FACULTY OF
ENGINEERING &
THE BUILT ENVIRONMENT

CPD
CONTINUING PROFESSIONAL DEVELOPMENT

Department of Geological Sciences
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MESSENGERS FROM THE MANTLE
Diamonds and Craton Roots

CENTRE FOR MINERALS RESEARCH

minerals to metals

KIMBERLITE RESEARCH GROUP
KIMBERLITES - LITHOSPHERE - DIAMONDS

The Departments of Chemical Engineering and Geological Sciences

Diamonds in Depth: Formation, Exploration, Processing & Sustainability

Presented in-person at UCT, 9 – 11 September 2026

UNIVERSITY OF CAPE TOWN
IYUNIVESITHI YASEKAPA • UNIVERSITEIT VAN KAAPSTAD

Course Objectives

This innovative short course offers a comprehensive and interdisciplinary overview of the diamond value chain, from the deep-Earth formation of diamonds to their discovery, extraction, processing, and the sustainability challenges that arise post-mining. Tailored for professionals in geology, mining, and mineral processing, the course blends cutting-edge academic research with practical industry insights, using detailed case studies and hands-on examination of real diamonds. By integrating geological, engineering, and environmental perspectives, participants will gain a holistic understanding of diamond formation and responsible extraction from both primary (kimberlite) and secondary (marine) deposits. As the only course of its kind in South Africa, it fills a unique and timely niche. It builds directly on UCT's leading research expertise in the field, offering a rare opportunity for advanced learning in a high-impact, multidisciplinary area.

Course Format and Delivery

This three-day in-person course delivers a dynamic blend of expert-led lectures, interactive practical sessions, and applied assignments. Participants will sort diamond indicator minerals and view real diamonds under the microscope, complete a targeted assignment focused on identifying where diamond breakage can occur in a processing circuit, and receive structured feedback to support mitigation strategies. On the final day, a field trip is planned for the afternoon to visit the facilities of two local companies involved with diamond exploration and processing. To maximise the learning experience, and allow for interactive sessions, the course will be capped at 20 participants. The course includes approximately 21 hours of immersive learning. Each day begins with an interactive check-in session to consolidate learning. Please note, this course is available exclusively in person and requires participants to bring a computer.

Who should attend?

This course is tailored for professionals such as process engineers, plant managers, marine mining technicians, geologists, and deep-Earth researchers or postgraduate students who work in the diamond industry or have a strong interest in how diamonds form and are recovered from primary kimberlite deposits or secondary marine deposits. It caters to a wide range of experience levels, from early-career professionals to senior decision-makers and provides valuable insights into both the geological origins of diamonds and the processing techniques used in their recovery. The interdisciplinary content is designed to benefit participants from diverse academic and technical backgrounds.

Course Overview

Course name	Diamonds in Depth: Formation, Exploration, Processing, & Sustainability	
Course dates	9 – 11 September 2026	
Delivery format	In-person	
Venue(s)	Snape TS3A; Geological Sciences seminar room (lunches)	
CPD	3 CPD points, ECSA Validation No: UCTDID26	
Participants	Process Engineers, Geologists, academics and postgraduate students.	
Fee per delegate	Early Bird: R15 000 (deadline 15 July 2026)	Standard fee: R18 000

Course Convenor(s)

Sara Burness (Chemical Engineering – UCT), Geoffrey Howarth (Geological Sciences – UCT) and Megan Becker (Centre for Minerals Research – UCT).

Course Presenters

Dr. Sara Burness is a lecturer in the Department of Chemical Engineering at the University of Cape Town (UCT) and is affiliated with the Centre for Minerals Research. Her research focuses on process mineralogy and geometallurgy across a variety of ore deposit types, with particular emphasis on diamond breakage and mantle xenolith studies. She teaches applied mineralogy to undergraduates and process mineralogy and geometallurgy to fourth-year students. Sara holds a unique crossover position funded by the South African Minerals Qualification Authority, designed to bridge Chemical Engineering and Geological Sciences and promote interdisciplinary collaboration. She completed her PhD at the University of the Witwatersrand, investigating sulphur mobility and metallogeny in eclogite xenoliths associated with kimberlite volcanism.

Prof. Geoffrey Howarth is an associate professor at UCT, specialising in kimberlites, mantle xenoliths, and diamonds. He is also an affiliated member of the Centre for Minerals Research. His research covers deep-Earth processes including kimberlite petrogenesis, melt–lithosphere interactions, and diamond genesis. He teaches economic geology courses to undergraduate and graduate students in the Department of Geological Sciences. After completing his PhD at Rhodes University and postdoctoral work in the U.S.A, he returned to UCT in 2019, where he co-leads the Kimberlite Research Group and curates the Diamond collection.

Prof. Megan Becker is based in the Centre for Minerals Research in the Department of Chemical Engineering at the UCT. She has twenty years of experience in the field of process mineralogy. The central focus of her research activities is the application of mineralogical knowledge for the understanding, optimisation and prediction of key unit processes within the mining industry from both techno-economic and environmental aspects. She has conceptualised, designed, developed and run courses in process mineralogy and geometallurgy at both the undergraduate student level and industry professional development level. To date, she has supervised and co-supervised close to 50 postgraduate students and has over 100 peer-reviewed publications.

Course Presenters (cont.)

Prof. Aubrey Mainza is the Dean of the Faculty of Engineering & the Built Environment at UCT. He graduated from UCT with a PhD in 2006. He has 18 years of collective experience in academia, research and industry. He is the Deputy Director and Head of Comminution and Classification Research in the Centre for Minerals Research, which is a large multi-disciplinary research centre. His research areas include comminution and classification and uses Discrete Element Method (DEM), Computational Fluid Dynamics (CFD), and Positron Emission Particle Tracking (PEPT) as tools in his modelling methods. He has participated in many local and international research projects and has worked on numerous comminution circuit design and optimisation projects. He is an active supervisor of postgraduate students and has published widely in the international mineral processing and aligned disciplines literature. He is the chairperson for the International Comminution Researchers Association African Chapter and committee member the Western Cape Branch of the Southern Africa Institute of Mining and Metallurgy. Aubrey is on many advisory committees for international conferences. He is a founder member of PEPT Cape Town, a facility established in Cape Town for studying flow behaviour in different systems and also for medical research.

Dr. Sherry Bremner is a physicist and academic with extensive expertise in the fields of granular flow modelling, mineral processing, and comminution. She holds a PhD in Physics from UCT, where her dissertation focused on developing a granular flow model for an annular shear cell. Dr. Bremner has served as a senior lecturer and lecturer in the Department of Chemical Engineering at the UCT, teaching courses in material and energy balances, fluid flow phenomena, and comminution. In addition to her academic roles, Dr. Bremner has served as the Secretariat for the Global Comminution Collaborative, coordinating international research projects and training sessions. Dr. Bremner's professional experience includes a stint as a data scientist, where she developed machine learning models and provided technical support. Her work is particularly focused on optimising mineral processing circuits and developing models for stirred mills.

Prof. Jennifer Broadhurst has more than 40 years of research and education experience in the field of minerals beneficiation within industry and academia. Her research interests over the past 15 years have expanded to include the broader sustainability challenges (environmental, economic and social) facing the resource extraction sector and the inter-generation burdens these places on mining communities, particularly in the South African and African contexts. She has held several leadership roles within UCT, including co-director of the Minerals to Metals Initiative, Research Coordinator and EXCO member of the Department of Chemical Engineering, Interim SARChI holder for Bioprocess Engineering, and Director of the UKRI-funded GCRF Mine Dust and Health Network.

Course Content Description

A brief description of the various themes and related content is provided below.

Day 1 – Tracing the Origins of Diamonds (Wednesday 4th February)

Lecture 1: “Deep Roots: exploring the SCLM, diamond stability, and lithospheric mantle conditions”

An understanding of the sub-continental lithospheric mantle (SCLM) is essential for anyone working in the diamond industry or researching Earth's deep processes. This lecture explores key models of SCLM formation, the use of thermobarometry to determine pressure-temperature conditions, and the thermal structure of the lithosphere. These concepts are crucial for identifying regions of diamond stability and understanding how and where diamonds can form and be preserved over geological time. By examining the SCLM, participants gain insight into the fundamental geological setting that controls diamond genesis.

Lecture 2: “Kimberlites and olivine lamproites: the diamond transport system”

This session explores the nature and diversity of kimberlites and olivine lamproites, the key volcanic rocks associated with diamond transport. It examines their mineralogy, classification, and petrogenesis, with particular attention on how complex interactions with the SCLM influence diamond preservation.

Lecture 3: “Indicator mineral chemistry & diamond exploration”

This session focuses on the role of indicator minerals in diamond exploration, highlighting their chemistry and how they reveal the presence of diamond-bearing rocks. It covers key mineral indicators, their geochemical signatures, and how these are used to target kimberlite and related deposits. Practical exploration strategies and case studies demonstrate how mineral chemistry guides effective and efficient diamond prospecting in various geological settings.

Lecture 4: “Primary diamond deposits, emplacement processes and diamond grade”

This session is focussed on the geology of primary diamond deposits. Here we explore pyroclastic processes responsible for forming complex volcanic pipes. We will discuss the range of emplacement processes and resultant pipe morphologies, including the classification of volcaniclastic kimberlites and useful descriptive schemes that can be applied to core logging. Real-world examples are used to demonstrate how emplacement processes can affect diamond grade and distribution within deposits.

Lecture 5: "Diamonds through time: Industry insights, natural vs. synthetic, and future trends"

The session will review the history of diamond research, highlighting the evolution of scientific knowledge and technological advances. It includes a techno-economic assessment of diamond deposits, evaluating their commercial potential. The differences between natural and synthetic (laboratory-grown) diamonds are explored, focusing on methods for differentiation and the importance of clear disclosure. The session concludes with a discussion on the future outlook for the diamond industry.

Lecture 6: " Assessing diamond parcels: morphology, classification, and analytical techniques"

This session covers key aspects of evaluating diamond parcels, focusing on morphology and classification as fundamental steps. Participants will learn about the 4Cs (cut, colour, clarity, and carat weight) along with common defects and impurities that affect diamond quality. Analytical techniques including, SEM FTIR (Fourier transform infrared spectroscopy), UV-Vis spectroscopy, and photoluminescence (PL) will also be covered as vital tools for thorough diamond characterization and quality assessment.

Practical components of Day 1:

Afternoon practical: “Kimberlites, mantle xenoliths, indicator minerals, and diamonds under the lens”

This hands-on session gives participants the opportunity to examine kimberlite and mantle xenolith samples from around southern Africa. In addition, participants with sort indicator minerals and assess diamond parcels under the microscope. The practical focuses on identifying key diamond morphological features, surface textures, resorption patterns, colour variations, defects, and impurities. By working directly with real samples, participants will develop a deeper understanding of diamond classification and what these physical characteristics reveal about their geological history and recovery potential. In addition, participants will learn how to identify diamond indicator minerals such as Cr-diopside, the many flavours of garnet, ilmenite, and many others using real-world heavy mineral concentrate from several different mines across southern Africa.

Day 2 – Maximising Recovery: Strategic Diamond Processing (Thursday 5th February)

Lecture 6: "Digging deep: mining methods for primary and secondary diamond deposits"

This session explores the range of mining techniques used to extract diamonds from both primary kimberlite sources and secondary marine deposits. Topics include mapping and accessing kimberlite pipes, open-cast and underground mining methods, as well as offshore marine dredging operations. Participants will gain an understanding of how deposit type, location, and geology influence mining strategy and design, with real-world examples from both land-based and seabed diamond recovery.

Lecture 7: "Process mineralogy for diamond circuit design”

This session focuses on the role of process mineralogy in designing and optimising diamond recovery circuits. Special attention is given to clay mineralogy and its impact on processing performance, including challenges related to dispersion, slime coatings, and recovery efficiency. Participants will learn how detailed mineralogical knowledge informs equipment selection, flow sheet design, and troubleshooting in both new and existing processing plants.

Lecture 8: "Overview of diamond processing circuits (including marine)”

This session provides a comprehensive introduction to the design and operation of diamond processing circuits, from primary crushing through to final recovery. Key topics include the principles of comminution, concentration, and sorting as applied to kimberlite and alluvial deposits. Students will gain insight into both conventional land-based circuits and offshore recovery systems, exploring how processing flowsheets are adapted to different operational requirements. By the end of the session, participants will understand the critical stages of diamond liberation and recovery, and appreciate the operational considerations that underpin efficient, cost-effective, and sustainable diamond processing.

Lecture 9: "Unit operations in a diamond processing circuit”

This session explores the key unit operations that make up a diamond processing circuit, from the initial stages of comminution and screening through to concentration, recovery, and final sorting. Emphasis will be placed on understanding the role and function of unit operation in liberating and recovering diamonds, and how these operations are configured to maximise efficiency and product quality while minimising losses. Topics covered will include scrubbers, crushers, HPGR, dense media separation, screening, and sorting.

Lecture 10: " Diamond breakage”

This session examines the phenomenon of diamond breakage, both as a natural outcome of geological processes and as a critical consideration within mineral processing plants. Attention will be given to methods used to characterise breakage in plant environments, with a focus on selected unit operations where diamond damage is most significant. The session will also explore findings from research on how diamond morphology influences susceptibility to breakage, providing insight into both the preservation of diamond value and the optimisation of processing strategies.

Lecture 11: " Disposal (tailings), diamond remining, etc”

This lecture explores the technical handling of tailings within the diamond industry, with particular emphasis on their disposal, management, and potential for re-mining. Key themes include the design and operation of tailings storage facilities, environmental and operational considerations, and the application of modern processing technologies to recover additional diamonds from previously treated material. Case studies will highlight how advances in mineral processing and sorting have enabled the re-treatment of tailings as a viable resource, transforming waste into value while addressing sustainability challenges

Practical component of Day 2:

Evaluating high risk areas of diamond beneficiation flowsheets

This practical exercise applies the concepts introduced in the preceding sessions to the evaluation of a representative diamond processing flowsheet. Participants will identify unit operations and circuit stages with elevated potential for inducing diamond breakage, drawing on the principles and evidence presented in lectures. The session will include critical analysis of the mechanisms contributing to breakage, followed by discussion of potential mitigation strategies and their implications for process efficiency, diamond value preservation, and overall circuit performance.

Alternatively:

In this session, students will assess a representative diamond processing flowsheet to identify stages with high potential for diamond breakage. Emphasis will be placed on analysing contributing mechanisms and discussing mitigation strategies to optimise circuit performance and diamond value preservation.

Day 3 – Tracing the Origins of Diamonds (Wednesday 4th February)

Lecture 12 (Guest): “Africa’s Diamond Wealth: Geology, Production, and Opportunity"

This session provides an overview of Africa’s diamond resources, highlighting major deposits, geological settings, and mining operations across the continent. Participants will gain insight into the scale, distribution, and economic significance of African diamond production, as well as current trends and challenges facing the sector.

Lecture 13: "Chasing Giants: Exploring for High-Value CLIPPIR Diamonds"

This session delves into the science and strategy behind targeting CLIPPIR (Cullinan-like, Large, Inclusion-poor, Pure, Irregular, and Resorbed) diamonds. It examines how geochemical data and indicator minerals can be used to identify favourable conditions for their formation and guides efforts to discover new sources of these extraordinary diamonds.

Lecture 14 (Guest): "Alluvial diamond deposits”

In this session, we will look at alluvial diamond deposits and their importance in the current diamond market.

Lecture 15: "Beyond the Mine: Managing Tailings and Building Sustainable Futures"

This session addresses the environmental and social dimensions of diamond mining after extraction ends. Topics include responsible tailings management, rehabilitation practices, and sustainability planning to ensure long-term benefits for surrounding communities and ecosystems.

Practical component of Day 3:

Attendees will have the chance to participate in a field trip to visit the facilities of two local companies engaged in diamond exploration and processing, both located within 10 km of UCT. Shuttle transportation will be included in the budget.

Lecture Programme

Diamonds in Depth: 4 – 6 Feb 2026

Wednesday 9 September				
Time	**Details**		**Venue**	**Coordinator/ Lecturer**
08:00 - 08:30	*Course registration - Morning tea*		*Snape TS3A*	
08:30 - 9:00	Discussion	Welcome and 'check-in'		SaB, GHH
09:00 - 09:45	Lecture 1	Deep Roots: exploring the SCLM, diamond stability, and lithospheric mantle conditions		SaB
09:45 - 10:30	Lecture 2	Kimberlites and olivine lamproites: the diamond transport system		GHH
10:30 - 11:00	*Tea*		*Snape TS3A*	
11:00 - 11:45	Lecture 3	Indicator mineral chemistry & diamond exploration		SaB
11:45 - 12:30	Lecture 4	Primary & secondary diamond deposits, emplacement processes and diamond grade		Guest Lecturer
12:30 - 13:00	Lecture 5	Diamonds through time: Industry insights, natural vs. synthetic, and future trends		Guest Lecturer
13:00 - 14:00	*Lunch*		*Geological Sciences Tearoom*	
14:00 - 14:45	Lecture 6	Assessing diamond parcels: morphology, classification, and analytical techniques		GHH, SaB
14:45 - 15:15	*Tea*		*Snape TS3A*	
15:30 - 17:00	*Day 1: Practical*	*Indicator minerals and diamonds under the lens*		GHH, SB

Thursday 10 September				
Time	**Details**		**Venue**	**Coordinator/ Lecturer**
08:00 - 08:30	*Course registration*		*Snape TS3A*	
08:30 - 9:00	Discussion	Daily 'check-in'		SaB, GHH
09:00 - 09:45	Lecture 7	Digging Deep: Mining Methods for Primary and Secondary Diamond Deposits		AM, ShB, SaB
09:45 - 10:30	Lecture 8	Process mineralogy for circuit design		MB
10:30 - 11:00	*Tea*		*Snape TS3A*	
11:00 - 11:45	Lecture 9	Overview of diamond processing circuits (including marine)		AM, ShB
11:45 - 12:30	Lecture 10	Unit operations in a diamond processing circuit		AM, ShB
12:30 - 13:00	Lecture 11	Diamond breakage		AM, ShB
13:00 - 14:00	*Lunch*		*Geological Sciences Tearoom*	
14:00 - 14:45	Lecture 12	Disposal of tailings and diamond remining		AM, ShB
14:45 - 15:15	*Tea*		*Snape TS3A*	
15:30 - 17:00	*Day 2: Practical*	*Evaluating high risk areas of diamond beneficiation flowsheets*		AM, ShB
19:00:00 - onwards	*Workshop Dinner*	*TBC*	*Pinelands*	All

Friday 11 September				
Time	**Details**		**Venue**	**Coordinator/ Lecturer**
08:00 - 08:30	*Course registration*		*Snape TS3A*	
08:30 - 9:00	Discussion	Daily 'check-in'		SaB, GHH
09:00 - 09:45	Lecture 13 (Guest)	Africa's Diamond Wealth: Geology, Production, and Opportunity		Guest lecturer
09:45 - 10:30	Lecture 14	Alluvial diamond deposits		GHH
10:30 - 11:00	*Tea*		*Snape TS3A*	
11:00 - 11:45	Lecture 15 (Guest)	Case study: ADP		Guest lecturer
11:45 - 12:30	Lecture 16	Beyond the Mine: Managing Tailings and Building Sustainable Futures		JB
12:30 - 13:30	*Lunch*		*Geological Sciences Tearoom*	
14:00 - onwards	*Field Trip*	*TBC*	*Pinelands*	*All*
17:00	*END*			

	Coordinator/ Lecturer	**Affiliation**
AM	Prof. Aubrey Mainza	EBE - CMR
GHH	Prof. Geoffrey H. Howarth	Geological Sciences
JB	Prof. Jennifer Broadhurst	EBE - Minerals to Metals
MB	Prof. Megan Becker	EBE - CMR
SaB	Dr. Sara Burness	EBE - CMR
ShB	Dr. Sherry Bremner	EBE - CMR

Registration

Registration and Cancellation

- Register for this course
- Registration covers attendance of all sessions of the course and course material.
- Registrations close one week before the start of the course. Confirmation of acceptance will be sent on receipt of a registration form.
- Earlybird registrations close on 15 July 2026. Thereafter the standard fee will apply.
- Cancellations must be received one week before the start of a course, or the full course fee will be charged.
- For more information on application and registration procedures, please visit our website: www.cpd.uct.ac.za

Certificates

A digital certificate of attendance will be awarded to all course members who attend and participate in 100% of the lectures, and practical sessions. For further information on digital certificates please visit Digital Certificates at UCT

According to guidelines set out by the Engineering Council of South Africa, attendance of this course will earn participants 3 points towards Category 1 (Developmental Activities).

Contact details

For more information or details on CPD courses, visit our website or contact us.

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