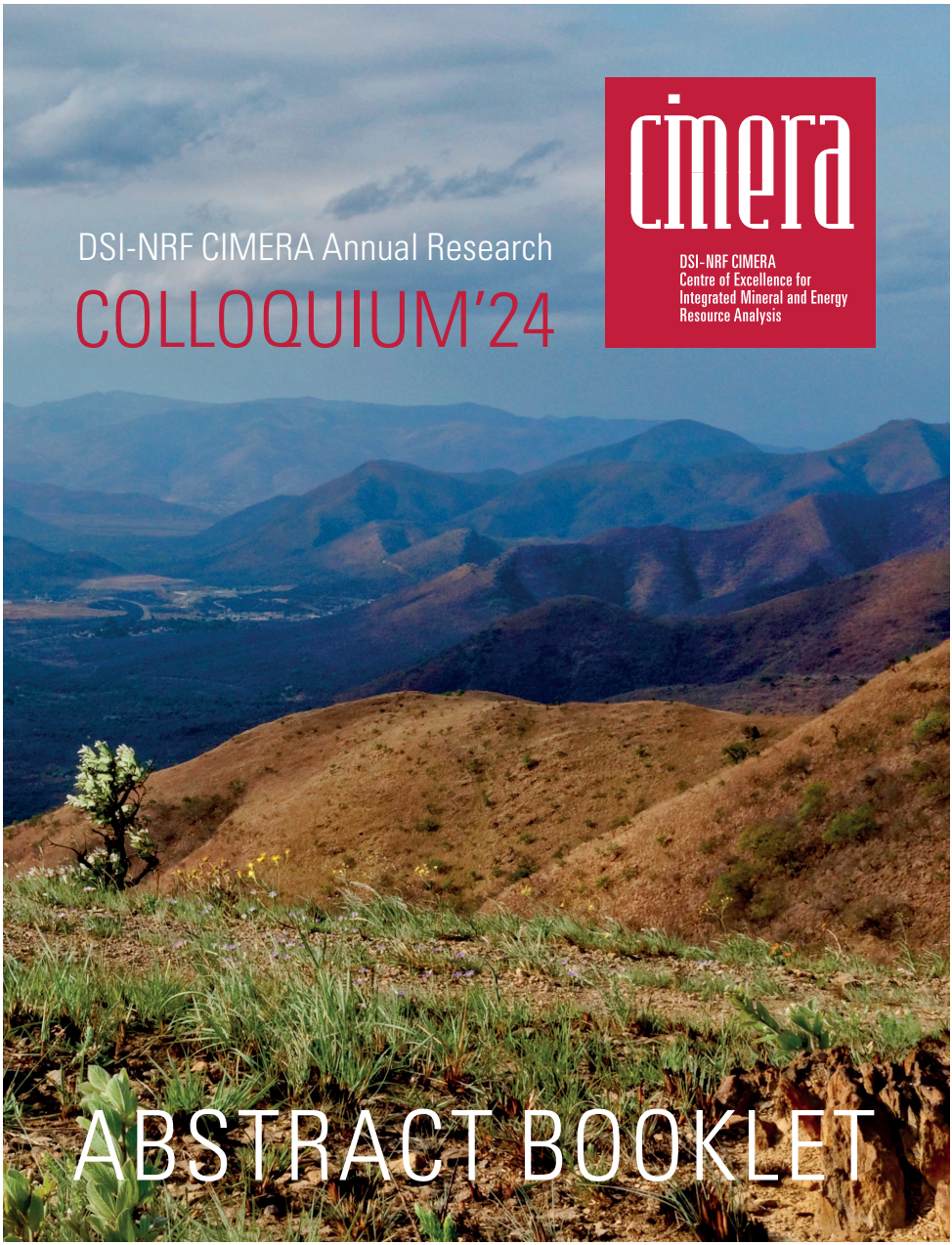

DSI-NRF CIMERA Annual Research

COLLOQUIUM'24

cimera

DSI-NRF CIMERA
Centre of Excellence for
Integrated Mineral and Energy
Resource Analysis

ABSTRACT BOOKLET

science & innovation
Department:
Science and Innovation
REPUBLIC OF SOUTH AFRICA

NRF National Research Foundation | RISA Research and Innovation Support and Advancement

UNIVERSITY OF JOHANNESBURG

UNIVERSITY OF THE WITWATERSRAND, JOHANNESBURG

DSI-NRF CIMERA ANNUAL RESEARCH COLLOQUIUM

25 & 26 November 2024

A hybrid event hosted

at the

Johannesburg Business School

DISCLAIMER: The University of Johannesburg encourages academic debate and discussion that are conducted in a manner that upholds respectful interaction, safety of all involved, and freedom of association as enshrined in the law, the Constitution, and within the boundaries of the University policies. The views expressed during events are expressed in a personal capacity and do not necessarily reflect the views of the University of Johannesburg. This event may be photographed and video recorded for marketing, social media and media purposes. By attending this event, you grant DSI-NRF CIMERA, University of Johannesburg and the University of the Witwatersrand permission to use and publish any recorded material.

DSI-NRF Centre of Excellence for Integrated Mineral and Energy Resource Analysis – CIMERA
Department of Geology
University of Johannesburg | Auckland Park Kingsway Campus (APK)
PO Box 524 | 2006 Auckland Park | South Africa
+27 11 559 4728 (tel) | +27 11 559 4702 (fax)
cimera@uj.ac.za | www.cimera.co.za

Dear All,

We extend a warm welcome to the 2024 DSI-NRF CIMERA Annual Research Colloquium, hosted by DSI-NRF CIMERA at the Johannesburg Business School, University of Johannesburg. We have put together a full programme, with opportunities to share scientific findings as well as time for networking, greeting friends and forming new contacts.

The Colloquium provides a platform for the DSI-NRF CIMERA supported postgraduate students, researchers, and academics from across South Africa to come together and share their research results stemming from the economic geology projects supported by DSI-NRF CIMERA. And we hope to see as many people as possible at our evening event on the 25th of November, a time to network and socialise.

A total of 21 presentations will be given over the next two days, as well 11 poster and 2 keynote presentations; abstracts and keynote bio's are provided herein.

We are extremely pleased to welcome the two keynote speakers:

- Dr Hielke Jelsma (Global Principle Mineral Systems Geoscientist, Discovery AngloAmerican);
- Dr Leonidas Vonopartis (School of Geosciences, University of the Witwatersrand).

At the close of the scientific programme, we will announce the prizes for the best poster and presentation. And present the results from the 'Translate your research' competition. Following this, the students will participate in a soft skills workshop facilitated by Raksha Naidoo (Chairperson of WiMSA and CEO of the Particle Group) and Chane de Jager (Geologist, Impala Bafokeng). The workshop will expose the postgraduate students to many aspects required for the workplace and life after graduation.

DSI-NRF CIMERA is a virtual centre of excellence (CoE) that brings together research excellence, capacity, and resources to enable collaboration across geoscience disciplines and institutions on long-term projects of economic and/or societal benefit in geology, that are locally relevant and internationally competitive. The DSI-NRF funded CoE currently provides direct and indirect funding support to over 50 postgraduate students hosted at 12 geology departments across South Africa; in 2025 we anticipate supporting 70 postgraduate students. The outputs of the research in economic geology benefit the region and the continent, as does the pool of skilled graduate students. Geology and the mining industry are back-bones of the South African economy, and geoscientists play a vital role in the development of the low carbon economy. Please visit our website (www.cimera.co.za) and follow us on LinkedIn, Facebook and other social media platforms for more information on our goals, research focus areas, and activities.

Congratulations to all students on the achievements in your studies to date, and we look forward to interacting with you over the next two days.

Regards,

Professor Nikki Wagner
Director: DSI-NRF CIMERA
nwagner@uj.ac.za

Professor J. Kinnaird
Acting Co-Director: DSI-NRF CIMERA
Judith.Kinnaird@wits.ac.za

KEYNOTE SPEAKER 1: Dr Hielke Jelsma

BIOGRAPHY ■ **Hielke Jelsma** is Principal Geoscientist in Anglo American, a leading global mining company with a diverse portfolio of metals and minerals. He completed his undergraduate training in 1989 and obtained a PhD in geology in 1993 from the Free University in Amsterdam, the Netherlands. Between 1993 and 2003 he lectured geosciences subjects at universities in Zimbabwe and South Africa, acted as geological consultant for exploration and mining companies, and worked as senior researcher within the cross-disciplinary Centre for Interactive Graphical Computing of Earth Systems at University of Cape Town. In 2003 he joined De Beers, the world's leading diamond company, and in 2014, Anglo American. Industry experience includes the evaluation of project areas and mining operations in over 20 countries on six continents. He is currently a member of the Foundational Geoscience Team, seeking generative opportunities and transformative value for the group. He is also involved in the execution and management of research projects and portfolios that support business decisions. He specializes in field mapping, , economic geology and tectonics, topics on which he has published >60 papers in peer-reviewed international journals. Ongoing interests include mineral systems science, metallogenesis, lithosphere geodynamics, supercontinent cyclicity and regional geological assessments. He is a Fellow of the Geological Society of South Africa, recipient of the Des Pretorius Award, and an Honorary Life Member of the Geological Society of Zimbabwe.

Image: Brum / Shutterstock.com

KEYNOTE SPEAKER 2: Dr Leonidas Vonopartis

BIOGRAPHY ■ **Leo Vonopartis** is a lecturer in Economic Geology at the School of Geosciences, University of the Witwatersrand. With a strong foundation in both academia and industry, Dr Vonopartis has a diverse research background, with a particular focus on critical metal mineralisation within granites and pegmatites in southern Africa. After his PhD and Post-doctoral research on magmatic-hydrothermal critical metal deposits, Dr Vonopartis then ventured out of academia and worked as a process mineralogist at Mintek. There he was involved in research and commercial work on the characterisation and evaluation of various ore deposits for exploration, mining, and mineral processing. Since then, he has rejoined the geoscience team at Wits and now specialises in furthering ore deposit science through applied mineralogy, geochemistry, and the sustainable beneficiation of mineral resources. Dr Vonopartis is also involved in meteorite and bolide research, with a particular focus on recent southern African meteorite events, especially in the classification and study of African meteorites."

Image: stock_adobe.com

PROGRAMME

DAY 1: **MONDAY 25 NOVEMBER 2024**				
		08:00 – 09:15	REGISTRATION AND TEA	
	SLOT	TIME	PRESENTER	TOPIC
SESSION 1		09:15 – 09:30	**Prof Nicola Wagner** (UJ) DSI-NRF CIMERA Director	WELCOME
		09:30 – 09:45	**Frank Mazibuko** (NRF) CoE Research + Infrastructure	WELCOME NOTE
	1	09:45 – 10:30	KEYNOTE SPEAKER: **Dr Hielke Jelsma** Global Principal Mineral Systems Geoscientist – Discovery, AngloAmerican	
	2	10:30 – 10:50	**Nancy Muriungi** (RU)	Garnet chemistry in the rare-element pegmatites from Embu County, Kenya
	3	10:50 – 11:10	**Yonela Mnothoza** (Wits)	Geochemistry and geochronology of mafic dykes from the Messina Mine in the Musina Area.
		11:10 – 11:30	TEA BREAK	
SESSION 2	4	11:30 – 11:50	**Mulanga Junior Masakona** (UJ)	Rare Earth Element Potential of the Western Unit of the Schiel Alkaline Complex, Limpopo, South Africa
	5	11:50 – 12:10	**Masonwabe Jubase** (Wits)	An integrated geochemical approach for investigating the composition and origin of the LCT pegmatite melts using trace elements and isotopic analyses from the Namaqua Belt, South Africa
	6	12:10 – 12:30	**Malebati Johannes** (UFS)	In situ multiple sulphur isotope analysis by SIMS of pyrrhotite, pentlandite, and chalcopyrite in the Flatreef, northern limb, Bushveld Complex.
	7	12:30 – 12:50	**Borbor AKK Gibson** (Wits)	Selective Base Metal Sulfides Dissolution from a Pre-treated PGM Flotation Tailings
		12:50 – 13:15	**POSTER PRESENTATIONS** (2-minute elevator pitches)	
		13:15 – 14:10	LUNCH AND POSTER VIEWING; PROFESSIONAL PHOTOGRAPHS	

PROGRAMME (cont.)

SESSION 3	8	14:10 – 14:30	**Jena Moldenhauer** (UCT)	Volcanology, petrology, and geochemistry of selected kimberlites from the Lulo kimberlite field, Angola
	9	14:30 – 14:50	**Glenance Ngomane** (UP)	Geochronology and Metallogenesis of pegmatoidal pods hosted in the Kunene Complex, Angola
	10	14:50 – 15:10	**Simphiwe Polar Ntuli** (Wits)	Petrogenesis of Proterozoic massif-type anorthites from the Kunene AMCG Complex in Angola
	11	15:10 – 15:30	**Mabatho Mapiloko** (Wits)	A contribution of the Paleoproterozoic sulphates to Bushveld Lower Zone sulphides
		15:30 – 15:40	COMFORT BREAK	
SESSION 4	12	15:40 – 16:00	**Marina Yudovskaya** (Wits)	PGE mineralization of the Lower Zone as a precursor of Critical Zone deposits
	13	16:00 – 16:20	**Peace Zowa** (Wits)	A systematic Sr-Nd isotope, major and trace element study of apatite in the Bushveld Large Igneous Province, South Africa.
	14	16:20 – 16:40	**Ntake Mahlatse Manthepeng** (UL)	Geology, geochemistry and occurrence of rare earth elements in coal and coal ash from the Soutpansberg and Waterberg Coalfields, South Africa
SESSION 4	15	16:40 – 17:00	**Eric Saffou** (Wits)	Geomechanical Response of Faulted Depleted Gas Reservoirs to Carbon Utilization and Storage
	16	17:00 – 17:20	**Kenneth Rapetsoa** (Wits)	Innovative seismic solutions for coal exploration and mining – a case study from a South African Coal Mine
		17:20 – 19:00	NETWORKING SESSION AND BRAAI	

PROGRAMME (cont.)

DAY 2: **TUESDAY 26 NOVEMBER 2024**				
		07:00 – 08:00	REGISTRATION AND TEA	
	SLOT	TIME	PRESENTER	TOPIC
SESSION 5		08:00 – 08:20	**Prof Kinnaird** DSI-NRF CIMERA Co-Director	WELCOME
	17	08:20 – 08:40	**Charl D Cilliers** (UWC)	New advances in the development of Virtual Geological Tours
	18	08:40 – 09:00	**Danielle Visagie** (UCT)	Automatic earthquake detection via Machine Learning in Leeu Gamka, Karoo, RSA
	19	09:00 – 09:20	**Ronaldo Malapana** (UL)	Geological and geochemical characterisation of the occurrence of rare earth elements in coal and carbonaceous shale at the Vele Colliery (Tuli Coalfield) in Limpopo Province, South Africa
	20	09:20 – 09:40	**Sibusiso Maseko** (UL)	Geology, Mineralogy And The Occurrence Of Rare Earth Elements In The Coal Deposit At The Uitkomst Colliery (Utrecht Coalfield), Kwazulu-Natal, South Africa
	21	09:40 – 10:00	**Itumeleng Matlala** (UJ)	Effects of chemical functional groups and structural orientation on the reactivity of coals from the Highveld Coalfield
	22	10:00 – 10:20	**Kananelo Letete** (Wits)	Age and origin of the lithospheric mantle below the Ancient Gneiss Complex, Eswatini
		10:20 – 10:35	TEA BREAK	
	23	10:35 – 11:15	KEYNOTE SPEAKER: **Dr Leonidas Vonopartis** School of Geosciences, University of the Witwatersrand	
		11:15 – 11:30	TRANSLATE YOUR RESEARCH PRESENTATIONS AND WINNERS	
		11:30 – 11:40	BEST PRESENTATION AND POSTER	
		11:40 – 11:50	**Prof Webb** DSI-NRF CIMERA Co-Director	COLLOQUIUM CLOSE

PROGRAMME (cont.)

12:00 – 13:15	Soft Skills Workshop Part 1 (students)	OR: ICDP projects update & brainstorming (open to all interested people)
13:15 – 13:45	LUNCH; PROFESSIONAL PHOTOGRAPHS	
13:45 – 15:30	Soft Skills Workshop Part 2 (students)	

Image: ICDP BASE (Moodies) Scientific Drilling Project, Barberton, South Africa.

POSTER PROGRAMME

12:50 – 13:10 **MONDAY 25 NOVEMBER 2024**	
PRESENTER	TOPIC
Fezeka Dliwako (Wits)	Tectonic processes affecting the central Kaapvaal craton.
Fatima Chitlango (UJ)	Characterization of coal seams within the Coalbrook Sub-basin, Vereeniging-Sasolburg Coalfield, South Africa: Insights into the palaeo-depositional environment.
Phumelele Mashele (Wits)	Testing for magma additions through mineral-scale characterisation of selected Upper and Upper Main Zone (UUMZ) subunits.
Joseph Mandondo (UCT)	Reassessing the genetic model for high-grade manganese ore in the northern Kalahari manganese field.
Nthabeleng Ramotholo (UKZN)	The Metallogeny of the mafic-ultramafic Sithilo Complex, Tugela Terrane, Natal Metamorphic Province.
Herve Wabo (UJ)	Contribution of the UJ Paleomagnetism Laboratory t o mineral exploration.
Yolanda Nocuze (UFH)	Mineralogical Characterization and 3D Modelling of the Pyrophyllite Deposit: A Case Study of Idwala Pyrophyllite Mine in the Ottosdal Area, North West Province of South Africa.
Faith Nyathi (Wits)	High-precision geochronology of the Waterberg and Rooiberg Groups to constrain the shallow crustal effects of the Bushveld LIP.
Merrily Tau (UCT)	Proto-kimberlite pre-conditioning of the Kalahari craton root – good or bad?
Kaydi Govenor (Wits)	Constraining the magma sources and tectonic setting of the Kunene AMCG Complex by radiogenic and stable isotope geochemistry.
Thabo Kgarabjang (UL)	Distribution of hydrothermal alteration associated with antimony-gold deposits along the Antimony Line, Murchison greenstone belt, South Africa.
Daniel Timpson (Wits)	Olivine chemistry and Sr-Nd-Hf isotopic constraints on the petrogenesis and metallogenesis of the mafic-ultramafic phase of the Kunene Complex.
Nthatisi Sandra Makhoba (Wits)	Paragenesis of different styles of magmatic sulphide mineralisation in the mafic-ultramafic phase of the Kunene Complex, Angola.

PRESENTATION TITLE	**Garnet chemistry in the rare-element pegmatites from Embu County, Kenya**
PRESENTING AUTHOR	**Nancy Muriungi**
UNIVERSITY	Rhodes University
EMAIL ADDRESS	n.kendi@outlook.com
SUPERVISOR/S NAME/S	Prof Steffen Büttner
DSI-NRF CIMERA FOCUS AREA	CRITICAL RAW MATERIAL
REGISTERED DEGREE	PhD
ORAL OR POSTER	Oral

Neoproterozoic rare-element granitic pegmatites were emplaced along a 3 x 15 km N-S trending field into medium-to-high-grade metamorphic rocks of Embu County, approximately 200 km NNE of Nairobi. These pegmatites show variable stages of melt evolution, from barren (with no rare element minerals) to highly evolved with aquamarine, Ta-rich columbite and REE minerals. Moderately evolved pegmatites contain Nb-rich columbite, niobium-rutile (ilmenorutile) and aquamarine.

Garnet is a common accessory mineral with size variations from 1 mm to 8 cm in diameter. Garnets are dark reddish brown in colour, except for one orange sample of gem quality. Major and trace elements of garnets from different pegmatites show compositional variations, but all are spessartine-almandine solid solutions. Almandine-rich garnets are present in the barren pegmatites, whereas increasing spessartine content correlates with increasing melt evolution.

Variations in total rare earth elements (REE) and yttrium(Y) distinguish three garnet groups. (i) A REE +Y enriched group has total REE contents ranging from 2000 to 6000 ppm and Y contents of 5000 ppm to 14000 ppm. (ii) An intermediate enriched garnet group contains total REE contents of 500 to 2000 ppm and Y of 1000 to 6000 ppm. (iii) In the least enriched garnet group, total REE contents do not exceed 200 ppm, and Y is less than 1000 ppm.

Two REE patterns are apparent in chondrite-normalised diagrams: (1) garnets with increasing ratios from MREE to HREE and (2) garnets with decreasing ratios from MREE to HREE. These patterns indicate the composition of the pegmatite melts, with pattern (1) observed from pegmatites enriched with other REE +Y minerals. All garnet types show low but increasing LREE ratios and a negative Eu anomaly.

Pegmatites containing garnet enriched in REE + Y also contain other REE-rich minerals such as euxenite-Y, monazite, xenotime, and gadolinite-Y. The orange, gem-quality garnet contains very low REE +Y, the highest spessartine proportion (~89 mol%) and the highest MnO content (~40 wt.%). However, the pegmatite from which this garnet was sampled is REE + Y-enriched, as evident from rare element-rich minerals assemblages at the exact location. We interpret the low REE+Y contents in the orange gem garnet as related to its late-magmatic growth when the residual melt was already depleted in REE and Y. The orange garnet is possibly paragenetic with other late-pegmatitic phases such as fluorite, topaz, and amazonite.

In combination with the absence, presence, and composition of other rare element phases, we intend to explore further the potential of garnet major and trace element geochemistry to reconstruct the fractionation and crystallisation history of the variably evolved pegmatites in Embu County.

PRESENTATION TITLE	**Geochemistry and geochronology of mafic dykes from the Messina Mine in the Musina Area**
PRESENTING AUTHOR	**Yonela Mnothoza**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	yonelamnothoza@gmail.com
SUPERVISOR/S NAME/S	Linda Iaccheri, Humbulani Mundulamo
DSI-NRF CIMERA FOCUS AREA	CRITICAL RAW MATERIALS, BASE METALS
REGISTERED DEGREE	Geology
ORAL OR POSTER	Oral

Understanding the geochemistry and geochronology of mafic dykes is important for revealing Earth's geological history, the evolution of continents, and the timing of mineralisation events. The age, geochemistry, and isotopic compositions of mafic dykes can help define the timing and magmatic sources of mineralising hydrothermal fluids for copper mineralisation and contribute to a better understanding of Large Igneous Provinces (LIPs). Subsequently, the aim of this study is to constrain the age, geochemistry and isotopic compositions of mafic dykes exposed in the Messina Mine area. The study analysed 10 samples collected from dykes in the Musina area using petrographic analysis, geochemical analysis of major and trace elements, and U-Pb zircon geochronology. Preliminary, geochemical analysis revealed four distinct groups of samples, each with unique compositional characteristics. These groups show trends consistent with magmatic differentiation through fractional crystallization. Major element analysis revealed that SiO_2 content varied from 35.37% to 52.73%, while MgO ranged from 3.03% to 16.12%. Trace element patterns showed enrichment in Light Rare Earth Elements (LREE) relative to Heavy Rare Earth Elements (HREE), with variations between groups suggesting different stages of magmatic evolution. Zr concentrations ranged from 19.49 to 737.75 ppm, while Nb varied from 2.99 to 32.02 ppm, indicating varying degrees of fractionation and possibly distinct magmatic sources. The geochemical diversity among the sample groups suggests multiple magmatic events or sources, each contributing to the region's complex magmatic history. The variations in elemental concentrations, particularly in Zr and Nb, indicate different stages of magmatic differentiation and possibly distinct mantle-derived sources. Geochronological analysis yielded a range of ages, spanning from approximately 1167 Ma to 2768 Ma, with most ages clustering between 1800 Ma and 2700 Ma. These ages correlate with several significant geological events in the Central Zone of the Limpopo Mobile Belt. Samples dating around 2700-2600 Ma align with the Neoarchean granulite-facies metamorphism (~2700-2600 Ma). Ages around 1800-2000 Ma indicate Paleoproterozoic reworking and metamorphism (~2000-1800 Ma). Some intermediate ages may be related to pre-Bushveld Igneous Complex events. The youngest ages (~1160 Ma) might represent later thermal or tectonic events, perhaps related to Umkondo LIP. This geochemical and geochronology variability is crucial for understanding the timing and processes of copper mineralisation in the Musina area. Furthermore, the potential association of these dykes with LIPs of the Kaapvaal Craton highlights their significance in the broader context of continental evolution. These findings can inform future exploration strategies, leading to more precise targeting of mineralisation zones in the region.

PRESENTATION TITLE	**RARE EARTH ELEMENT POTENTIAL OF THE WESTERN UNIT OF THE SCHIEL ALKALINE COMPLEX, LIMPOPO, SOUTH AFRICA**
PRESENTING AUTHOR	**Mulanga Junior Masakona**
UNIVERSITY	University of Johannesburg
EMAIL ADDRESS	masakonamulanga@gmail.com
SUPERVISOR/S NAME/S	Professor Marlina A Elburg
DSI-NRF CIMERA FOCUS AREA	CRITICAL RAW MATERIALS
REGISTERED DEGREE	Honours in Geology
ORAL OR POSTER	Oral

The Schiel Alkaline Complex (SAC) intruded the Goudplaats Hout-River Gneiss of the Southern Marginal Zone of the Limpopo Complex at ca. 2.06 Ga, using U-Pb dating of zircon. The present study focuses on the western unit of the Schiel Alkaline Complex, which consists of quartz syenite rocks and dykes. Previous studies have compared the Schiel Alkaline Complex to the Phalaborwa Complex which was also emplaced around 2.06 Ga, based on the similar geology and the presence of phosphate in both complexes. Both complexes have apatite as a phosphate-bearing mineral, and this mineral also contains significant concentrations of Rare Earth Elements (REE), with light rare earth elements enriched relative to heavy rare earth elements.

Samples of the western unit of the SAC are being studied for their mineralogy and to determine the REE-bearing minerals. Petrography and X-ray fluorescence (XRF) spectrometry whole rock analysis showed that the sample set contains syenite, pyroxenite, and quartz syenite with minerals such as orthoclase, microcline, plagioclase, pyroxene, titanite, apatite, and quartz. Using Scanning Electron Microscopy (SEM), the rare earth-bearing minerals were determined to be titanite, apatite and to a lesser extent pyroxene. Laser Ablation Inductively Coupled Plasma Mass Spectrometry (LA-ICP-MS) will be used to quantify the trace elements within the minerals in order to establish their contributions to the total REE budget of the rocks.

PRESENTATION TITLE	**An integrated geochemical approach for investigating the composition and origin of the LCT pegmatite melts using trace elements and isotopic analyses from the Namaqua Belt, South Africa**
PRESENTING AUTHOR	**Masonwabe Jubase**
UNIVERSITY	University of Witwatersrand
EMAIL ADDRESS	1053004@students.wits.ac.za
SUPERVISOR/S NAME/S	Dr Nonkuselo Madlakana
DSI-NRF CIMERA FOCUS AREA	CRITICAL RAW MATERIALS
REGISTERED DEGREE	Master of Sciences by Dissertation
ORAL OR POSTER	Oral

Globally, most governments have accepted the call to reduce greenhouse gas emissions to net-zero by 2050 as one of their important pillars of sustainable development (Belousova et al., 2022). Demand for most green energy transition metals, such as Li is expected to rapidly grow in the future and is unlikely to be met by metal recycling alone (Ali et al., 2017). One of the most sought-after green transition metals is Li as is needed to meet the increasing demand for high-energy batteries and battery storage (Müller et al., 2022). In addition, Li is the lightest metal in the periodic table with unique physicochemical properties which make it ideal for battery components. In Africa, Li is mined from hard rock deposits like pegmatites (Mohr et al., 2012) and it is found in relatively small deposits of up to a few 100 m^2 in size within Li-Cs-Ta bearing pegmatites (London, 2018). The main lithium ore minerals are spodumene, petalite, and lepidolite (Minnaar and Theart, 2006; Cerny, London, and Novak, 2012; London, 2018). The Li-Cs-Ta pegmatites are usually hosted within metamorphosed supracrustal rocks in the upper greenschist to lower amphibolite facies conditions (Bradley et al., 2017). However, the origin and the nature of the melt/ fluid enriched in Li-Cs-Ta bearing pegmatites are poorly understood. One of the outstanding questions that remain unanswered is whether this melt originated from 'extreme fractionation of a cooling parental granite' (Bradley and McCauley, 2013), or was sourced directly from dehydration of metasediments during metamorphism (Müller et al., 2017). To understand the origin of melt enriched in Li-Cs-Ta metals, and the underlying reasons why some pegmatites host Li-Cs-Ta metals compared to others, this study uses mineral chemistry (both major and trace) as well as isotopic analyses of apatite, zircon, and quartz to trace the source of the melt responsible for the mineralization of the pegmatite in the Richtersveld subprovince in the Namaqua Metamorphic belt in South Africa. This region is of particular interest because it hosts both Li-mineralized and non-mineralized pegmatites and the fact that the pegmatites are hosted by both amphibolite facies metasedimentary and igneous rocks. Preliminary results from the Li-mineralized pegmatite of this study reveal notable variations in trace and major elements in apatite and zircon, indicating complex interactions between crustal and mantle components. These findings provide fresh perspectives on the petrogenesis of LCT pegmatites and refine our understanding of their geological and geochemical settings within the Namaqua Belt. Moreover, this research enhances the existing knowledge of pegmatite melt genesis, potentially improving the accuracy of lithium resource exploration and exploitation. The integrated methodological approach utilized here offers a framework for future investigations into other pegmatitic systems or analogous geological contexts.

PRESENTATION TITLE	**In situ multiple sulphur isotope analysis by SIMS of pyrrhotite, pentlandite, and chalcopyrite in the Flatreef, northern limb, Bushveld Complex**
PRESENTING AUTHOR	**Malebati Johannes**
UNIVERSITY	The University of the Free State
EMAIL ADDRESS	malebatimoraka@gmail.com
SUPERVISOR/S NAME/S	Dr JJ Keet and Prof CDK Gauert
DSI-NRF CIMERA FOCUS AREA	LIPS AND LICS
REGISTERED DEGREE	MSc (Geology)
ORAL OR POSTER	Oral

The Flatreef, a recently discovered world-class PGE-Ni-Cu deposit constituting a downdip extension of the mineralized unit of the Platreef of the northern limb, is among the best platinum group elements (PGE) hosts globally. This reef was found down-dip from Ivanhoe Minesunderneath the Turfspruit and Macalacaskop farms. This study seeks to better constrain the extent of crustal contamination and assimilation of the lithological units of the Flatreef and improve the understanding of the formation and evolution of the Flatreef/ Platreef/ Merensky Reef PGE mineralization. While previous studies have focused on whole-rock $\delta^{34}S$ analyses of the Platreef, with recent work extending these analyses to the Flatreef, in-situ multiple sulphur isotope (^{33}S and ^{33}S) analysis of the Flatreef has remained unexplored. Here, we present the first in situ multiple sulphur isotope (^{33}S and ^{34}S) analysis of pyrrhotite, pentlandite, and chalcopyrite from the Flatreef, as intersected by drill hole UMT-393 on the farm Macalacaskop, using Secondary Ion Mass Spectrometry (SIMS).

The lowermost unit of the Merensky Reef (MR) and Bastard Reef (BR) of the Flatreef exhibit signs of alteration such as serpentinization and sericitization. Measured $\delta^{34}S$ values of Flatreef ranging from 1 to 8.4‰ are in general agreement with those reported in previous studies for the Platreef (ranging from 1 to 13‰). This consistency suggests similar sulphur sources and processes, although the narrower range between 2 and 5‰ observed in the current study may indicate localized crustal contamination within the Flatreef . Generally, compared to typical mantle sulphur compositions ($\delta^{34}S$= 0±2‰), the $\delta^{34}S$ values indicate that the mineralization process involved surface sulphur or contamination by floor rock dolomitic calc-silicates. The elevated $\delta^{34}S$ values in the BR and Footwall Cyclic Unit (FCU) suggest significant sulphur contamination from the sulphur-rich sedimentary footwall rocks of the Transvaal Supergroup. The $\delta^{34}S$ values below 2‰ indicate minimal contamination of the Flatreef magma. The heterogeneous, non-zero $\Delta^{33}S$ imply that significant crustal contamination was unlikely during the emplacement of the Flatreef, instead, relatively efficient mixing of assimilated material into a long-lived, magma body deep in the crust was possible.

PRESENTATION TITLE	**Selective Base Metal Sulfides Dissolution from a Pre-treated PGM Flotation Tailings**
PRESENTING AUTHOR	**Borbor A.K.K. Gibson**
UNIVERSITY	Economic Geology Research Institute (EGRI), School of Geosciences University of the Witwatersrand, Johannesburg 2000, South Africa
EMAIL ADDRESS	2051925@students.wits.ac.za
SUPERVISOR/S NAME/S	Prof Glen Nwaila and Prof Jochen Petersen
DSI-NRF CIMERA FOCUS AREA	CRITICAL RAW MATERIALS (GEOMETALLURGY)
REGISTERED DEGREE	PhD
ORAL OR POSTER	Oral

In this investigation, a selective base metal sulfide (BMS) leaching approach was evaluated to extract readily leachable residual BMS from an oxidized Platinum Group Element (PGM) flotation tailing material. The highly oxidized tailing material was subjected to chemical pre-treatment in a previous investigation. To obtain optimum treatment conditions for the selective dissolution process we evaluated the BMS extraction in ammoniacal and glycine alkaline systems at varying reagent concentrations, leaching times (3, 6, 12, and 24 hours), temperatures (25°C, 40°C, and 60°C), and pulp densities (10, 20, 30, 40, and 50 w/v%). The BMS content in the material was very low grade for Cu (0.0030%) and Co (0.0007%) but contained a relatively good amount of Ni (0.125%) when compared to its tenor in the as-receive tailing material (Ni, 0.147%). More so, Fe known to be deleterious in downstream BMS recovery processes was about 10 - 12% content in the pre-treated tailings material. XRF/ ICP-OES and TIMA were chemical and mineralogy techniques that were used to characterise the bulk pre-treated tailings feed and leached residue.

The BMS extraction efficiency based on the reagent type was in the order of ammonia-ammonium persulfate> ammonium persulfate> glycine-ammonia-permaganate> glycine-ammonia-peroxide, where the ammonia-ammonium persulfate system exhibited extraction efficiencies of about 26% Cu, 14% Ni, and 33% Co. The ammoniacal systems were more selective with higher kinetic rate toward Cu, Ni, and Co over Fe extraction (6%). Extraction efficiencies in the ammoniacal systems for Cu and Ni were about 2 times more than the glycine systems, but Co was similar. The Ni dissolution was lowest apparently due to the Ni association with Fe but this could not be entirely the case.

The effective leaching parameter conditions determined in the ammonia-ammonium persulfate system were 3 hours, 25°C, and 40 w/v%. However, the overall BMS dissolution efficiency from the pre-treated tailing was low. The low extraction was apparently plausible given the very low-grade BMS tenor in the pre-treated material. Furthermore, considering that the material had been pre-treated in acidic media, the dissolution response suggests that the extraction results were the maximum extractable extent to which the BMS could have been dissolving while the residual BMS was fully locked. This argument is evident by a similar peak extraction efficiency in the range of ±3% observed after all the tested leaching times, even up to 24 hours. However, Ni is an exception, given its relatively high abundance but very low extraction; this extraction phenomenon is yet to be fully understood in the ongoing investigation.

PRESENTATION TITLE	**Volcanology, petrology, and geochemistry of selected kimberlites from the Lulo kimberlite field, Angola**
PRESENTING AUTHOR	**Jena Moldenhauer**
UNIVERSITY	University of Cape Town
EMAIL ADDRESS	jenahauer@outlook.com
SUPERVISOR/S NAME/S	Geoffrey Howarth
DSI-NRF CIMERA FOCUS AREA	MANTLE AND CRUSTAL PROCESSES, AND ASSOCIATED METALLOGENESIS INCLUDING KIMBERLITES
REGISTERED DEGREE	MSc by Dissertation (Geology)
ORAL OR POSTER	Oral

The Lulo Kimberlite Field, Angola, contains hundreds of kimberlite targets where exploration is currently being undertaken by the Lucapa Diamond company. The importance of these targets is due to their proximity to high-value alluvial diamond deposits currently being mined along the Cacuilo River valley. The diamonds under investigation are euhedral in morphology and show sharp edges with little abrasive signs of travel, indicating that their primary kimberlite source is likely to be nearby.

To date, 52 targets have been confirmed as kimberlite pipes within the Lulo Field in which one, or multiple drill cores have been drilled within a single pipe. 142 thin sections from representative kimberlite phases have been obtained from these various boreholes, in order to characterize the internal geology of these kimberlite pipes. The analysis and classification of these individual thin sections helps to identify the internal distribution of the pipes within the Lulo Field. In addition, analysing and subsequently describing fresh representative samples of thin sections and obtaining bulk-rock geochemistry of coherent kimberlites enables these varying types of kimberlites to be put in context with other worldwide occurrences. This all assists with the overarching aim to help build geological models for the Lulo Field, primarily focusing on whether this area is the likely source of the nearby alluvial diamond deposits.

Petrographic analyses of the thin sections allow for the classifications of the kimberlites, at the most primary form of subdivision (based on kimberlite magma texture), as either coherent or magmaclastic. The magmaclastic samples are then further subdivided into mainly Fort á la Corne-type Pyroclastic Kimberlites (FPK) and Resedimented Volcaniclastic Kimberlites (RVK); and additionally Massive Volcaniclastic Kimberlites (MVK). Within the Lulo field, the diverse range of kimberlite deposits found implies that there are various processes contributing to magma fragmentation, pipe formation and infilling – meaning multiple events could have taken place within a single pipe.

The internal distribution of volcaniclastic kimberlite types within the pipes in the Lulo Field varies within each kimberlite. To gain a good understanding of the internal distribution, pipes with many representative thin sections at varying depths provided the best examples. Variations from the typical RVK to PK transition within the crater and diatreme zone will give insight into additional geological processes.

Magmaclasts, which can be described as fluidal-shaped clasts that are comprised of kimberlite magma that formed through a process of magma disruption (fluidal fragmentation or segregation processes), are used to further identify, and interpret the history of emplacement and geological processes. Magmaclasts found within representative samples of predominantly FPK's are the primary focus, with the aim of using a standardized descriptive scheme (devised by Webb & Hetman, 2021) to aid in these identifications and interpretations.

Representative samples of FPK's and RVK's show distinct variations in texture and magmaclast properties. Other features (texturally and magmaclast related) within the samples, are currently being analysed and will further contribute to the unfolding of the geological processes responsible for the formation of these kimberlite pipes.

PRESENTATION TITLE	**Geochronology and Metallogenesis of pegmatoidal pods hosted in the Kunene Complex, Angola**
PRESENTING AUTHOR	**Glenance Ngomane**
UNIVERSITY	University of Pretoria
EMAIL ADDRESS	U22844253@tuks.co.za
SUPERVISOR/S NAME/S	Prof Lorenzo Milani, Prof Grant Bybee, Thoriso Lekoetje
DSI-NRF CIMERA FOCUS AREA	EARLY EARTH MINERAL SYSTEMS AND METALLOGENESIS + BASE, CRITICAL METALS, GOLD AND OTHER DEPOSITS
REGISTERED DEGREE	MSc (Geology)
ORAL OR POSTER	Oral

Proterozoic massif-type anorthosites formed on Earth between 2.7 and 0.5 billion years ago. The Mesoproterozoic AMCG suite of the Kunene Complex (KC) is one of the largest massif-type anorthosite complexes in the world, with an estimated area of over 42,500 km², situated along the southern margin of the Congo Craton in northern Namibia and southern Angola.

Anorthosites frequently contain sulphide-bearing pegmatoidal enclaves primarily composed of coarse-grained high-aluminium orthopyroxene megacrysts, Fe-Ti oxides, apatite, and plagioclase, with minor amounts of olivine, zircon, and sulphides. A zircon age of ca. 1500 Ma was measured on a KC enclave, and it predates the oldest measured age in anorthosite (1440 Ma) by about 60 Myr.

Currently, there are no combined ages for both enclaves and surrounding anorthosites, and this study aims to address this gap by presenting new dates on enclaves and host anorthosites from the Chibemba and Graniserra quarries from the central KC, in Angola. This work also investigated the sulphide disseminations in enclaves.

Use of the Tescan Integrated Mineral Analyser allowed mineral mapping on polished thin sections to identify in-situ datable minerals and characterise the sulphides. Cathodoluminescence and backscattered electron imaging revealed morphology and internal structure of the datable phases and sulphides. U-Pb zircon, apatite, and titanite ages (in-situ and from separates) were determined using Laser Ablation-Inductively Coupled Plasma-Mass Spectrometry (LA-ICP-MS).

At Chibemba, the enclaves yielded U-Pb zircon ages between 1452 and 1505 Ma. The host anorthosite, with a U-Pb zircon age of 1511 Ma, suggests coeval emplacement with the enclave. Primary apatite grains in the enclave, often mm-size, yield U-Pb dates from 1352 to 1378 Ma, and testify to long resetting during cooling, or re-equilibration induced by late anorthosite pulses.

Emplacement of early batches of anorthosite at ~ 1.5 Ga, with coeval enclave crystallisation, was recorded also at Graniserra, with U-Pb zircon ages at 1498-1432 Ma in the hosting anorthosite, and 1495 Ma in the enclave. A 100 Myr span in the concordant anorthosite ages supports re-setting and dissolution-reprecipitation processes, likely due to significant pulse(s) of anorthosite at ~ 1.4 Ga. Such prolonged magma activity would also explain the apatite U-Pb ages at ~ 1400 Ma in both anorthosite and enclaves. Multiple thermal episodes and associated fluid circulation crystallised secondary titanite, with ages at around 1405 Ma and 1365 Ma in anorthosite and enclaves, respectively.

Sulphides, mostly disseminated, are minor constituents within the enclaves. Pyrite is the dominant mineral, followed by chalcopyrite and pyrrhotite, with rare pentlandite and very minor sphalerite, galena, covellite, and millerite. Trace element geochemistry, obtained via LA-ICP-MS focused on pyrite, chalcopyrite, pyrrhotite, and millerite. At Chibemba, pyrite exhibits PGE enrichment, while pyrrhotite shows enrichment in Cu, Ru, Rh, Pt, Pd, resembling other Cu-Ni deposits associated with convergent settings (e.g., Lac des Iles, Aguablanca). At Graniserra, two pyrite types were observed: primary (euhedral-subhedral) and secondary (anhedral-interstitial, sometimes replacing other minerals). Primary pyrite attests to a magmatic origin for the sulphides but low-temperature (hydrothermal?) processes resulted in element enrichment (Cu, Ni) and precipitation of late-stage covellite and millerite.

PRESENTATION TITLE	**Petrogenesis of Proterozoic massif-type anorthites from the Kunene AMCG Complex in Angola**
PRESENTING AUTHOR	**Simphiwe Polar Ntuli**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	1894205@students.wits.ac.za
SUPERVISOR/S NAME/S	Dr B Hayes, Prof G Bybee, Dr T Owen-Smith
DSI-NRF CIMERA FOCUS AREA	LIPS AND LICS
REGISTERED DEGREE	MSc (Geology)
ORAL OR POSTER	Oral

The Mesoproterozoic (ca. 1.5–1.37 Ga) Kunene Complex (KC) in Angola-Namibia comprises the best examples of coalesced, batholith-scale (~42,500 km^2) and plagioclase-dominated plutons, also termed Proterozoic massif-type anorthosites. The KC anorthosite sensu-lato (e.g., anorthosite, leuconorite, leucogabbronorite, leucotroctolite) is associated with volumetrically minor (~10 km^2) contemporaneous mafic-ultramafic intrusions which have the potential to host economic Ni-sulphide ore deposits. Globally, Proterozoic massif-type anorthosites (e.g., KC anorthosite suite) represent an unresolved petrologic problem as the source(s) of their parental melts and tectonic setting remain largely unknown. Moreover, the Angolan portion of the Kunene Complex remains least studied, particularly in comparison to the Namibian domain (Zebra Lobe). The aim of this study is to provide new high-precision radiogenic Sr-Nd-Hf isotopic compositions to constrain the origin and evolution of the anorthosite sensu-lato in the Angolan portion of the Kunene Complex.

The KC anorthosite suite shows an igneous mineral association of plagioclase; minor clinopyroxene, orthopyroxene, olivine, Fe-Ti oxides and biotite. It is divided into six geochronologically and lithologically distinct domains, with five located in Angola. Domain 1 (1380 Ma) in the north comprises olivine-rich anorthosites, separated from the magnetite-bearing and interlayered pyroxene-poor and olivine-rich in Domain 2 (1412–1400 Ma) by the Red Granite Belt. Domain 3 (1391 Ma) structurally mirrors Domain 2 but lacks magnetite-bearing anorthosites, while Domain 4 (1390 Ma) is defined by pyroxene-poor and olivine-rich ridge-valley topography. Domain 5 (1438 Ma) in the SE of the complex is lithologically similar to Domain 2. Domain 6 (Zebra Lobe, 1385 Ma) in NE Namibia is marked by interlayered anorthosites, and it is separated from bulk of the KC by the Kunene River.

Trace element analysis for the KC anorthosite suite reveal systematic variations in the enrichment and depletion patterns. The anorthosites exhibit enrichment in incompatible elements compared to the pyroxene-bearing and olivine-bearing anorthosites, suggesting that the KC anorthosites underwent varying degrees of magmatic differentiation and crustal contamination. The olivine-dominated lithologies likely represent the most primitive/least evolved magmas. General trace element patterns across all domains show enrichment in light rare earth elements and depletion in heavy rare earth elements relative to chondrite. Additionally, enrichment in large ion lithophile elements (e.g., Ba, K, Sr), accompanied by Nb enrichment (except in Domain 2 and 5), low abundances of other high field strength elements (e.g., Ta, Th and Zr) relative to the primitive mantle is apparent. These trace element signatures are reminiscent of arc-related magmatism. Preliminary whole-rock $^{87}Sr/^{86}Sr_{initial}$ (0.70357–0.704918), εNd_{inital} values (-13.27 to +6.89), $\varepsilon Hf_{initial}$ values (-7.76 to +11.76) and average in-situ $^{87}Sr/^{86}Sr_{initial}$ (0.70320–0.70451) in plagioclase are consistent. These results show a complex interplay between depleted mantle (DM) and crustal sources in the genesis of the KC anorthosites. The isotopic signatures and trace elements patterns indicate that the parent melts were primarily derived from a DM source, with significant contributions from a Paleoproterozoic crust, likely in an arc-related tectonic setting.

PRESENTATION TITLE	**A contribution of the Paleoproterozoic sulphates to Bushveld Lower Zone sulphides**
PRESENTING AUTHOR	**Mabatho Mapiloko**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	604450@students.wits.ac.za
SUPERVISOR/S NAME/S	Dr Marina Yudovskaya and Prof Paul Nex
DSI-NRF CIMERA FOCUS AREA	METALLOGENY AND PALEOGEOGRAPHIC IMPLICATIONS OF LAYERED IGNEOUS COMPLEXES (LICS) AND LARGE IGNEOUS PROVINCES (LIPS)
REGISTERED DEGREE	PhD
ORAL OR POSTER	Poster

This study examines sulphide mineralisation within the Lower Zone and Platreef/Critical Zone of the Uitloop area, a part of the Zebediela Nickel project in the central sector of the northern limb. The lithological sequences on Uitloop are richly endowed in base-metal sulphides (BMS), predominantly pyrrhotite, pentlandite, and chalcopyrite, locally associated with platinum-group minerals (PGMs). Sulphide melt fractionation is evident, characterized by pyrrhotite cores with exsolved pentlandite, while chalcopyrite is confined to rims. Secondary sulphide replacement (e.g., by pyrite, chalcocite, and violarite) further complicates the mineral assemblages, suggesting ore-forming system influenced by both primary magmatic processes and subsequent fluid interactions. The distribution of mineralisation is highly is variable: increasing towards the footwall contact, occurring as disseminated and blebby aggregates in mafic/ultramafic rocks and as more extensive net-textured and massive mineralization within footwall rocks, in the Duitschland Formation hornfelses in particular.

The role of crustal sulphur in driving Cu-Ni-PGE mineralization within the Bushveld Complex, especially in the Platreef, is well-recognized; however, debates continue regarding the extent and sources of sulphur contamination. This study integrates multiple sulphur isotope analyses ($\delta^{34}S$, Δ^{33S}, and $\Delta^{36}S$) to elucidate the sources and processes influencing the formation of magmatic sulphide deposits at Uitloop. Sulphides within pristine Platreef rocks predominantly exhibit mantle-derived S signatures, whereas contaminated Platreef and LZ rocks display a broader spectrum of $\delta^{34}S$ (–0.8‰ to +12.1‰) and $\Delta^{33}S$ (–1.8‰ to +0.13‰) values, indicating significant assimilation of Paleoprotrozoic sulphate-derived S and a subordinate amount of Archaean sulphidic S. Footwall lithologies of the Duitschland and Penge Iron formations as well as the Malmani subgroup show $\delta^{34}S$ values ranging from –6.3‰ to +15.2‰ and $\Delta^{33}S$ values of up to 4.15‰, suggesting diverse sulphur sources, including addition of magmatic sulphide melts, biogenic sulphate reduction, and closed-system sulphide-sulphate exchange.

The findings underscore the significant impact of the Great Oxygenation Event (GOE) on styles of Cu-Ni-PGE mineralization. The GOE facilitated the formation of sulphate-rich evaporites, specifically of the Paleoproterozoic upper Duitschland Formation, which were subsequently assimilated by multiple pulses of ascending magma. This assimilation played a crucial role in triggering sulphide saturation, thus facilitating the formation of Cu-Ni-PGE mineralization on Uitloop and other areas of the northern limb. The integration of isotopic data and mineralogical evidence points to a complex interplay of magmatic differentiation, crustal assimilation, and sulphide saturation processes that were influenced by evolving atmospheric conditions during the Paleoproterozoic.

PRESENTATION TITLE	**PGE mineralization of the Lower Zone as a precursor of Critical Zone deposits**
PRESENTING AUTHOR	**Marina Yudovskaya**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	marina.yudovskaya@wits.ac.za
SUPERVISOR/S NAME/S	
DSI-NRF CIMERA FOCUS AREA	METALLOGENY AND PALEOGEOGRAPHIC IMPLICATIONS OF LAYERED IGNEOUS COMPLEXES (LICS) AND LARGE IGNEOUS PROVINCES (LIPS)
REGISTERED DEGREE	PhD
ORAL OR POSTER	Oral

Mantle-derived high-Mg magmas of the Bushveld Complex are thought to contain sufficiently high PGE and Ni contents to form a deposit if their efficient extraction from a large volume of magma is enabled. There is a general belief that the well-known pattern of the PGE distribution in Bushveld Critical Zone rocks, which is characterised by Rh-Pt-Pd enrichment relative to Os-Ir-Ru, is a result of PGE fractionation during partial melting of a mantle source, which has experienced precursive sulphide removal. Therefore, this PGE geochemical specialization is assumed to be inherited from a deep source. However, the most primitive ultramafic sequences of the Lower Zone, including chromite-rich and chromite-poor cumulates, are distinguished by a distinct PGE distribution pattern with relatively flat Os to Pd distribution. The difference reflects more evolved compositions of the Critical Zone magmas enriched in Pt and Pd compared to a U-type magma parental to the Lower Zone. This suggests that the well-recognizable Critical Zone PGE pattern is a result of later fractionation and does not correspond to the initial PGE distribution in primary magmas of a komatiitic lineage. Von Gruenewaldt et al. (1989) assigned the contrasting patterns to different processes of PGE concentration in chromite-rich and sulphide-rich rocks based on the PGE data for the Crasvally chromitite body in the northern limb. Our PGE data for ultramafic rocks of the Lower Zone in the northern limb show that Lower Zone peridotites, regardless of their chromite content, share the flat pattern. At a relatively low total PGE content of generally <150-200 ppb, their PGE patterns are characterised by a depletion in Os and Ir and shallow distribution of Ru, Rh, Pt and Pd, being more similar to those of Grasvally chromite-rich rocks than to those of sulphide-bearing rocks from the overlying Platreef.

The observed enrichment in IPGE and Rh could be a result of the coeval precipitation of IPGM and chromite or PGE partitioning into chromite, which is a notable accessory mineral in ultramafic rocks. However, the known range of PGE content in Bushveld chromite does not support the latter scenario. Our mineralogical study of Grasvally Lower Zone chromitites revealed that PGMs are predominantly represented by Ir-Os-Rh-Pt sulfarsenides, which are located in the interstitial space rather than inside the chromite grains. This supports later PGM crystallization from interstitial liquid initially undersaturated in sulphidic S although sulphide saturation could have been achieved at a later stage of crystallization.

So far, our model suggests that the flat PGE pattern is a universal characteristic of the U-type komatiitic magma undersaturated in sulphide S during its ascent from depth whereas evolved magmas in the chamber reach sulphide saturation due to differentiation or mixing such that their PGE budget is controlled by PGE extraction into the sulphide liquid.

PRESENTATION TITLE	**A systematic Sr-Nd isotope, major and trace element study of apatite in the Bushveld Large Igneous Province, South Africa.**
PRESENTING AUTHOR	**Peace Zowa**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	2399607@students.wits.ac.za
SUPERVISOR/S NAME/S	Dr Ben Hayes and Prof Grant Bybee
DSI-NRF CIMERA FOCUS AREA	LIPS AND LICS (2)
REGISTERED DEGREE	PhD in Geology
ORAL OR POSTER	Poster

The metallogenesis, magmas and mantle sources responsible for the formation of the Rustenburg Layered Suite remain exceptionally controversial despite many years of research and investigation. Recent work by Zirakpavar et al. (2019) using zircon and bulk-rock Lu-Hf isotope data show variations in isotopes and suggests that the Bushveld Large Igneous Province intrusions were produced by the melting of distinct reservoirs. In this study, we present systematic *in-situ* Sr-Nd isotopic compositions, major (Cl, F, OH) and trace element (Na, Mg, V, Mn, Fe, Sr, Y, Zr, Ba, REEs, Th, U) abundances in apatite, from the carbonatitic Phalaborwa Complex, gabbroic-dioritic Marble Hall, Lindeques Drift, Roodekraal, as well as the mafic-ultramafic Molopo Farm Complex and Uitkmost intrusions. Understanding the geochemical properties of these intrusions, which are coeval to the Rustenburg Layered Suite, is essential in providing insights into the metallogenesis of the Bushveld Large Igneous Province. Our aim is to provide the first comprehensive *in-situ* data set for apatite from the Bushveld Large Igneous Province using LA-MC-ICP-MS, Electron Microprobe, and a Tescan Integrated Mineral Analyser. Apatite geochemical information can be used to assess magmatic processes, as it is capable of retaining important geochemical information and a repository of REEs. Major element compositions in this study show that Molopo Farm Complex is Cl-rich, while the Roodekraal, Marble Hall, Uitkmost, Lindeques Drift and Phalaborwa show variable F-rich apatite compositions. Trace element data, although variable for these intrusions, generally show a negative slope suggestive of Light Rare Earth Element enrichment consistent with the apatite trace element trends that have been previously reported for carbonatites and mafic-ultramafic rocks. Our *in-situ* Sr-Nd isotopes show that apatite from the different intrusions record variable initial isotopic compositions at 2.06 Ga for $^{87}Sr/^{86}Sr$ (0.7030 to 0.7130) and εNd (-11 to -2). We show that apatite in the Phalaborwa Complex has similar Sr-Nd isotopic values as the Rustenburg Layered Suite (average initial $^{87}Sr/^{86}Sr$ of 0.7107 and εNd of ~-8 ± 0.8 at 2.06 Ga). *in-situ* apatite in the Uitkomst Complex has initial $^{87}Sr/^{86}Sr$ values at 2.06 Ga (0.7049 – 0.7118) that corroborate with historical whole rock initial $^{87}Sr/^{86}Sr$ (at 2.06 Ga) data which range from 0.7040 – 0.7150. The apatite data provide evidence of *in-situ* Sr-Nd isotopic variability for these intrusions. On the basis of this new isotopic data, we provide insights into the magmatic processes involved in forming the Bushveld Large Igneous Province in order to advance the current understanding of the existing models (e.g., Zirakpavar et al., 2019).

PRESENTATION TITLE	**Geology, geochemistry and occurrence of rare earth elements in coal and coal ash from the Soutpansberg and Waterberg Coalfields, South Africa**
PRESENTING AUTHOR	**Ntake Mahlatse Manthepeng**
UNIVERSITY	University of Limpopo
EMAIL ADDRESS	202253197@keyaka.ul.ac.za
SUPERVISOR/S NAME/S	Prof Christopher Baiyegunhi
DSI-NRF CIMERA FOCUS AREA	5
REGISTERED DEGREE	Master of Science (Geology)
ORAL OR POSTER	Poster

The supply security of rare earth elements (REE) is a global key concern due to the scarcity of their conventional sources and the current increased demand. As a result, the search for new alternative non-conventional sources of these critical elements has sparked a heightened interest in coal deposits as the new alternative source. This quest for alternative sources is essential for countries which are still significantly relying on REE imports. South Africa hosts substantial coal reserves, however, there is a gap in understanding the occurrence, geochemistry, concentration, and distribution of REE in the coals and their associated sediments.

This study aims to investigate the geology and geochemistry of coal stockpiles and coal ash in the Soutpansberg and Waterberg Coalfields to determine the REE content in the samples. For this purpose, thirty coal and coal ash samples were collected from seven coal stockpiles in the Makhado CoAL Projects area and from the Medupi and Matimba power stations. The techniques used included, coal petrography, proximate analysis, ultimate analysis, X-ray diffraction (XRD), scanning electron microscopy (SEM), and inductively coupled plasma-mass spectrometry (ICP-MS). These methods were employed to characterize the coal as well as to give the occurrence and concentration of REE within the studied samples. Several rare earth elements (Er, Tm, Ho, Gd, Yb, Lu, Sm, Eu, Tb, Pr, Dy, Nd, Ce and La), Sc and Y were identified.

Coal petrography revealed that the samples are high volatile bituminous coals predominantly rich in vitrinites, with minor amounts of liptinites and inertinites. Additionally, some samples exhibited high mineral matter with clay minerals being the dominant minerals. X-ray diffraction (XRD) did not detect any of the common rare earth-bearing minerals. However, SEM revealed that the samples exhibited some monazite and xenotime, as well as silicate minerals, correlating the presence of rare earth elements in the samples to these minerals. The concentration of REE in coal was quantified using ICP-MS. The results showed that the concentration of REE within the samples varied between 108 ppm to 325 ppm with the coal ash samples exhibiting more REE content than the coals. Overall, both the coals and coal ash samples were enriched with light rare earth elements (LREE) in comparison to medium REE and heavy REE.

Keywords: Rare Earth Elements, geochemistry, coal, coal ash, Waterberg Coalfield, Soutpansberg Coalfields

PRESENTATION TITLE	**Geomechanical Response of Faulted Depleted Gas Reservoirs to Carbon Utilization and Storage**
PRESENTING AUTHOR	**Eric Saffou**
UNIVERSITY	University of Witwatersrand
EMAIL ADDRESS	Eric.saffou@wits.sc.za
SUPERVISOR/S NAME/S	Prof Musa Manzi
DSI-NRF CIMERA FOCUS AREA	ENERGY RESOURCES
REGISTERED DEGREE	Postdoctoral Fellow
ORAL OR POSTER	Oral

A one-way geomechanical model was constructed in this study to investigate the geomechanical response of faulted depleted gas reservoirs to CO_2 storage. Three simulation scenarios were created to evaluate the geomechanical behaviour of faulted depleted gas reservoir during depletion, enhanced gas recovery and CO_2 storage. The uplift displacement (heave) was estimated to be 1.8 cm in the overburden and a downward vertical displacement of 6 mm in the underburden after 40 years of CO_2 injection. The underburden heaves to accommodate the volumetric deformation experienced by the reservoir during CO_2 injection. Moreover, it was found that geomechanical issues associated with enhanced gas recovery depend on whether the production of natural gas balanced CO_2 injection. Furthermore, CO_2 injection seems to lower the slipping tendency of faults, while depletion causes the opposite effect.

PRESENTATION TITLE	**Innovative seismic solutions for coal exploration and mining – a case study from a South African Coal Mine**
PRESENTING AUTHOR	**Moyagabo K Rapetsoa**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	Moyagabo.rapetsoa@wits.ac.za
SUPERVISOR/S NAME/S	Prof Musa Manzi
DSI-NRF CIMERA FOCUS AREA	ENERGY RESOURCES
REGISTERED DEGREE	Postdoctoral Researcher
ORAL OR POSTER	Oral

Coal mining is characterized by two fundamental challenges: the need to optimize extraction and to ensure safe mining operations. Achieving these goals requires a full understanding of several critical factors. Firstly, it is essential to thoroughly analyze the characteristics of the coal seams targeted for extraction. This includes understanding their thickness, continuity, and the geological conditions surrounding them. Secondly, it is important to identify any unexpected anomalies or variations within the coal seams that could pose potential risks during mining. These anomalies might include sudden changes in seam thickness, faults or fractures, variations in coal quality, or areas where the seam may be difficult to access. By gaining a deep understanding of both the coal seams and any potential hazards ahead of mining, mining companies can develop effective strategies for resource extraction, mitigate safety risks, and ensure the overall efficiency and sustainability of the mining operation.

Peters and Hendrick (2005) demonstrated the application of seismics methods for coal exploration. In this paper we present innovative solutions of land seismic data acquired at a Coal Mine site to image and define geological complex coal seams down to 200 m depth below ground surface. The data were acquired in October 2022 with the goal to delineate 2 coal seam floors and their associated geological structures (faults/fractures), as well as define geometric attributes of the seam such as dip, azimuth and strike. The active seismic data were recorded along 9 profiles with a total length of ~ 8 km. For the recording, a combination of cabled and wireless sensors (1C- 5 Hz, 3C – 10 Hz wireless nodes and 14 Hz cabled sensors) were deployed at each shot position. A 500 kg accelerated weight drop (GPEG-500) was used as the energy source. At each location (5 m spacing), 4-6 shots were generated and stacked during the processing to improve the signal-to-noise ratio (SNR). The seismic records had a length of 2 s and a sampling rate of 2 ms. Despite higher noise levels caused by underground mining activities, the data exhibit high SNR with clear reflections resulting from 2 and 4 coal seams. The seams show as strong reflections due to a significant acoustic impedance (a product of density and seismic velocity) contrast between the seam and host rocks (e.g., sandstones and shales).

Our innovative approach of using wireless recording system and a strong energy source provided high-resolution images of the subsurface, providing detailed information on the geometry of the coal seams down to 2000 m depth. These seismic results have been integrated with geological data to provide a final 3D geological model for mine planning and scheduling at Coal Mine 2.

PRESENTATION TITLE	**New advances in the development of Virtual Geological Tours**
PRESENTING AUTHOR	**Dr Charl D Cilliers**
UNIVERSITY	University of the Western Cape (UWC)
EMAIL ADDRESS	charlcilliers75@gmail.com; 2475326@myuwc.ac.za
SUPERVISOR/S NAME/S	Dr Matthew S Huber (UWC)
DSI-NRF CIMERA FOCUS AREA	GEOLOGY FOR SOCIETY
REGISTERED DEGREE	Post Doctoral Research Fellow
ORAL OR POSTER	Oral

South Africa, a 1997 signatory of the World Heritage Convention, has a current total of ten UNESCO-designated World Heritage Sites. Two of these, the Vredefort Dome, the oldest visible impact crater on Earth, and the Barberton Makhonjwa Mountains, which include some of the world's oldest rocks, were assigned world heritage status specifically because of their geological significance.[1] South Africa also boasts a great many other important outcrops that preserve the history of continents, the emergence and evolution of life, and the origins of man, among others. Some of these "geosites", such as the Sea Point Contact where Cape Granites intrude into Malmesbury Shales,[2] are protected under the National Heritage Resources Act of 1999. Others, like structurally deformed Cape and Karoo Supergroup exposures near Laingsburg,[3] are recognised as important geological field skills training sites for undergraduate university students. Unfortunately, many significant geohistorical outcrops have been damaged or lost due to construction or vandalism, with public access to some sites threatened by land ownership changes. This prompted the Geological Society of South Africa, the Council for Geoscience and the South African Heritage Resources Agency, to document these sites for prosperity, geotourism, and education purposes, inter alia with the Geodyssey mobile phone app.[4]

To support such initiatives, we are using a novel combination of panoramic image-stitching, photogrammetric, image- and video-editing software packages such as "PTGui", "Agisoft Metashape", "LIME", "Handbrake" "Pano2VR", and "Microsoft Clipchamp" to create easily navigable, interactive virtual tours (VTs) of key geological and geoheritage sites. These VTs are being produced at three levels of complexity: 1) to add visual material to Geodyssey; 2) to create Google Earth-hosted geotourism-focused tours; and 3) to build longer, more comprehensive VTs with high resolution imagery to allow professionals to visually access sites, or to supplement student field trips. Notably, the educational efficacy of the latter has been proven with statistical analyses that show significant positive impacts that also increase with target population education levels.[5]

To that end, our most recently produced VTs of key outcrops at Laingsburg (upper Cape Supergroup; Dwyka and lower Ecca groups of the Karoo Supergroup), and the Cape Peninsula (Malmesbury Group; Cape Granite Suite; Table Mountain Group) are presented at differing levels of complexity intended for use by the public, geology students, and experienced geologists alike. The inception of these introductory VTs has facilitated a reproducible workflow that will be expanded (e.g. via hotspot-linked panoramas and/or three-dimensional geo-models) and applied to sites across the country to preserve geoheritage, promote geotourism, and support higher education.

REFERENCES:

1) UNESCO (2024). World Heritage List. https://whc.unesco.org/en/list/

2) Bailie, R.H., Mhlanga, M., Reinhardt, J. (2024). The Sea Point contact, Cape Town, South Africa: a geological site made famous by Charles Darwin's visit. Geological Society, London, Special Publications, 543(1), pp.SP543-2022. https://doi.org/10.1144/SP543-2022-237

3) Flint, S.A., Hodgson, D.M., Sprague, A.R., Brunt, R.L., Van der Merwe, W.C., Figueiredo, J., Prélat, A., Box, D., Di Celma, C., Kavanagh, J.P. (2011). Depositional architecture and sequence stratigraphy of the Karoo basin floor to shelf edge succession, Laingsburg depocentre, South Africa. Marine and Petroleum Geology, 28(3), pp.658-674.

https://doi.org/10.1016/j.marpetgeo.2010.06.008

4) Geological Society of South Africa Western Cape Branch (2024). Geodyssey web map. https://www.gssawc.org.za/geodyssey

5) Van Bever Donker, J., Marshal, D., Maart, R., Mayekiso, L., Solomon, H., Huber, M., Mgabisa, N. (2024). Can Virtual Field Trips be used to prepare students for real fieldwork? EGU General Assembly 2024, Vienna, Austria. EGU24-18133. https://doi.org/10.5194/egusphere-egu24-18133

PRESENTATION TITLE	**Automatic earthquake detection via Machine Learning in Leeu Gamka, Karoo, RSA**
PRESENTING AUTHOR	**Danielle Visagie**
UNIVERSITY	University of Cape Town
EMAIL ADDRESS	VSGDAN002@myuct.ac.za
SUPERVISOR/S NAME/S	Diego Quiros, Alastair Sloan
DSI-NRF CIMERA FOCUS AREA	ENERGY RESOURCES
REGISTERED DEGREE	MASTER
ORAL OR POSTER	Oral

The availability of seismic data has greatly expanded over the years, due to significant advancements in instrumentation and methodology. To efficient process and derive insights from these datasets, seismologists adopted Machine Learning (ML) techniques, which utilize both supervised and unsupervised learning algorithms, that can be trained to identify earthquakes (and potentially yield other geoscientific insights) on seismic data. When compared to traditional or other automated methods, ML can process larger datasets within a shorter period while still yielding accurate results and identifying smaller-scale insights.

South Africa tends to be classified as a stable continental region where seismicity is expected to be low, yet clusters of seismic activity are present throughout. One of these clusters occurs near Leeu Gamka in the Karoo, where the International Seismological Centre (ISC) reported anomalous seismicity near the region between 2007 and 2013. With ongoing shale gas exploration in the Karoo, it is crucial to identify any pre-existing geological structures and determine the potential seismic hazards associated. For these reasons, scientists from the University of Cape Town deployed a temporary seismic array to identify and locate seismicity in the region near Leeu Gamka.

Previous work done by Fynn (2018) on this dataset focused on creating a seismic catalogue based on visual detection and semiautomated methods such as STA/LTA. This project applied a Machine Learning (ML) package, Seisbench, to data collected near Leeu Gamka and tested the validity of the ML catalogue versus that derived from the more standard seismic methods used by Fynn (2018).

While the previous study identified a total of 105 seismics events, the ML approach detected 159 events with 9 false detections. Out of the 105 events identified in Fynn catalogue, 13 were not included in the ML catalogue. However, the ML catalogue shows an additional 50 events, not present in the original catalogue, which are not classified as false detections. These events tend to be smaller in magnitude and coherence than those detected with standard methodologies. These findings suggest that an ML-based approach has potential to enhance seismic detection capabilities and improve our understanding of regions such as the Karoo however, there are still inaccuracies within the ML-based approach that need to be refined to enhance the accuracy and reliability.

PRESENTATION TITLE	**Geological and geochemical characterisation of the occurrence of rare earth elements in coal and carbonaceous shale at the Vele Colliery (Tuli Coalfield) in Limpopo Province, South Africa**
PRESENTING AUTHOR	**Ronaldo Malapana**
UNIVERSITY	University of Limpopo
EMAIL ADDRESS	malapaneron@gmail.com
SUPERVISOR/S NAME/S	Professor Christopher Baiyegunhi
DSI-NRF CIMERA FOCUS AREA	ENERGY RESOURCES
REGISTERED DEGREE	MSc Geology
ORAL OR POSTER	Oral

The demand for rare earth elements (REEs) in the global market is increasing on daily basis due to the surging demand from various sectors, such as emerging economies and green technology. Few studies were carried out on the occurrence of REEs in South African coalfields, despite these attempts, there has yet to be a study that investigates the occurrence of REEs in coal and shale in the Tuli Coalfield. Therefore, investigation of the geology, mineralogy and occurrence of REEs in carbonaceous shale and coal at the Vele Colliery in the Tuli Coalfield was carried out. Core logging, petrographic studies, proximate analysis, ultimate analysis, X-Ray Diffraction (XRD) analysis, Scanning Electron Microscope with Energy Dispersive X-ray (SEM+EDX) analysis and Inductively Coupled Plasma-Mass Spectrometry (ICP-MS) were utilized to analyze the data. The stratigraphic column of the Madzaringwe Formation showed a complete domination of black carbonaceous shales, greyish mudstone, coal and sandstone. The petrographic characterization revealed that vitrinite is the dominant maceral group in the coals, with values of the coals ranging from 59.5-96.9%vol.mmf of the total sample. Collotellinite is the dominant vitrinite maceral, with the total count varying between 52.4%vol.mmf and 74.9%vol.mmf, with vitrodetrinite and pseudovitrinite indicated. The shales have a varying domination of macerals, with half of the samples dominated by inertinite ranging between 48.7-80.4%vol.mmf, with fusinite as the abundant maceral. The mean random vitrinite reflectance (Rov) values for the raw coals ranges between 0.61 and 0.92%, placing the coals in the medium rank C bituminous coal category. The dyke affected coals have vitrinite reflectance ranging between 1.12-1.3% for medium rank B bituminous coals and 2.80% high rank C anthracite.

The proximate and ultimate analysis revealed that the coals have ash 21.2-51.4% with a sulphur content between 1.05-7.19%, while the carbonaceous shale ash and sulphur values range between 67.7-86.2%, and 0.30-3.82%, respectively. The XRD data shows the dominance of quartz and kaolinite for the coals, and dolomite and calcite for the altered dyke coals. The carbonaceous shales reported a large occurrence of kaolinite, quartz and plagioclase. The XRD analysis did not detect any REE bearing minerals in the Vele Colliery samples. Through the analysis of SEM, the data for the coals have shown presence of monazite and xenotime is association with micas, feldspars, chlorite and pyrite within the coal matrix. The EDS data showed that monazite had cerium, lanthanum and neodymium while xenotime had yttrium. Furthermore, clay minerals along with organic matter of the coals and carbonaceous shales are not associated with REEs. The average rare earth elements, yttrium and scandium (REY+Sc) value in the studied coals and carbonaceous shale at the Tuli Coalfield are 102.19mg/kg and 168.65mg/kg, respectively. The accumulation of REEs in the coals and carbonaceous shales were detected in a reducing environment, of weak oxidization. The Vele Colliery carbonaceous shales and coals exhibited light rare earth element enrichment as opposed to heavy rare earth elements.

Keywords: Tuli Coalfield, pseudovitrinite, anomalies, monazite, xenotime

PRESENTATION TITLE	**Geology, Mineralogy And The Occurrence Of Rare Earth Elements In The Coal Deposit At The Uitkomst Colliery (Utrecht Coalfield), KwaZulu-Natal, South Africa**
PRESENTING AUTHOR	**Sibusiso Maseko**
UNIVERSITY	University of Limpopo
EMAIL ADDRESS	Sibusisomaseko129@gmail.com
SUPERVISOR/S NAME/S	Christopher Baiyegunhi
DSI-NRF CIMERA FOCUS AREA	ENERGY RESOURCES
REGISTERED DEGREE	Geology
ORAL OR POSTER	Oral

The surging demand for REEs for use in various industries has stimulated the search for alternative sources for REEs including coal as the conventional deposits cannot meet the high REE demand globally. South Africa is well endowed with coal deposits, having the sixth largest coal resources globally. The Utrecht coalfield is one of the coalfields of the main Karoo basin which is currently underexplored and there is no information regarding the concentration of REEs. Before extracting the REEs, it is significant to examine their distribution and concentration in the coal they are hosted in. The study is aimed to explore the mineralogical and geochemical characteristics, and occurrence of REEs in the coal deposits of the Utrecht coalfield (Uitkomst colliery). Seventeen samples from three different seams (Gus, Alfred, and Fritz) were analysed using petrography, ultimate analysis, proximate analysis, and XRD analysis. the concentration in the samples was determined by ICP-MS, whereas SEM-EDS was used as a direct method and Pearson's correlation as an indirect method to determine the mode of occurrence of the REEs in the samples from the Utrecht coalfield.

The coal samples from the Utrecht coalfield were categorised as medium-rank-B high volatile while others were classified as medium-rank- C high volatile bituminous. The samples showed an increase in ash content towards the dyke intrusion. Few of the samples were low sulphur coals whereas others were medium sulphur coals. the dominant minerals detected by XRD were quartz and kaolinite. The concentration of REEs ranged from 23.15 to 173.50 ppm, the average REE concentration of the Gus seam was 79.47 ppm, 120.79 ppm for the Alfred seam, and 137.63 ppm for the Fritz seam. The samples had an REE concentration higher than that of world and USA coals except for cmb-l1, cb2-l1, cb1-l2, cb2-l2, and cb2-s1, while some samples (cb1-l1, cmb-d, jcbh08b, and jcbh20) were higher than that of Chinese coals. The Pearsons' correlation indicated a mixed inorganic-organic affinity of REEs as shown by the positive correlation. The SEM-EDS analysis of the samples revealed that the REEs have inorganic and organic affinities. The occurrence of the REEs in the samples may be from mafic basalts, felsic-intermediate, hydrothermal, and seawater inputs.

Keywords: Coal, Uitkomst Colliery, Utrecht Coalfield, Mineralogy, Rare Earth Elements, Critical Elements, Sem

PRESENTATION TITLE	**Effects of chemical functional groups and structural orientation on the reactivity of coals from the Highveld Coalfield**
PRESENTING AUTHOR	**Itumeleng Matlala**
UNIVERSITY	University of Johannesburg
EMAIL ADDRESS	ivmatlala@uj.ac.za
SUPERVISOR/S NAME/S	Dr Marvin Moroeng and Prof Nicola Wagner
DSI-NRF CIMERA FOCUS AREA	ENERGY RESOURCES
REGISTERED DEGREE	PhD
ORAL OR POSTER	Oral

The study of the macromolecular structural parameters of coal is essential for pairing them to specific industrial applications. The present study applied Fourier Transform Infrared (FTIR) spectroscopy to characterize the functional groups and X-ray Diffraction (XRD) to characterize degree of crystalline order in coal. Five medium (5) rank D bituminous coals and their float products (density fractionated at 1.7 and 1.9 g/cm^3) from the Highveld Coalfield, South Africa have been studied. Thermogravimetric (TGA) analysis was also used to understand the effect of heat (25–850 ^oC) on the studied coals. The resultant derivative thermogravimetric (DTG) curves were used to evaluate the combustion performance of the coals and to understand the effect of elemental composition, maceral composition, FTIR parameters and orientation of crystalline structure on coal reactivity. Inertinite (semifusinite and inertodetrinite) constitute a high proportion of organic matter in parent coals (70.3 - 88.7 vol.%). Reactive macerals (a combination of vitrinite, liptinite, and reactive semifusinite) are generally enriched in the float products, particularly in the 1.7 g/cm^3 fraction. The H/C ratios (used to estimate aromaticity) are higher for the F1.7 samples compared to the F1.9 samples ("F" denotes float products), indicating the latter is most aromatic. Based on the FTIR parameters, the aliphatic branch and chain parameter (ratio of CH_2/CH_3 at 2800-3000 cm^{-1}) for the parent coals is lower compared to the float products (F1.7 and F1.9 samples). Typical for inertinite-rich coals, condensed aromatic rings (ratio of Ch_{ar} and C=C located ~1600 cm^{-1}) are higher for the parent coals and the F1.9 samples. XRD showed a low degree of crystallinity in F1.7 sample compared to parent and F1.9 samples. The TGA analysis showed that devolatilization, ignition, and burnout occurred much earlier and faster for the F1.7 samples and slower for the parent coals and the F1.9 samples. Longer aliphatic chains mainly influenced the early loss of weight (%) during heating of the F1.7 samples. The polyaromatization started early for the parent coals and F1.9 samples due to high degree of crystalline order and condensed aromatic rings. The structural model for this product makes it more suitable for carbon fibre production, gasification, and combustion. Due to high reactive macerals and high aliphatic hydrocarbons in the F1.7 samples, this product may be suitable products for coking coal and liquefication (synthetic petroleum-based).

PRESENTATION TITLE	**Age and origin of the lithospheric mantle below the Ancient Gneiss Complex, Eswatini**
PRESENTING AUTHOR	**Kananelo Letete**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	1631264@students.wits.ac.za
SUPERVISOR/S NAME/S	Dr Karen Smit
DSI-NRF CIMERA FOCUS AREA	MANTLE AND CRUSTAL PROCESSES, AND ASSOCIATED METALLOGENESIS INCLUDING KIMBERLITES
REGISTERED DEGREE	MSc
ORAL OR POSTER	Oral

The Ancient Gneiss Complex (AGC) and Barberton Greenstone Belt (BGB) in the eastern Kaapvaal Craton are key to understanding early craton formation and the onset of plate tectonics. To understand the region's tectonic evolution from a mantle perspective, we analyse mantle xenocrysts from the Dokolwayo Carbonate-rich Olivine Lamproite in Eswatini. These xenocrysts reveal the composition and evolution of the lithospheric mantle below the AGC, thermo-barometric conditions and diamond stability during kimberlite eruption, and evidence of subduction within these minerals.

Olivines exhibit Mg# ([Mg/Mg + Fe] ×100) between 89.8 and 93.6, with the majority corresponding to harzburgitic and lherzolitic compositions. Five olivines with Mg# > 92.7 indicate derivation from depleted dunitic residues produced by primary melt depletion. Among 55 analysed peridotitic garnets, the majority (96.4%) are fertile G9 lherzolites and only 3.6 % are depleted G10 harzburgites. The G10 garnets display sinusoidal REE_N patterns (REE_N refers to chondrite normalisation) that indicate a partial melting residue origin. In contrast, the majority of G9 garnets (n = 43) show normal REE_N patterns, with $LREE_N$ depletion and flat $MREE_N$-$HREE_N$ slopes (Lu/Gd_N = 1.5). Seven G9 garnets, display fractionation within $MREE_N$-$HREE_N$, this, together with their negative Ti and Y anomalies and elevated Zr contents, suggest re-enrichment by a low-temperature fluid metasomatic agent. One G9 garnet is heavily enriched in $LREE_N$ with flat $MREE_N$-$HREE_N$, implying second-stage chemical overprint possibly by the kimberlite melt, which would have re-enriched the garnet in incompatible elements.

All 72 eclogitic garnets exhibit normal REE_N patterns, negative Sr anomalies, and slightly positive Eu anomalies (Eu/Eu^* = 0.99–1.27). The majority (83%) are gabbroic, reflecting plagioclase-bearing oceanic lithosphere protoliths. Additionally, 63% have Na_2O > 0.07 wt.% and classify as G4D (Grütter et al., 2004), suggesting a strong diamond association. In line with clinopyroxenes from the J4 fertile lherzolite (Stachel et al., 2022), the Chrome-diopsides in our suite show moderate to extreme $LREE_N$ enrichment (La/Sm_N = 0.9–3.8), progressive $HREE_N$ depletion, and HFSE depletion (Nb, Ti, Zr). Omphacites originate from a plagioclase-bearing protolith at low-pressure conditions, evidence is seen in their Na/Na + Ca > 0.2 and K_2O < 0.01 wt.%, positive Sr anomalies, as well as their humped REE_N patterns.

Evidence for subduction of oceanic lithosphere is observed in both omphacites and eclogitic (gabbroic) garnets. On-going $\delta^{18}O$ analyses will investigate variations from the mantle value of 5.5‰ (Mattey et al., 1994), which could indicate a hydrothermally altered oceanic crust protolith. Kyanites are eclogitic and their presence at Dokolwayo signifies subduction activity. Nine lherzolitic garnets contain high-Cr contents (Cr_2O_3 > 5 wt.%) and show low Lu/Er_N suggesting they formed from partial melting at low pressures in the spinel stability field (Stachel et al., 1998) and were possibly subducted to greater depths.

Clinopyroxene geothermobarometry indicates a 220–230 km lithospheric mantle thickness, with diamond stability > 860 °C. Peridotitic garnets yield Ni-in-garnet temperatures between 980 and 1210 °C (Canil, 1999), and their projection onto the clinopyroxene-derived geotherm revealed they are derived from diamond stability field.

Future work includes Lu-Hf isotopic analyses on peridotitic and eclogitic garnets to constrain the age of the lithospheric mantle below the AGC and the timing of subduction.

REFERENCES

Canil, D., 1999. The Ni-in-garnet geothermometer: calibration at natural abundances. Contributions to Mineralogy and Petrology, 136(3), pp.240-246.

Grütter, H.S., Gurney, J.J., Menzies, A.H. and Winter, F., 2004. An updated classification scheme for mantle-derived garnet, for use by diamond explorers. Lithos, 77(1-4), pp.841-857.

Mattey, D., Lowry, D. and Macpherson, C., 1994. Oxygen isotope composition of mantle peridotite. Earth and Planetary Science Letters, 128, pp.231-241.

Stachel, T., Viljoen, K.S., Brey, G. and Harris, J.W., 1998. Metasomatic processes in lherzolitic and harzburgitic domains of diamondiferous lithospheric mantle: REE in garnets from xenoliths and inclusions in diamonds. Earth and Planetary Science Letters, 159(1-2), pp.1-12.

Stachel, T., Aulbach, S. and Harris, J.W., 2022. Mineral inclusions in lithospheric diamonds. Reviews in Mineralogy and Geochemistry, 88(1), pp.307-391.

PRESENTATION TITLE	**Tectonic processes affecting the central Kaapvaal craton**
PRESENTING AUTHOR	**Fezeka Dliwako**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	2320205@students.wits.ac.za
SUPERVISOR/S NAME/S	Dr. Karen Smit and Dr. Linda Iaccheri
DSI-NRF CIMERA FOCUS AREA	MANTLE AND CRUSTAL PROCESSES, AND ASSOCIATED METALLOGENESIS INCLUDING KIMBERLITES
REGISTERED DEGREE	MSc
ORAL OR POSTER	Poster

The Kaapvaal Craton in southern Africa is one of the best-preserved ancient environments for studying early Earth processes (e.g., Anhaeusser, 2014). Existing knowledge of the evolution of the Archaean Kaapvaal comes primarily from studies on the Barberton granite-greenstone terrane and the Ancient Gneiss Complex. The central Kaapvaal is craton has received significantly less attention compared to its peripheral regions, leaving gaps in our understanding of its formation and evolution.

This study aims to address these gaps by investigating the age and evolution of the central Kaapvaal Craton. This will be done through analysing TTG gneisses from the Johannesburg Dome and rare peridotitic xenoliths that were sampled by the Roberts Victor kimberlite upon ascent..The age of lithospheric mantle will primarily be determined using Lu-Hf isotopes of garnets from the Roberts Victor peridotites, along with Pb-Pb isotopes in clinopyroxene. Crystallisation ages of the Johannesburg Dome TTGs will be determined through U-Pb isotopes in zircons. These crustal ages will be supplemented by Sm-Nd and Lu-Hf isotopes on a subset of samples in order to shed light on the timing of crustal formation and the potential protolith of the TTGs.

Preliminary results from Roberts Victor show that the xenoliths have transitional pyroxenitic-lherzolitic assemblages, similar to the compositions of Voorspoed diamond mineral inclusions (Viljoen et al., 2018). Calculated pressures and temperatures range between 2.8 GPa and 5.2 GPa and 681 and 1021 °C, yielding a lithospheric thickness of 220–230 km below the central Kaapvaal. Age dating of these xenoliths will allow us to know whether the lithosphere attained this thickness during Archaean craton formation, or later during lithospheric evolution.

The 29 TTG samples from the Nooitgedacht Platform of the Johannesburg Dome have metaluminous to peraluminous whole-rock compositions (Anhaeusser, 1999), and overall have similar compositions to TTGs from worldwide Archaean granite-greenstone terranes. The Nooitgedacht TTGs are characterised by being silica-rich (SiO_2 ~70 wt.%), aluminous (Al_2O_3 ~15 wt.%), with high Na_2O (3–7 wt.%) and a Na_2O/K_2O ratio greater than 1 (Anhaeusser, 1999; Van Tonder and Mouri, 2010). The Nooitgedacht TTGs exhibit $LREE_N$ enrichment and $HREE_N$ depletion relative to chondrite composition and this indicates metasomatism, TTGs in Archaean loacalities worldwide show this REE pattern relative to chondrite composition.

Investigating the specific age relationships between the mantle roots of cratons and their overlying crust will help constrain the mode of craton formation (Pearson et al., 2021), whether at convergent margins, within a stagnant or partially mobile lid, and with either plume and/or subduction geochemical signatures. This study aims to shed light on the tectonic processes that shaped the heart of the Kaapvaal Craton and the continental assembly and tectonic events that influenced this ancient part of southern Africa.

PRESENTATION TITLE	**Characterization of coal seams within the Coalbrook Sub-basin, Vereeniging-Sasolburg Coalfield, South Africa: Insights into the palaeo-depositional environment**
PRESENTING AUTHOR	**Miss Fatima Chitlango**
UNIVERSITY	University of Johannesburg
EMAIL ADDRESS	zonkechitlango@gmail.com
SUPERVISOR/S NAME/S	Prof Nicola Wagner and Dr Marvin Moroeng
DSI-NRF CIMERA FOCUS AREA	ENERGY RESOURCES
REGISTERED DEGREE	PhD
ORAL OR POSTER	Poster

Understanding the physical and chemical properties of coal is vital for deciphering its paleodepositional environments, and it also informs utilization, mining methods, and mine planning. This study aims to conduct a detailed characterization of borehole core coal samples from the Coalbrook Sub-basin, Vereeniging-Sasolburg Coalfield, South Africa, to gain insight into the petrology, mineralogy, and geochemistry of coal occurring within this under-studied part of the MKB and ultimately decipher the paleodepositional environments. Forty coal samples from four boreholes, namely SLD01a, 02a, 04a, and 06a, were characterized using proximate and ultimate analyses, petrography, X-ray diffraction (XRD), and X-ray fluorescence (XRF).

The samples are classified as low-rank A sub-bituminous to medium-rank D bituminous with variable maceral composition, dominated by inertinite group macerals ranging from 42.0 to 90.6 vol% (semifusinite, fusinite, and inertodetrinite). The dominance of inertinite macerals in these coals suggests oxidation and paleofires in and around the mire. The vitrinite to inertinite ratio (V/I) varies from 0.06 to 1.14 (highest in sample B from DLS01a) and suggests a dry and oxidizing environment, except for sample B from SLD02a. The occurrence of both inertinite and vitrinite also reflect variations in palaeomire conditions, from oxic to anoxic. The dominant minerals in the studied coals are kaolinite (mainly detrital) and quartz (detrital), showing a syngenetic mode of occurrence. Authigenic kaolinite precipitated in cell lumens and maceral pores under acidic pH levels. Inertodetrinite was observed to be closely associated with liptinite (mostly sporinite) and detrital minerals (quartz and clay), indicating the reworking of charcoal associated with fluvial influences. A geochemical plot of Al_2O_3/TiO_2 suggests that the provenance of the detrital minerals in the coals were mostly derived from felsic and intermediate sources. Total sulphur contents are generally low, apart for sample B from borehole SLD02a. This indicates the dominance of fluvial facies, with the paleomire experiencing marine transgression. The microlithotype facies plot suggests that the coals from the Coalbrook Sub-basin were deposited in lacustrine and lower deltaic depositional environments. The depositional sites for the coals from the Coalbrook Sub-basin slightly differ from other coalfields in the MKB as they were mainly deposited in deltaic and fluvial depositional environments. Gaining insights into the depositional environment and coal's properties could uncover other applications and facilitate strategic decisions that align with global energy trends and economic opportunities.

PRESENTATION TITLE	**Testing for magma additions through mineral-scale characterisation of selected Upper and Upper Main Zone subunits**
PRESENTING AUTHOR	**Phumelele Mashele**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	
SUPERVISOR/S NAME/S	Prof Lewis Ashwal, Dr Ben Hayes, Prof Frederick Roelofse
DSI-NRF CIMERA FOCUS AREA	LIPS AND LICS (2)
REGISTERED DEGREE	PhD
ORAL OR POSTER	Poster

Evidence of magma replenishment within layered mafic-ultramafic intrusions include changes in physical properties (e.g. density), mineral composition, the crystallising mineral assemblage and / or isotopic changes. In many cases, there is a lack of isotopic data to support official igneous stratigraphic boundaries or a proposed level of magma replenishment. This is not the case for the isotopically proposed lower boundary of the Upper Zone, the uppermost unit of the 2.06 Ga Rustenburg Layered Suite. Evidence for magma addition at this level of the intrusion includes a change in the nature of Ca-poor pyroxene, from pigeonite below to primary orthopyroxene above, reversals in mineral compositions and changes in Sr- and Nd-isotopic compositions across the boundary. Less clear is the cause of cyclic mineralogical variations associated with the abundant Ti-bearing magnetitites of the Upper Zone. They remain open to interpretation either as products of open- or closed system petrogenetic processes. As a result, the origin and assembly of these important titanium hosts remains equivocal.

As part of an ongoing study of the ICDP BVDP drill core that will produce Sr-Nd-Hf multi-isotope profiles of the Upper- and Upper Main Zone, we present geochemical trends of a transect through an Upper Zone magnetitite to test whether magma replenishment may have been responsible for its formation. The thin (25 cm) second lower magnetitite layer (LML2) was chosen because it is the lowest compact magnetitite with unambiguous margins in the Upper Zone core sampled.

Our current data show that the economically significant titanium of magnetitite LML2 occurs in two modes. It is homogeneously distributed as a solid solution component of magnetite crystals, and it forms irregular ilmenite patches, the largest of which are 500 microns across. The ilmenite patches represent 2.5 to 20 % of the upper and lower parts of the magnetitite, respectively. Individual patches may be at magnetite-silicate contacts, or form part of contact-parallel stringers disturbed by silicate aggregates or irregularities at the base of the magnetitite.

In terms of mineralogy, we found that the abundance of disseminated magnetite in the core box of magnetitite LM2 is variable at a decimetre scale. Magnetite-gabbronorite forms the hangingwall and an 8-cmthick magnetite-leucogabbronorite forms the immediate footwall, grading into a magnetite-gabbronorite at depth. In terms of geochemistry, labradorite occurs in the footwall (An_{50-66}) and in the hangingwall (An_{52-61}). Magnetite gabbronorites of the hanging wall and footwall have comparable Sr/Al_2O_3, REE and incompatible trace element patterns.

Due to similar mineralogical composition, there is no major shift in whole rock REE patterns, in the footwall and hangingwall Sr/Al_2O_3, An%, Mg#, thus suggesting that magma replenishment may not have occurred at the level of magnetitite LML2. The more primitive An% content of plagioclase within LML2 is attributed to secondary processes.

Further work will employ Sr-Nd-Hf isotope systematics to further elucidate whether magma replenishments may have been responsible for the formation of Ti-magnetite layers of the Upper Zone.

PRESENTATION TITLE	**Reassessing the genetic model for high-grade manganese ore in the northern Kalahari manganese field**
PRESENTING AUTHOR	**Joseph Madondo**
UNIVERSITY	University of Cape Town
EMAIL ADDRESS	Joseph.madondo@uct.ac.za
SUPERVISOR/S NAME/S	Rosalie Tostevin
DSI-NRF CIMERA FOCUS AREA	MANGANESE AND IRON
REGISTERED DEGREE	Postdoctoral Research
ORAL OR POSTER	Poster

The Hotazel area comprises a minor segment, specifically 3%, of the high-grade manganese ore found within the Kalahari Manganese Field. Nonetheless, it represents a significant economic resource with substantial potential for future manganese exploration. This study utilizes Drillcore HDH-6 from the Hotazel mine to examine the textural-mineralogical transition from high-grade manganese ore to low-grade Mamatwan-type ore within the lowest Braunite lutite layer and assesses the significance of this transition. Comprehensive analyses were conducted using Electron Microprobe, X-ray Powder Diffraction (XRD), X-ray Fluorescence (XRF), and petrography to generate detailed chemical and mineralogical profiles indicative of manganese ore grade transition.

The findings reveal a distinct division within the lowest Braunite lutite layer, distinguished by variations in Mn grade, mineralogy, chemistry, and texture. The upper half is characterized by a high-grade Mn zone, exhibiting a massive, coarse to fine-grained texture resembling Wessels-type ore. In contrast, the lower half manifests as a low-grade zone, displaying laminated, fine-grained characteristics akin to Mamatwan-type ore.

The high-grade zone further divides into distinct paragenetic zones with specific mineralogical variations. Notably, the low-grade zone is not entirely unaltered, exhibiting dissolution textures and higher than expected abundances of hausmannite. The transformation of low-grade sedimentary manganese ore into high-grade Wessels-type ore is attributed to metasomatic hydrothermal alteration. Hydrothermal fluids likely utilized the Kalahari unconformity as a conduit, percolated vertically through the Hotazel rocks, resulting in the leaching of carbonate and silica. This process led to the loss of CO2 and minor SiO2, with the redistribution of Ca, Mg, and other trace components, alongside iron input from the hydrothermal fluids. The metasomatic hydrothermal event permeated the entire lowest Braunite lutite layer, with the low-grade zone representing the distal margins of the hydrothermal fluid front, leading to residual Mn enrichment.

PRESENTATION TITLE	**The Metallogeny of the mafic-ultramafic Sithilo Complex, Tugela Terrane, Natal Metamorphic Province**
PRESENTING AUTHOR	**Nthabeleng Ramotholo**
UNIVERSITY	University of KwaZulu-Natal
EMAIL ADDRESS	216000607@stu.ukzn.ac.za
SUPERVISOR/S NAME/S	Dr Lauren Hoyer and Dr Nigel Hicks
DSI-NRF CIMERA FOCUS AREA	BASE METALS
REGISTERED DEGREE	MSc Geology
ORAL OR POSTER	Poster

The Sithilo Complex is a mafic-ultramafic segment of the Evuleka ultramafic unit that occurs in the Mandleni thrust sheet within in the Mesoproterozoic Tugela Terrane, Natal Metamorphic Province, South Africa. The complex stretches over a length of ~3 km and width of up to 1 km and has been identified as a potential source of chromium. Despite previous investigations and minor extractions of ~2000 t chromite in the 1950's, the complex remains under-explored. This study revisits the Sithilo Complex to 1) delimit potential resources using modern analytical techniques to identify areas within the complex that may contain significant mineral deposits. 2) Define the relationship between the mineralization and the host rock through modelling. 3) Understand formation processes by studying the mineralogy and formation mechanisms of the complex, to gain insights into the creation of similar ultramafic intrusions in the region. The Sithilo Complex and the podiform chromite ore deposits within it have previously been hypothesized to be preserved as an ophiolite complex, thus originating from obducted oceanic lithosphere during accretion.

A total of 49 cores were drilled by the Interprovince Prospecting Co. Ltd from a section of Bantu Reserve No. 21 (Sithilo Hill, now referred to as the Sithilo Complex). The logs from these cores were acquired from the Council for Geoscience and are used here to determine the 3D relationships within the complex. These boreholes were distributed across the NNW to eastern regions of the Sithilo Complex and from the 49 core logs, 26 indicate the presence of chromite ore. The cores lengths range from 26 to 81 m, revealing abundant serpentinization of the harzburgite, dunite, and olivine pyroxenite units in the complex. The podiform chromite bodies intersected are lenticular to nodular chromite stringers and pods, and chromite also occurs as disseminated accessory phases within the serpentinsed units of the complex. The thicknesses of the disseminated chromite range from 0.6 to 13.2 m, while chromite seams exhibit thicknesses between 0.6 and 6.7 m. Chromite seams are predominantly concentrated in the NNW regions, while units hosting disseminated chromite are mainly found in the northeastern to eastern regions of the complex. The chromite deposits are characterized by low Al_2O_3 content (less than 5%). The Cr_2O_3 grades vary across the Sithilo Complex, with the NNW regions exhibiting higher Cr_2O_3 grades of 29.5–35%, while the NE to eastern regions show lower grades of 12.5–17% and 5–11%, respectively. The Cr/Fe ratio of the chromite seams in the NNW regions are 2.2–2.6, 0.89–1.2 in the east and 1.37–2.0 in the NE regions, which correlate directly with the Cr_2O_3 grades. The Cr/Fe in the disseminated chromite units in the NE is 0.89–0.9. It is noteworthy that the Cr/Fe ratios in the Sithilo Complex are generally less than 2.5, a characteristic more typical of layered complexes rather than the previously suggested ophiolite-type chromite (which typically has a Cr/Fe ratio of 2.5–4.5), indicating that the Sithilo Complex may not be associated with an ophiolite depositional environment.

PRESENTATION TITLE	**Contribution of the UJ Paleomagnetism Laboratory to mineral exploration**
PRESENTING AUTHOR	**Dr Hervé Wabo (Research Associate, Lab Manager)**
UNIVERSITY	University of Johannesburg
EMAIL ADDRESS	hwabo@uj.ac.za / waboherve@yahoo.fr
SUPERVISOR/S NAME/S	N/A
DSI-NRF CIMERA FOCUS AREA	METALLOGENY AND PALEOGEOGRAPHIC IMPLICATIONS OF LARGE IGENOUS COMPLEXES AND LARGE IGNEOUS PROVINCES
REGISTERED DEGREE	N/A
ORAL OR POSTER	Poster

The UJ Paleomagnetism Laboratory in South Africa has been involved in multidisciplinary research incorporating mineralization studies in the last two decades. These studies, some of which are reviewed here, illustrate the contribution of paleomagnetism to the mineral industry. The advantage of paleomagnetism over the traditional geological methods is its capability to provide spatial information (paleomagnetic pole or paleopole) and temporal information (apparent polar wander path or APWP). The latter allows magnetic dating of rocks, fluid flow, ore genesis and alteration via comparison of paleopoles against the APWP of the concerned craton. Magnetic mineral phases like pyrrhotite, magnetite or hematite in the paragenesis of rocks or ores can be dated. If associated with ore forming fluids, the ore genesis can be dated. The age of magnetic remanence is estimated by interpolation between precisely dated paleopoles of the APWP. Magnetic dating provides an interesting alternative when radiometric ages are absent or conflicting. In the Bushveld Complex for example, paleopoles from main complex as well as satellite intrusions (e.g., Uitkomst Complex and mafic sill suites) support at least two magma pulses (at ~2054 Ma and ~2058 Ma) for emplacement of the economically important Rustenburg Layered Suite and its associated marginal rocks. This has contributed to better constrain the chronology of PGE and PGM deposits within the Rustenburg Layered Suite and Ni-Cu-PGE mineralization in the Uitkomst Complex. Magnetic dating has further showed that the fluids that produced polymetallic mineralization (Cu-Pb-Zn-Ag-U-F) in the Lebowa Granite Suite circulated during the general Bushveld times. Paleomagnetic dating was also successfully used to test previous ore-forming models in the Kalahari manganese field in the Northern Cape Province. Dissimilar paleopoles from samples spanning several enrichment grades confirmed the multistage evolution for the Kalahari manganese ores. In Southern India (Bastar and Dharwar cratons), paleomagnetism was used for dating and correlation of carbonate units (in the so-called Sequence III) of the Purana basins. Because of the lack of radiometric ages, the timing of deposition of these widely separated basins that host important manganese deposits and conglomeratic diamonds was very disputed. All paleopoles of Sequence III carbonates match a ~1.2 Ga aged pole, implying that the manganese deposits within this sequence formed during Mesoproterozoic and are not associated with Neoproterozoic glaciations as suggested earlier. In ongoing projects, such as the Kunene project in Angola and Namibia (Congo Craton), the paleomagnetic method is being used to constrain the age and initial geometry of the Zebra Lobe and prospective mafics and ultramafics for Ni-Cu-Co-PGE. Ongoing paleomagnetic investigations of redbeds of the Francevillian basin in Gabon (Congo Craton) are expected to provide better age constraints on the genesis of the high-grade Uranium deposits associated with this sedimentation. For the years to come, the UJ Paleomagnetism Laboratory will continue exploring new research topics related to economic geology, with the goal to help industrials formulate appropriate exploration strategies.

PRESENTATION TITLE	**Preliminary 3D geological modeling for mineral resource estimation of the Idwala Pyrophyllite Mine in the Ottosdal area, North West province of South Africa**
PRESENTING AUTHOR	**Yolanda Nocuze**
UNIVERSITY	University of Fort Hare
EMAIL ADDRESS	201904896@ufh.ac.za
SUPERVISOR/S NAME/S	Dr.Benedict Pharoe
DSI-NRF CIMERA FOCUS AREA	ECONOMIC GEOLOGY
REGISTERED DEGREE	Master of Science in Geology
ORAL OR POSTER	Poster

Mineable pyrophyllite deposits in the Republic of South Africa are mainly associated with the Mesoarchean volcano-sedimentary succession in the Syferfontein Formation of the Dominion Group. The history of mining these deposits dates back to the 1930s when the Wonderstone Quarry became the main producer of pyrophyllite in the Ottosdal Area. Shortly after, in the early 1990s, Idwala Quarry was opened approximately 11 km southeast of the Wonderstone Quarry. Pyrophyllite in these areas usually occurs with other minerals such as kaolinite, muscovite, quartz, alunite, sericite, diaspore, and corundum. This study aimed to evaluate the ore resources at Idwala Pyrophyllite Mine. Furthermore, the pyrophyllite mineral assemblage was assessed, and the geological structure influencing the mineralization style was evaluated. Idwala Pyrophyllite Quarry is located on the Witpoort 281 IP Farm portion near the small farming town of Ottosdal in the North-West Province. The mining of the pyrophyllite deposit at Idwala began almost 35 years ago with the initial purpose of mining, milling, and marketing the micronized pyrophyllite as an inert filler in the paint industry. The production volumes grew significantly over the years to reach highs of approximately 20,000 tons from one of the three production pits. Currently, the mine experiences unsteady ore production due to the lack of an ore resource model that may potentially guide the mining process and areas of targeted ore grades. The methodological approach for the study involved the collection of data from twelve boreholes drilled during the early exploration stage, and Micromine 2024 software was used to develop a 3D geological model. The exploratory data analysis (EDA) involved statistical analysis and data visualization to identify trends, anomalies, sub-populations, geological cut-off grades, and relationships within the assay data using decomposed histograms, probability plots, and data declustering. Furthermore, EDA tools were used to assess the normality of data distribution, and log-normal transformations were applied where data was skewed and not normally distributed. The modeling process resulted in ore estimation, and variogram models were generated to understand spatial trends and discontinuity. Various curves, such as grade tonnage and cumulative frequency, were generated to assess the economic potential of the deposit.

The statistical and geostatistical analyses conducted on the assay data provided crucial insights into the spatial variability and distribution of key elements within the ore body. Histograms and cumulative frequency plots for Al_2O_3 and SiO_2 revealed that these elements are distributed heterogeneously throughout the deposit. The 3D geological model reveals that subsurface geological structures significantly influence the ore body, with considerable variations in ore thickness and grade distribution across the deposit. The model identified key structural features, such as faults and folds, that critically impact the geometry and continuity of the ore body. Identifying these structural features is essential for guiding future exploration and mining operations. Furthermore, the 3D geological model and the generated curves are important tools for improving resource estimation, predicting ore zones, and optimizing mine planning.

PRESENTATION TITLE	**High precision geochronology of the Waterberg and Rooiberg Groups to constrain the shallow crustal effects of the Bushveld LIP**
PRESENTING AUTHOR	**Faith Nyathi**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	2364547@students.wits.ac.za
SUPERVISOR/S NAME/S	Dr Scott Maclennan, Prof Nils Lenhardt
DSI-NRF CIMERA FOCUS AREA	BUSHVELD LARGE IGNEOUS PROVINCE
REGISTERED DEGREE	MSc by Research (Geology)
ORAL OR POSTER	Poster

The Bushveld large igneous province (LIP) stands as the most important global source of Platinum Group elements, chromium, and vanadium. This large igneous province comprises the mafic-ultramafic Rustenburg Layered Suite (RLS) alongside the more evolved Rashoop granophyre and Lebowa granitoid suites. Recent research has proposed the existence of an extrusive component of the Bushveld LIP in the form of the Rooiberg Group, a silicic large igneous province. This challenges previous paradigms regarding the temporal relationship of the Rooiberg Group to Bushveld magmatism, which postulated that the Rooiberg Group precedes Bushveld magmatism for the most part. The rocks of the Rooiberg Group are conformably overlain by a thick succession of siliciclastics known as the Waterberg Group. The currently available geochronology for these supracrustal rocks is relatively imprecise but suggest that extrusive volcanism occurred a few million years prior to the emplacement of the RLS, and that siliciclastic deposition of the Waterberg Group occurred a few million years after Bushveld LIP magmatism. Field and geochemical evidence, however, suggests that extrusive volcanism and rift related siliciclastic sedimentation were broadly contemporaneous with RLS magmatism and Bushveld LIP magmatism. The absence of high-precision U-Pb zircon age constraints for both the Rooiberg and Waterberg Groups greatly limits the degree to which the upper crustal record (represented by the Rooiberg and Waterberg Groups) can be interrogated. Outstanding questions related to the Kaapvaal Craton shallow crust include whether the Rooiberg Group represents an extrusive component of the RLS, and to what degree rift related siliciclastic sedimentation was ongoing during Bushveld LIP magmatism. Additionally, this raises intriguing possibilities regarding the Rooiberg and Waterberg Groups serving as shallow crustal reservoirs for hydrothermal critical metal deposits and could act as important records of tectonic and climatic changes in the Kaapvaal craton during the LIP's magmatic activity.

The overall aim of this study is to use high-precision U-Pb Isotope Dilution Thermal Ionization Mass Spectrometry (ID-TIMS) geochronology to create precise age models for the depositional histories of the supracrustal Rooiberg and Waterberg Groups, to:

1) Evaluate to what degree the silicic large igneous province of the Rooiberg Group, and potentially the lowermost Waterberg Group, is connected to RLS magmatism deeper in the crust.
2) Probe the uplift, subsidence, and tectonic history of the Kaapvaal Craton during one of the largest LIP events in Earth history,
3) Evaluate the potential of the supracrustal Rooiberg and Waterberg Groups to contain critical metal deposits originating from RLS-related hydrothermal systems.

PRESENTATION TITLE	**Proto-kimberlite pre-conditioning of the Kalahari craton root – good or bad?**
PRESENTING AUTHOR	**Merrily Mathume Tau**
UNIVERSITY	University of Cape Town
EMAIL ADDRESS	txxmer002@myuct.ac.za
SUPERVISOR/S NAME/S	Geoffrey H Howarth and Andrea Giuliani
DSI-NRF CIMERA FOCUS AREA	MANTLE AND CRUSTAL PROCESSES AND ASSOCIATED METALLOGENESIS, INCLUDING KIMBERLITES
REGISTERED DEGREE	PhD Geology
ORAL OR POSTER	Poster

Studies of peculiar mantle xenoliths (e.g., polymict breccias) have shown that failed kimberlite eruptions are common [2, 5, 7]. The precursor kimberlite-like melts (i.e., proto-kimberlites) are believed to have pre-conditioned the base of the subcontinental lithospheric mantle (SCLM) prior to the ascent of subsequent kimberlite pulse(s) to the surface [9]. Proto-kimberlite melts metasomatized (e.g., Fe refertilization) the SCLM and crystallization resulted in megacrysts. Some regions of the deep lithosphere were more extensively pre-conditioned than others. High and low melt/rock ratios resulted in Cr-poor and Cr-rich megacrysts, respectively [4, 6]. Thus, a greater proportion of entrained Cr-poor megacrysts in kimberlites that ascend to the surface generally correspond to high degrees of SCLM pre-conditioning and vice versa. In addition, the SCLM pre-conditioning by proto-kimberlites has been associated with destruction of diamonds [3].

We use olivine in kimberlites and carbonate-rich olivine lamproites (CROL) to constrain the extent of proto-kimberlite melt pre-conditioning of the SCLM across the Kalahari craton. The majority of the olivine grains show sharp compositional zoning between xenocrystic cores and magmatic rims. Generally, average Mg# of xenocrystic olivine in kimberlites/CROL is correlated with the average Mg# of olivine rims [8].

Over 80 grains were analysed per locality. Xenocrystic olivine cores from the CROL are predominantly Mg-rich with Mg# of 90.0 – 95.0, corresponding to olivine in peridotitic mantle xenoliths. More Fe-rich (Mg# <90) Cr-poor megacrystic olivine constitute less than 4% of the analysed grains. The olivine population is more variable in kimberlites, with Fe-rich cores comprising between 10% (e.g., Jagersfontein) and 55% (e.g., Damtshaa) of the analysed grains. Consequently, Mg# of olivine rims is ≥90 and ≤90 in CROL and kimberlites, respectively.

The low proportion of Cr-poor olivine megacrysts and olivine rims Mg# ≥90 for CROL suggests minimal pre-conditioning of the traversed SCLM. Thus, diamond destruction at these localities (e.g., Finsch, Roberts Victor, Star, Marsfontein, etc.) was limited. Conversely, kimberlites such as Monastery, Karowe, Damtshaa, Letšeng, Mothae, and Kao show high proportions of Cr-poor megacrystic olivine (>50%) and olivine rims with Mg# ≤ 89. The suggested extensive pre-conditioning of the SCLM sampled by these kimberlites is consistent with their low diamond grades (<21.5 cpht) [1]. The Jwaneng kimberlite has a high olivine rim Mg# of 90 and high diamond grades (119-159 cpht). However, not all kimberlites with high olivine rims Mg# (~90) display high diamond grades (e.g., Jagersfontein with 12 cpht) due to heterogeneous diamonds distribution in the SCLM even in unmodified regions.

Of particular interest is that kimberlites containing high-value, type II diamonds appear to have extensively sampled pre-conditioned SCLM. For example, the world's largest diamond (3 106 carats) was recovered from Cullinan kimberlite, which displays olivine rims Mg# ~88.4 [3]. Furthermore, world's second-largest diamond (2 492 carats) was recently recovered from Karowe, which displays olivine rims Mg# ~87. It thus appears like there is a trade-off between high diamond grades, which are controlled by the abundance of lithospheric type I diamonds, and occurrence of the high-value sublithospheric type II diamonds.

REFERENCES

1. de Wit, M., Bhebhe, Z., Davidson, J., Haggerty, S.E., Hundt, P., Jacob, J., Lynn, M., Marshall, T.R., Skinner, C., Smithson, K. and Stiefenhofer, J., 2016. Overview of diamond resources in Africa. Episodes Journal of International Geoscience, 39(2), pp.199-237.
2. Giuliani, A., Kamenetsky, V.S., Kendrick, M.A., Phillips, D., Wyatt, B.A. and Maas, R., 2013. Oxide, sulphide and carbonate minerals in a mantle polymict breccia: Metasomatism by proto-kimberlite magmas, and relationship to the kimberlite megacrystic suite. Chemical Geology, 353, pp.4-18.
3. Giuliani, A., Phillips, D., Pearson, D.G., Sarkar, S., Müller, A.A., Weiss, Y., Preston, R., Seller, M. and Spetsius, Z., 2023. Diamond preservation in the lithospheric mantle recorded by olivine in kimberlites. Nature Communications, 14(1), p.6999.
4. Howarth, G.H., Giuliani, A., Soltys, A. and Bussweiler, Y., 2022. Compositional variations in primitive kimberlite melts and entrained mantle cargo from a global survey of trace element compositions in kimberlite olivine. Journal of Petrology, 63(8), p.egac062.
5. Lawless, P.J., Gurney, J.J. and Dawson, J.B., 1979. Polymict peridotites from the Bultfontein and de Beers mines, Kimberly, South Africa. The Mantle Sample: Inclusion in Kimberlites and Other Volcanics, 16, pp.145-155.
6. Nkere, B.J., Janney, P.E. and Tinguely, C., 2021. Cr-poor and Cr-rich clinopyroxene and garnet megacrysts from southern African group 1 and group 2 kimberlites: clues to megacryst origins and their relationship to kimberlites. Lithos, 396, p.106231.
7. Pokhilenko, N.P., 2009. Polymict breccia xenoliths: Evidence for the complex character of kimberlite formation. Lithos, 112, pp.934-941.
8. Sarkar, S., Giuliani, A., Phillips, D., Howarth, G.H., Ghosh, S. and Dalton, H., 2022. Sublithospheric melt input in cratonic lamproites. Geology, 50(11), pp.1296-1300.
9. Soltys, A., Giuliani, A., Phillips, D. and Kamenetsky, V.S., 2020. Kimberlite metasomatism of the lithosphere and the evolution of olivine in carbonate-rich melts—evidence from the Kimberley kimberlites (South Africa). Journal of Petrology, 61(6), p.egaa062.

PRESENTATION TITLE	**Constraining the magma sources and tectonic setting of the Kunene AMCG Complex by radiogenic and stable isotope geochemistry**
PRESENTING AUTHOR	**Kaydi Govender**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	2332536@students.wits.ac.za
SUPERVISOR/S NAME/S	Prof Grant Bybee, Dr Trishya Owen-Smith, Dr Karen Smit, and Dr Lorenzo Milani
DSI-NRF CIMERA FOCUS AREA	THE KUNENE AMCG COMPLEX, ANGOLA/NAMIBIA
REGISTERED DEGREE	Master of Science (Dissertation) (Geology)
ORAL OR POSTER	Oral

Proterozoic anorthosites are usually associated with an anorthosite-mangerite-charnockite-granite (AMCG) suite of coeval silicic rocks. The petrogenesis of AMCG rocks is still unresolved, with isotopic and experimental data to support both mantle and/or crustal sources. Our study focuses on the Mesoproterozoic (1.50–1.38 Ga) Kunene AMCG Complex (KC) which stretches from NW Namibia to SW Angola, spanning approximately 42 500 km^2 making it one of the largest Proterozoic anorthosite complexes globally (Drüppel et al., 2000, Gleißner et al., 2011, Rey-Moral et al., 2022). Due to its substantial size, the KC merits further investigation into its temporal restriction, tectonic setting, emplacement processes, and magma source (Milani et al., 2022; Bybee et al., 2019).

This study aims to determine the sources of parental magma and the tectonic setting of the KC by analysing the whole-rock Sr, Nd, and Hf isotopic compositions of 28 samples of anorthositic and coeval granitoid lithologies. These samples were strategically chosen for their location as they had to spatially represent the KC and contain pre-existing age data. Additionally, the study will employ stable potassium (K) isotopes to explore the tectonic setting of the KC. Potassium isotopes are of particular interest due to their recent proposal as a tracer of sources and transport of fluid-mobile, incompatible elements in subduction zones. Sediments and the altered oceanic crust, are both enriched in K, whereas the overlying melt-depleted lithospheric mantle is low in K. This difference potentially makes K isotopes a sensitive tracer of slab-to-wedge fluid transfers (Wang and Ionov, 2023).

The acquired trace element data has been analysed and plotted to provide interpretive insights. Preliminary results show significant variation in HREE among anorthositic samples, likely related to their locations, and will be further investigated through isotopic analysis. The chondrite-normalized REE diagram reveals LREE enrichment, HREE depletion, and positive Eu anomalies, indicative of a dominant plagioclase presence, consistent with anorthosites having > 90% plagioclase feldspar. Granitoids display a general decrease from LREE to HREE, with Eu depletion reflecting feldspar fractionation. Evolved samples exhibit HREE enrichment and a REE M-type tetrad effect, suggesting possible hydrothermal alteration. The trace element data will then be incorporated into spike calculations for column chemistry. Additionally, this data will serve as supplementary evidence to support our isotopic analysis. K isotope analysis is scheduled for January 2025. This will complement the major element, trace element, and isotopic data collected this year, with the K isotopic results expected to be more sensitive to subduction effects.

By integrating traditional isotopic methods with K isotopic evidence, this study aims to understand Kunene magmatism better and assess the role of subduction in its formation. Furthermore, if K isotopes do fingerprint oceanic sediments, there may be a possible link to mineralisation associated with subduction environments. The integration of these methods within a multidisciplinary framework is expected to significantly advance our understanding of the KC and establish a more comprehensive comparative database for future research.

REFERENCES

Bybee, G.M., Hayes, B., Owen-Smith, T.M., Lehmann, J., Ashwal, L.D., Brower, A.M., Hill, C.M., Corfu, F., and Manga, M., 2019. Proterozoic massif-type anorthosites as the archetypes of long-lived (100 Myr) magmatic systems—new evidence from the Kunene Anorthosite Complex (Angola). Precambrian Research 105393.

Drüppel, K., Littmann, S., and Okrusch, M., 2000. Geo-und isotopenchemische Untersuchungen der Anorthosite des Kunene-Intrusiv-Komplexes (KIC) in NW Namibia. Ber. Deutsch. Mineral. Gesellschaft, Beiheft Eur. Journal of Mineralogy, 12(1), pp. 37.

Gleißner, P., Drüppel, K., and Romer, R.L., 2011. The role of crustal contamination in massif type anorthosites, new evidence from Sr-Nd-Pb isotopic composition of the Kunene Intrusive Complex, NW Namibia. Precambrian Research, 185, pp. 18–36.

Milani, L., Lehmann, J., Bybee, G.M., Hayes, B., Owen-Smith, T.M., Oosthuizen, L., Delport, P.W.J., and Ueckermann, H., 2022. Geochemical and geochronological constraints on the Mesoproterozoic Red Granite Suite, Kunene AMCG Complex of Angola and Namibia. Precambrian Research, 379, 106821.

Rey-Moral, C., Mochales, T., Martínez, E.M., Lobón, J.L.G., Bahut, M.T.L., Martín-Banda, R., Feria, M.C., Ballesteros, D., Machadinho, A., and Alves, D., 2022. Recording the largest gabbro-anorthositic complex worldwide: The Kunene Complex (KC), SW Angola. Precambrian Research, 379, pp.106790.

Wang, K., and Ionov, D.A., 2023. Potassium isotope evidence for slab-derived fluids in the sub-arc mantle. Earth and Planetary Science Letters, 619, 118315. https://doi.org/10.1016/j.epsl.2023.118315

PRESENTATION TITLE	**Distribution of hydrothermal alteration associated with antimony-gold deposits along the Antimony Line, Murchison greenstone belt, South Africa**
PRESENTING AUTHOR	**Thabo Kgarabjang**
UNIVERSITY	University of Limpopo
EMAIL ADDRESS	kgarabjangts@gmail.com
SUPERVISOR/S NAME/S	Napoleon Q Hammond and Axel Hofmann
DSI-NRF CIMERA FOCUS AREA	GOLD
REGISTERED DEGREE	PhD
ORAL OR POSTER	Poster

The effect of fluid-rock interactions are known to serve as useful geochemical parameters for mineral exploration in orogenic gold systems. By understanding the extent and nature of alteration, delineation of ore body extensions in these systems can be defined more effectively. Therefore, establishing patterns of hydrothermal alteration with associated deposits is necessary. The orogenic antimony-gold deposits located along the Antimony Line (AL) are hosted within quartz-carbonate rocks in the center of the Archaean Murchison greenstone belt at the northeastern edge of the Kaapvaal Craton. Four (4) deposits, Beta, Athens, Monarch, and Louwskop, along the Antimony Line, are studied for hydrothermal alteration patterns. Petrographic studies of the host rock samples reveal a least-altered zone with a chlorite-albite-augite-epidote-actinolite assemblage that still bears mineralogical evidence of a basaltic protolith, a transitional zone marked by chlorite-augite-biotite-calcite-quartz with sulphide disseminations, and a high alteration ore zone marked by chlorite-fuchsite-talc-biotite-quartz-carbonate-sulphides associated with quartz-carbonate veins. The sulphides are variably distributed along the AL, with antimony-bearing sulphides being more dominant in the Beta and Athens deposits. The distribution of the gold-bearing sulphides such as arsenopyrite and pyrite are dominant in the Monarch and Louwskop deposits, respectively. Quantification of hydrothermal alteration reveals enrichment of gold (Au) in the Monarch and Louwskop deposits and depletion in the Beta and Athens deposits, while antimony (Sb) distribution appears to be increasing in the Beta and Athens deposits. This is consistent with mineralogical observations and suggests mineralogical control on antimony-gold deposits along the AL. The arsenic (As) enrichment in the deposits is variable and typical of most greenstone belts, suggesting As-Au co-deposition. In particular, the Louwskop deposit experienced high SiO_2 and K_2O enrichment, with relatively high degrees of silicification and potassic alterations in the host rocks at Louwskop and may also be correlated with the highest gold enrichment in the Louwskop deposit. Quartz-dolomite isotopic geothermometry indicates variable mineralisation temperatures along the AL with the precipitation of antimony sulphides in the Beta and Athens deposits favoured by low temperature (Beta; 268°C, Athens; 242°C) conditions in the southwestern region compared to elevated temperatures (≥380°C) towards the northeastern region.

PRESENTATION TITLE	**Paragenesis of different styles of magmatic sulphide mineralisation in the mafic-ultramafic phase of the Kunene Complex, Angola**
PRESENTING AUTHOR	**Nthatisi Sandra Makhoba**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	2896038@students.wits.ac.za
SUPERVISOR/S NAME/S	Dr Ben Hayes and Prof Lorenzo Milani
DSI-NRF CIMERA FOCUS AREA	BASE METALS AND PGEs
REGISTERED DEGREE	Master of Science (Dissertation) in Geology
ORAL OR POSTER	Poster

Nickel is an essential metal for various industries (e.g., stainless steel), and future demand is set to soar due to its importance in the green energy sector (e.g., electric vehicles). There have been few discoveries in recent decades of new magmatic Ni-Cu-(Co-PGE) sulphide deposits, but more are required to meet the growing demand for nickel.

Proterozoic massif-type anorthosites attained economic interest as targets for magmatic sulphide deposits after the discovery of the Voisey's Bay Intrusion of the Mesoproterozoic Nain Plutonic Suite in Labrador, Canada. The Kunene Complex (1.5 – 1.37 Ga) is one of the largest and best-preserved Proterozoic massif-type anorthosites on Earth and is situated in southwestern Angola and northern Namibia at the present-day south-west margin of the Congo craton. The Kunene Complex is associated with numerous mafic-ultramafic intrusions that are preferentially localized along its southern and western margins. These peripheral intrusions are volumetrically small (≤ 10) with some hosting magmatic sulphide mineralisation. The Kunene Complex and the Nain Plutonic Suite share multiple similarities such as their ages of emplacement, long magmatic timescales, emplacement into Paleoproterozoic-Archean basement rocks and lithological makeups, including a suite of mafic-ultramafic intrusions. However, the Kunene Complex, and its mafic-ultramafic intrusions, remain relatively underexplored due to poor accessibility, exposure and previous political issues in Angola. Anglo American have recently acquired drillcore material (from Gevale) for Oncocua, Malola, Lufinda, Chibia, Otchinjau and Chiange, which are all mafic-ultramafic intrusions situated along the western margin of the Kunene Complex in Angola. Using drillcore and petrographic observations, we recognised four distinct compositional groups of sulphide mineralisation in these intrusions.

Oncocua is ferrodioritic and ferroperidotitic and hosts net-textured to blebby sulphides, semi-massive sulphides and massive sulphides. Pyrrhotite is dominant and is rimmed by/or contains chalcopyrite inclusions and minor pentlandite. Lufinda is mainly anorthositic with sulphide mineralisation (pyrrhotite is dominant and is rimmed by/or contains chalcopyrite inclusions) concentrated at the contacts between anorthosite and peridotitic autoliths. Malola is peridotitic and gabbroic with disseminated pyrrhotite. Chiange and Chibia are gabbroic in composition and have little to almost no sulphide mineralisation. Broadly, these mafic-ultramafic intrusions have compositional groupings of sulphide mineralisation comparable to those defined for the Nain Plutonic Suite, however, the paragenesis of the mineralisation types in the Kunene Complex is not yet understood. We suggest that the ultramafic Malola intrusion has greater potential for hosting Ni-Cu-PGE-enriched sulphides with high metal tenors whilst the more mafic intrusions including the iron-rich lithologies at Oncocua have lower potential. During the rest of this research project, we will investigate the paragenesis of these distinct compositional groups of sulphide mineralisation in the Kunene Complex. This will be achieved by using elemental mapping, sulphide metal tenor calculations, and bulk rock sulphur isotopes. This project will contribute to better understanding the origin of the mafic-ultramafic phases of the Kunene Complex and its economic potential.

PRESENTATION TITLE	**Olivine chemistry and Sr-Nd-Hf isotopic constraints on the petrogenesis and metallogenesis of the mafic-ultramafic phaseof the Kunene Complex**
PRESENTING AUTHOR	**Daniel Ryksen Timpson**
UNIVERSITY	University of the Witwatersrand
EMAIL ADDRESS	2896378@students.wits.ac.za
SUPERVISOR/S NAME/S	Ben Hayes, Lorenzo Milani
DSI-NRF CIMERA FOCUS AREA	FOCUS AREA 2
REGISTERED DEGREE	Master of Science (Dissertation) Geology
ORAL OR POSTER	Poster

Nickel is essential in clean technology. The rising popularity of electric vehicles (EVs) contributes to the rising demand for Nickel as it is a vital component in the production of lithium-ion batteries used to power these vehicles. This, along with the demand for stainless steel as developing countries continue to invest in infrastructure and construction, is set to increase the demand for Nickel worldwide.

Voisey's Bay, Labrador, Canada is a world-class Ni-Cu-(Co-PGE) sulphide deposit hosted in a mafic-ultramafic (MUM) intrusion of the same name within the Mesoproterozoic Nain Plutonic Suite. The discovery of Voisey's Bay has provided new insights into the economic value of Proterozoic massif-type anorthosites and more particularly the subordinate mafic-ultramafic intrusions that generally occur on the periphery of these massive plutonic bodies.

The Kunene Complex (KC) is the largest known Proterozoic massif-type anorthosite with an estimated areal extent of 42 500km^2 exposed across present day northern Namibia and southwestern Angola. The KC hosts many volumetrically subordinate MUM intrusions along its western and southern periphery. The composition of these MUMs, their intrusion into Paleoproterozoic host rocks as well as their temporal association and spatial proximity to the KC, draw many intriguing parallels with the Voisey's Bay intrusion and have therefore become a target for Ni-Cu-(Co-PGE) exploration. This study focuses on drillcore material from various MUM intrusions on the western periphery of the Kunene Complex within Angola namely, Malola, Oncócua, Otchinjau, Tchimpialondo and Hamutenha. Malola and Oncócua both host sulphide mineralization and represent end member types and therefore a greater emphasis is placed on these two intrusions. Malola is a primitive, peridotitic, relatively uncontaminated intrusion and Oncócua is a more Fe-rich gabbroic, seemingly contaminated intrusion.

Petrographic study on polished thin sections indicate that Malola consists of variably textured feldspathic peridotite to troctolite and olivine gabbro. Oncócua consists of magnetite and apatite-bearing olivine clinopyroxenite to websterite as well orthopyroxenite and troctolite. Further petrographic study of these intrusions as well as Otchinjau, Tchimpialondo and Hamutenha will elucidate the nature of the contacts as well as document the mineral assemblages, modal proportions and textures of these variable rock types. Olivine is a powerful recorder of petrogenetic processes in magmatic systems as well as a fertility indicator for magmatic sulphide potential due to the chalcophile nature of Ni. Olivine in these MUM intrusions will be probed to build an extensive olivine compositional database, where Ni-Fo systematics will be used to infer the petrogenesis of these intrusions as well as evaluate their potential sulphide fertility. Radiogenic isotopic analysis (Rb-Sr, Sm-Nd, Lu-Hf) will be done to identify the composition of the mantle source as well as possible contamination histories and sources. Understanding the "mineral system" of these intrusions will help guide future exploration within the MUMs of the KC.

DSI-NRF CIMERA @CimeraSA @CimeraSA www.cimera.co.za

Landscape of Barberton Makhonjwa Mountains, South Africa. Beate Wolter at Shutterstock.com