MANDELA MINING PRECINCT
MINDS FOR MINES

SATCAP

Mining Careers Study Tour Programme

14 July 2026

science, technology & innovation
Department:
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CSIR
Touching lives through innovation

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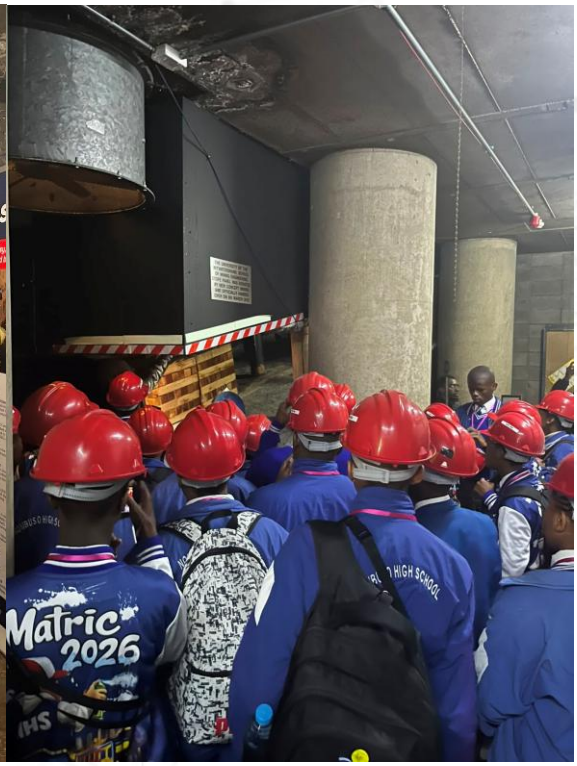
Highlights



Abbreviations

4IR	Fourth Industrial Revolution
AI	Artificial Intelligence
EUP	Enterprises University of Pretoria
GNSS	Global Navigation Satellite System
GPS	Global Positioning System
ML	Machine Learning
MMP	Mandela Mining Precinct
MQA	Mining Qualifications Authority
RIIS	Research Institute of Innovation and Sustainability
SATCAP	Successful Application of Technology Centered Around People
TVET	Technical and Vocational Education and Training
UCS	Uniaxial Compressive Strength
WMI	Wits Mining Institute

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1. Introduction

On Tuesday, 14 July 2026, the MMP's SATCAP programme together with RIIS hosted a Mining Careers Study Tour at WMI for a group of Gr 10, 11 and 12 students from Nombuso High School. The tour was aimed at showcasing careers in mining and exposing the attractive sides of working in the mining industry. Another purpose was to inspire and empower the students to view the mining industry as a diverse pool of opportunity and growth.

The tour was comprised of two main components, a presentations component, and an interactive component. For the presentation component, six speakers shared their experiences and perspectives of the mining industry, each with a unique theme that addressed different aspects of choosing a mining career. The interactive component gave the students direct exposure to some of the different resources and labs available to mining engineering students at the University of the Witwatersrand, particularly at WMI.

2. Presentations

The presentations formed the first component of the Mining Careers Study Tour and provided delegates with valuable insights into the diverse opportunities available within the mining industry. Through a series of presentations delivered by academic, industry, and innovation experts, participants gained an understanding of the mining value chain, the skills required for future mining, technological advancements, entrepreneurship opportunities, and funding available for mining-related studies. Collectively, the presentations demonstrated that modern mining is a multidisciplinary industry that offers rewarding careers across engineering, technology, research, business, and environmental management.

2.1. Mining Engineering careers

Matsobane Nong, a Mining Engineering lecturer at WITS, introduced the concept of mining engineering and explained the mine value chain from mineral discovery to responsible closure (see **Figure 1**). She highlighted some of the different activities in each stage and explored the various career opportunities presented by the activities. Some examples are a banker in the mine investment sector valuating a potential mine's value, an environmentalist rehabilitating a closed mine, a chemical engineer working on a mine's processing plant etc. All these careers are not necessarily mining careers, however, a career in mining can easily open the doors to a completely different career within the mining industry.

Matsobane also emphasized on the importance of finding one's place in the mine value chain where the one can make the most meaningful contribution. She encouraged the students to set clear academic goals and work hard and put in the effort to achieve those goals.

2.2. My experience as an Engineer

An Engineer in Training from Harmony Gold, Benedict Matlala, shared his experience as a mining engineering student and NSFAS and Harmony Gold bursar at Wits. Benedict described his journey of being a matriculant from the rural villages of Limpopo and how he discovered mining engineering as a career choice. He urged the students to explore bursary options for studies in mining and expressed the benefit of having a bursary. Benedict described a bursary as a toolbox that allows students to study comfortably.

Figure 1. Mine value chain and associated activities.

Benedict stressed that a career is a journey along which one needs to continually learn and upskill in order to grow as a professional and as a person. He ended his presentation by sharing five lessons that changed his life along his journey:

1. Background is not a definition.
2. Education creates option.
3. Success requires sacrifice.
4. Growth comes from challenges.
5. Opportunities change lives.

2.3. Skills for modern/future mining

Wessel Botha, a human capital specialist from EUP, shared his perspective on the future of mining in light of the current boom in AI, ML and robotics (these three terms will collectively be referred to as AI for this discussion). He explained how AI and people work hand-in-hand to solve problems that previously made humans jobs unsafe, difficult or impossible. Wessel trumped all belief of AI taking over the role of humans in some jobs and increasing the rates of unemployment; he clarified that AI requires constant interaction, monitoring, implementation and interpretation by humans. He added that AI requires humans to grow and emphasized that a growth in AI applications translated to an increased demand in humans.

2.4. Digital innovation in mining

Dwyka Mining Services uses a machine + human approach to solving problems in the mining environment. Tjaart Kruger, a mining technologist from Dwyka, shed some light on the development, adaptation and adoption of technologies in the mining industry. Tjaart came escorted by SPOT, a Boston Dynamics autonomous, quadruped robot, equipped with instruments and sensors for applications in hazardous environments. **Figure 2** below shows SPOT walking through the WMI during the study tour.

Figure 2. SPOT Boston Robotics robodog.

2.5. Entrepreneurship opportunities in mining

Zamani Ndlela from RIIS discussed the endless opportunities for entrepreneurship in mining. He went through the mine value chain and explored the gaps that can be filled by entrepreneurs outside of the mining industry. Some of these opportunities are listed in **Figure 3.** This discussion corroborated the point brought forth by Matsobane regarding the opportunities for growth beyond a career in mining. Opportunities that one can become a beneficiary of by simply choosing a career in mining and ultimately having a background or knowledge and understanding of the mining industry and the mine value chain.

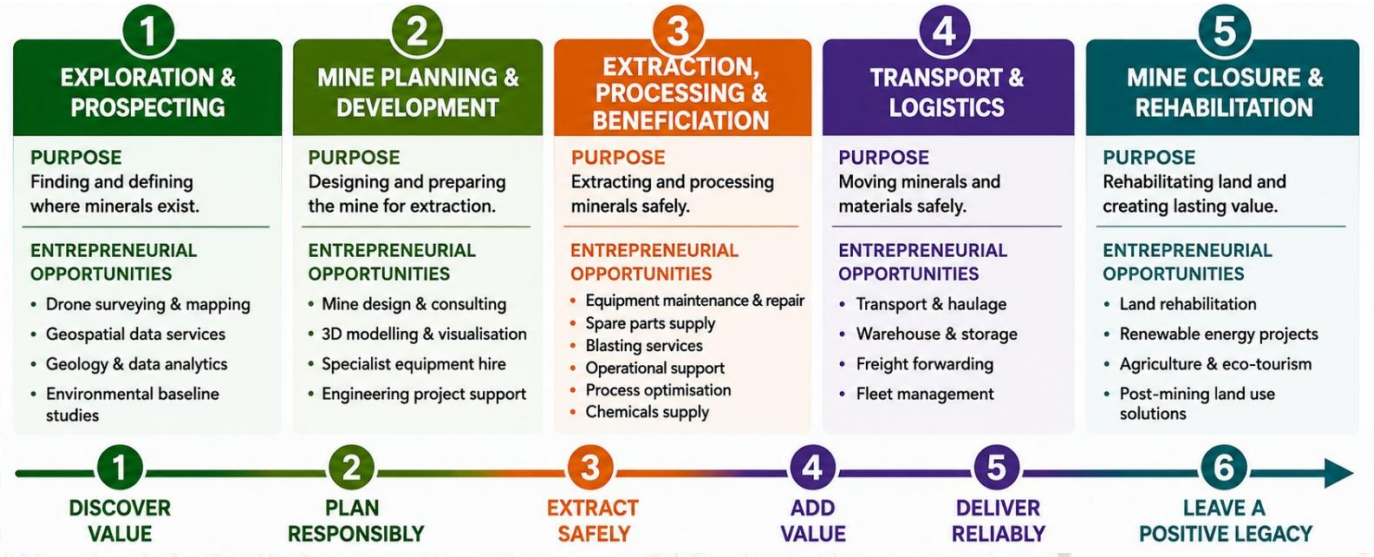

Figure 3. Entrepreneurship opportunities in mining across the mine value chain.

2.6. Bursary opportunities in mining

The MQA offers bursaries to South African students studying scarce and critical skills required by the mining and minerals sector at public universities, universities of technology, and TVET colleges. The bursaries support both unemployed and employed learners and cover qualifications in fields such as Mining Engineering, Geology, Mine Surveying, Metallurgical Engineering, Environmental Management, Occupational Health and Safety, and other priority disciplines, including emerging areas such as exploration, drone technology, and 4IR programmes. Depending on the funding allocation, the bursary may

cover tuition, registration, accommodation, prescribed books, meals, and a living allowance, with preference often given to academically deserving students from disadvantaged backgrounds and those demonstrating financial need.

3. Interactive

As part of the Study Tour, the delegates visited the Wits Faculty of Engineering and the Built Environment to gain first-hand exposure to the engineering disciplines that support modern mining. The tour provided practical insights into how specialised laboratories support teaching, research, and innovation while contributing to safe, efficient, and sustainable mining operations. This section presents highlights from visits to the Survey Laboratory, Sample Preparation Laboratory, Rock Engineering Laboratory, and Electrical Engineering Laboratory, showcasing the technologies, equipment, and technical skills that support different stages of the mining value chain and demonstrating the diverse career opportunities available within the mining sector.

3.1. Engineering department tour

Wits has several specialised laboratories within the Faculty of Engineering and the Built Environment, where students can gain practical experience through hands-on learning, experimentation, and research. The facilities support disciplines such as mining, mechanical, civil, electrical, chemical, and metallurgical engineering, while also enabling innovation, prototype development, and industry collaboration to address real-world engineering and mining challenges.

3.1.1. Survey

The first lab visited on the tour was the survey lab. At the lab, a total station was exhibited and explained. Other commonly used survey equipment that were described included GNSS and GPS receivers, levels and theodolites– these are shown in **Figure 4.**

3.1.2. Mine ventilation

Underground mine ventilation is essential for maintaining safe working conditions and complying with the Mine Health and Safety Act. A mine ventilation system works like ‘the lungs’ of an underground mine. Large fans on the surface push fresh, cool air down an intake shaft and through the main haulages and tunnels where it is directed by ventilation doors, regulators, stoppings, and auxiliary fans to the active face. This fresh air removes heat, dust, harmful gases and fumes, making the underground environment safe to work in. The warm, contaminated air is then collected through separate tunnels and channelled back to the surface by exhaust fans, creating a continuous flow of clean air throughout the mine. This ventilation cycle is shown clearly in **Figure 5** where the blue arrows symbolise cool, clean air, and the red arrows symbolise warm, contaminated air.

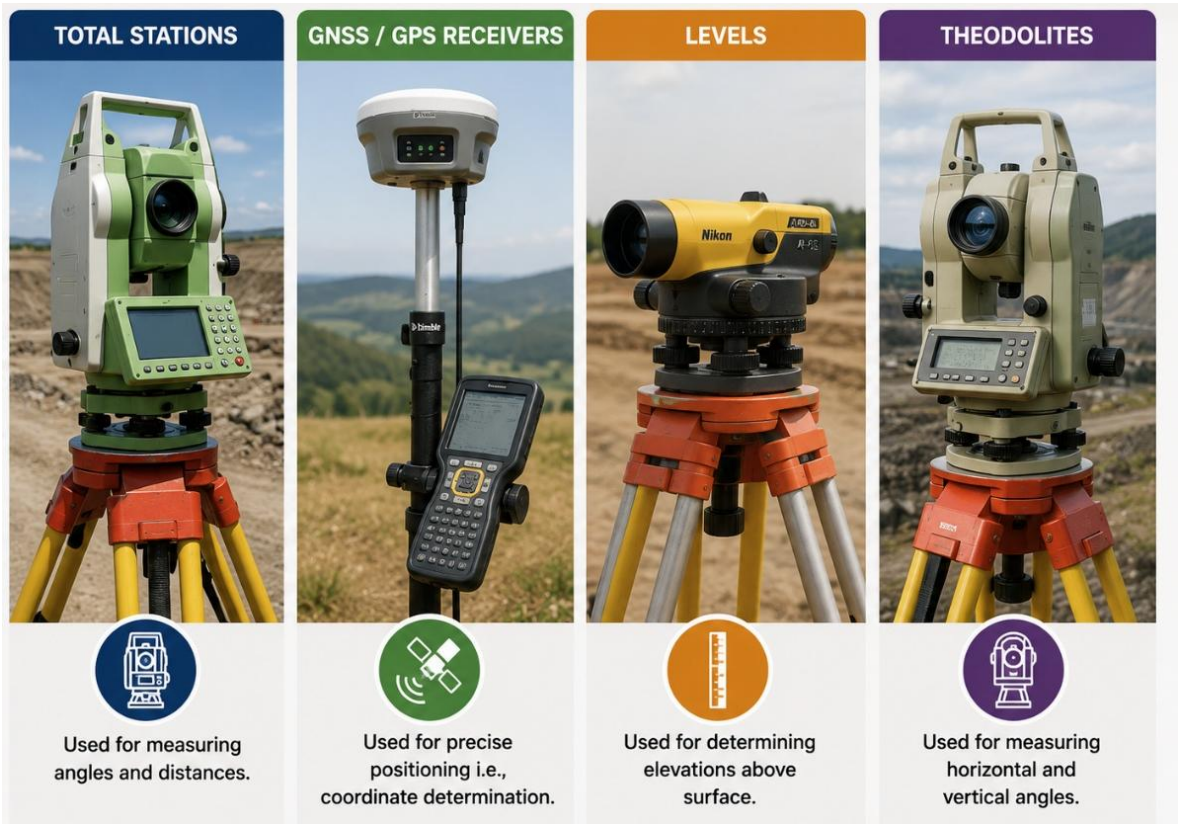

Figure 4. Commonly used survey equipment described at the survey lab.

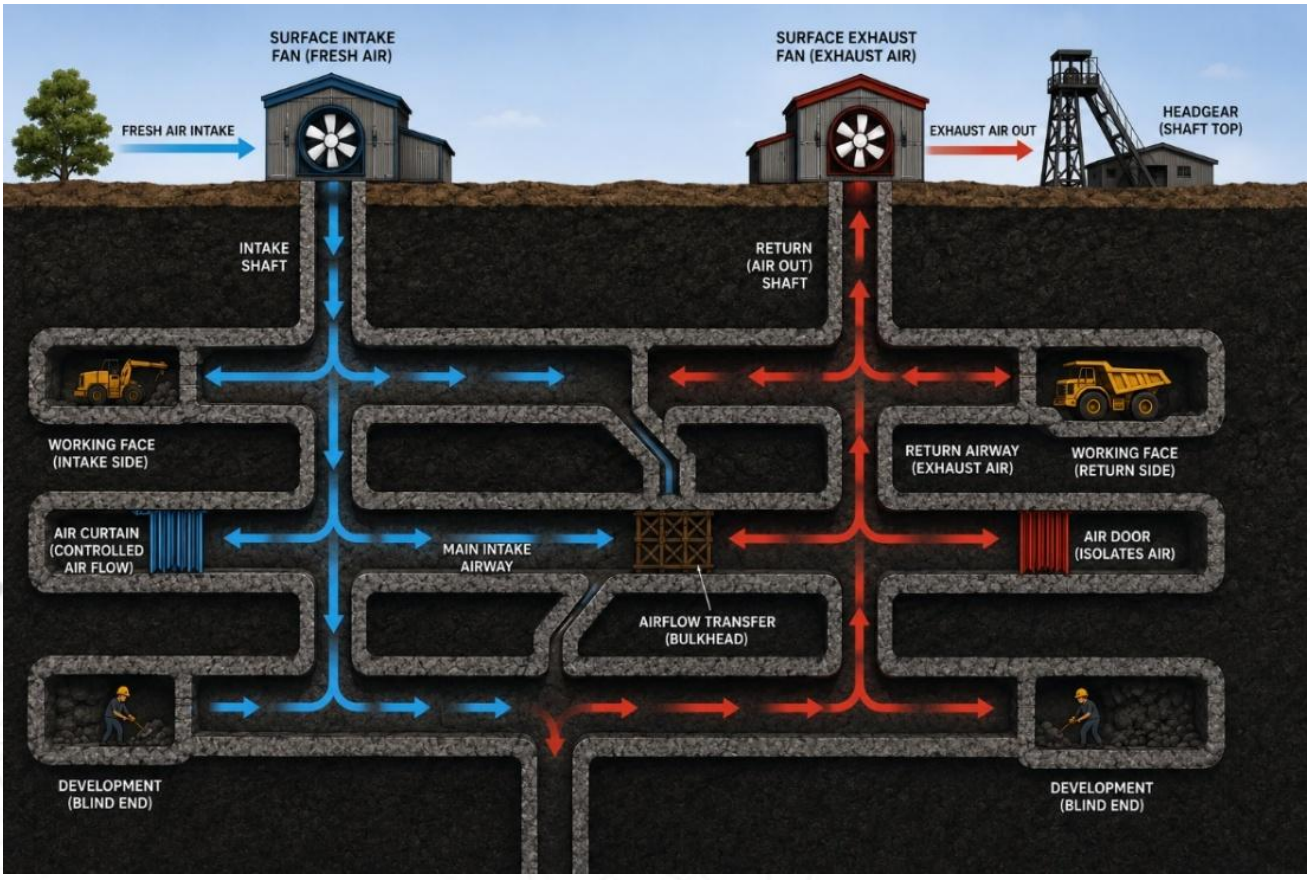

Figure 5. Schematic illustration of the continuous mine ventilation system and the key components that drive efficient ventilation.

3.1.3. Rock Engineering labs

A UCS test is used to measure the maximum compressive strength of a rock by applying increasing pressure to the prepared sample until it fails. The results, expressed in megapascals (MPa), indicate how much load the rock can withstand and are used to assess rock strength and stability. In mining, the UCS test is crucial for mine planning and design, ground support selection, and drilling and blasting.

The Wits engineering department has several connected labs, specifically developed for the preparation of rock samples for rock engineering studies. **Figure 6** shows images from two of these labs where sample preparation was demonstrated. The image on the left shows the lab that is used for cutting out cylindrical core samples of various sizes from large slabs of rock The image on the right was taken from a lab that is used for preparing the samples for UCS testing. The dial caliper in the image is used to measure the height of the sample along its top; this reveals how even the sample is. An uneven sample may compromise UCS test results by redistributing the stress applied to the sample along the higher ridges instead of across the whole sample.

Figure 6. Wits rock engineering labs for sample preparation.

3.1.4. Other

- **Noise testing**

The Wits engineering department also has a noise testing booth which is a soundproof room used to test workers' hearing and monitor their exposure to workplace noise. Before entering the booth, a worker wears custom made headphones connected to an audiometer, a device that plays a series of tones at different pitches and volumes. The worker signals whenever they hear a sound, allowing the audiologist or occupational health practitioner to determine the softest sounds they can detect. The results are compared with previous tests to identify any signs of noise-induced hearing loss, which is a common occupational hazard in mining. Regular hearing tests help mines ensure that hearing protection is effective, detect hearing problems early, and comply with occupational health and safety regulations.

- **Electrical Engineering labs**

The Wits Electrical Engineering labs have specialised equipment used for research in electrical systems ranging from coding, communication networks, energy and automation. One group of students showcased a fully functional solar energy system, designed to power small households in under-developed communities. The system is shown in **Figure 7**, and its dimensions are 1m height and 0.6m width.

Figure 7. Renewable energy system developed by a team of Wits electrical engineering students.

3.2. Digimine

The Wits Mining Institute's Digimine Laboratory is a state-of-the-art digital mining facility that simulates an underground mine to support research, innovation, skills development, and industry collaboration. Equipped with 4IR technologies such as automation, artificial intelligence, robotics, the Internet of Things (IoT), digital twins, and real-time data analytics, the laboratory enables researchers, students, and mining companies to develop, test, and demonstrate technologies that improve the safety, productivity, and sustainability of mining operations. Some equipment that was shown included a handheld XRF tool for analysing the composition of natural and unnatural materials and a photogrammetry equipped drone used for creating digital twin models (**Figure 8**).

The tour was concluded at the Digimine mock mine which is a simulated underground mine with the typical features of a tunnel and panel on a mine. Some key features that were highlighted are:

- **Hanging wall**: The layer of rock located above a mineral ore body or reef in an underground mine.
- **Foot wall**: The layer of rock located below a mineral ore body or reef, providing the floor of the excavation.
- **Face**: The active working surface of a mine where drilling, blasting, and mineral extraction take place.
- **Timber pack**: A support structure made from stacked timber blocks that is installed underground to support the hanging wall and help prevent rock falls and a collapsing roof.
- **Timber pole**: A wooden support post placed between the footwall and hanging wall to provide temporary support in underground excavations.
- **Hydraulic bladders**: Inflatable support bags filled with water or another fluid and stacked into the timber pack to ensure that there are no gaps between the hanging wall, the footwall and the timber in the packs.
- **Mechanical prop**: An adjustable steel support installed between the footwall and hanging wall to provide temporary ground support and maintain roof stability at the face.

Figure 8. Students at Digimine lab and XRF 'gun' and drones acquired and used in the Digimine lab.

4. Conclusion

The Mining Careers Study Tour successfully exposed learners to the diverse career pathways, technologies, and engineering disciplines that underpin South Africa's modern mining industry. Through engaging presentations and interactive laboratory visits, participants gained a practical understanding of the mine value chain, emerging technologies, entrepreneurship opportunities, bursary funding, and the specialised skills required to support safe, efficient, and sustainable mining operations.

The tour demonstrated that mining extends far beyond mineral extraction, encompassing disciplines such as surveying, rock engineering, electrical engineering, automation, digital mining, and environmental stewardship. By connecting learners with academics, industry professionals, and state-of-the-art facilities at the Wits Mining Institute and the Faculty of Engineering and the Built Environment, the programme inspired participants to consider careers in mining and highlighted the industry's significant role in driving innovation, economic development, and societal impact.

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The Mandela Mining Precinct (MMP) was represented by Administrator, Tshepo Maswanganye; interns, Kamogelo Baloyi and Swelihle Mabaso. As well as Thiru Swettenham and Zamani Ndlela from Research Institute for Innovation and Sustainability (RIIS).

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