

# Increasing mineral discovery success

Investment in low-impact, cost-effective technologies will assist in addressing the urgent need to increase the success rate of discovering new, internationally competitive Australian mineral deposits in increasingly challenging geological, environmental and social conditions.

## Mineral discovery challenges

In 2015-2016, mining directly contributed ~6 per cent of Australia's GDP, employed more than 220,000 people, and generated 50 per cent of the nation's export earnings. The indirect contribution is estimated to have added a further \$104 billion and 650,000 jobs to the economy.

However, we cannot be complacent about the future contribution of the mining industry to the nation. Over the last 20 years, Australia has gone from hosting approximately one quarter of the world's mineral exploration expenditure to approximately one eighth, and few major new mineral discoveries are being made in Australia.

The majority of Australia's existing mines were discovered where mineralised rocks are at, or close to, the surface. The next generation of successful exploration in Australia will require that new discoveries are made, with greater success and at lower cost than has been achieved to date, beneath the barren cover that obscures mineralised rocks across about 70 per cent of the country.

Predicting the location of and then detecting new economic mineral resources by penetrating this cover presents a significant challenge to cost-effective and globally competitive minerals exploration. Given there is commonly a delay of over a decade between ore deposit discovery and mining production, Australia needs to act urgently in a coordinated effort from industry, the research community, and government, to ensure the long-term economic contribution of the mining sector.

A variety of factors influence the quality and quantity of mineral exploration that is undertaken. These include the availability of risk tolerant capital, land access, the availability of appropriately skilled professionals, quality underpinning science, pre-competitive geoscience data, and mineral exploration technologies. This Action Statement is particularly concerned with those factors that affect the application of science and technology to improve discovery success.

## Addressing the challenge

The potential for new technology to contribute to a step change in exploration success has been highlighted by the success of the Deep Exploration Technologies Cooperative Research Centre (DET CRC) which, since its establishment in 2010, has been delivering research programs aimed at more successful, cheaper, and safer ways to drill, analyse, and target deep mineral deposits. Similarly, government has recognised the importance of the mining equipment, technology, and services (METS) sector through the establishment of the METS Ignited Industry Growth Centre. Australia's \$90 billion METS industry is a significant contributor to the economy and a global leader in mining innovation. Minerals exploration underpins a successful METS sector, and the current lack of exploration success across much of the country threatens the future of the METS sector in Australia.

UNCOVER<sup>1</sup> is an additional national initiative to increase the discovery rate of major new mineral deposits, and was convened under the aegis of the Australian Academy of Science. It has identified a number of themes on which to focus, which include characterising and understanding cover rocks, defining full-thickness crustal architecture, geodynamics and 4D history of terranes, and characterising the distal footprints of mineral systems.

A report detailing a pathway for achieving the objectives of the UNCOVER initiative, *Unlocking Australia's Hidden Potential: An industry roadmap*<sup>2</sup>, was published by AMIRA International in 2017. Both the Roadmap and UNCOVER represent an agreement on priorities by over 450 individuals from companies, research organisations and industry peak bodies. Consensus on this scale is a rare and major achievement, and the Academy supports the Roadmap's 15-year plan.

UNCOVER outlines a suite of interrelated and integrated knowledge areas, innovative technologies, and geoscience data sources. When combined and deployed, these will address the challenges of being able to both predict and detect new economic resources concealed beneath barren cover. Priority items identified by the collective Australian geoscience community via the Roadmap include:

1. UNCOVER Australia <https://www.uncoveraustralia.org.au/>

2. *Unlocking Australia's Hidden Potential: An industry roadmap*, AMIRA International <http://www.amirainternational.com/WEB/site.asp?section=activities&page=ExplorationUnderCover-STAGE2-RegistrationForm>

- » Knowledge through new scientific research, particularly focused on cover geology, mineral system footprints, and minerals system scales and types.
- » New and enhanced technologies focused on using automation and AI, simulation and modelling, deep-penetration geophysics and advanced geochemical methods.
- » New complementary pre-competitive national data focused on national standards and workloads, and rapid updating and new data integration.

## Imperatives for future success

Knowledge of Australian geology under cover is about more than mineral discovery; it is important for uncovering the whole geological context of Australia and furthering the scientific knowledge of the continent. The Academy believes action in the following areas is crucial to furthering geoscientific knowledge and achieving the UNCOVER vision.

### New technologies

While there will always be restrictions to land access due to cultural and environmental sensitivities, universal access via non-invasive technologies will enable geoscientists to assemble a complete picture of the Australian geological context with zero impact on communities or the environment.

Geophysical, drilling, and geochemical technologies will remain important for cost-effective exploration at depth, but in an era where mining companies are striving for minimal community and environmental impact, greater focus should be given to advancing low-impact data acquisition to allow a large volume of data to be collected at high quality and low cost.

Although increased data collection through advanced technologies is an enormous opportunity, the volume of data presents a huge challenge for processing, analysis and interpretation. It is not currently possible to extract the full value of the data through fully integrated analysis for all geoscience data. Overcoming this challenge will require the development of universal standards that make geoscience data findable, accessible, interoperable, and reusable.

New technologies developed to improve exploration success and spending require testing in Australia's unique ground conditions. Test ranges in areas with well-defined stratigraphy, such as DET CRC's now closed Brukunga Drilling Research and Training Facility, should be established throughout Australia so new and internationally-developed technologies can be tested and compared in a real-world environment.

### Education

Building capacity in human capital will be vital to future minerals exploration success. Ensuring the diversification of perspective and experience through gender equity and cultural diversity at all levels of the future workforce will be key to fostering innovation, transitioning mining into a 21st century, fully inclusive industry across the full minerals value chain.

Many geoscience university courses have little focus on the skills necessary for a career in minerals exploration, often creating graduates ill-equipped for the exploration industry. Given the number of geoscientists employed by industry, greater focus should be given to industry-relevant skills, including digital literacy, in university curricula.

New courses that specifically target undercover exploration skills are required urgently to account for the delay between the commencement of training and graduates reaching exploration teams. The Minerals Tertiary Education Council courses, which are no longer operating, and the National Exploration Undercover School are excellent examples of such targeted programs, and these should be continued and expanded.

Recognising the dynamic and disruptive nature of new knowledge and technologies on the future workforce, there will be a need to continually review and update education and training.

### Collaboration

The successful development of new knowledge, technologies and data required for future resource discovery will require increased collaboration and coordination between research organisations, government agencies and industry. Greater industry-research collaboration, leading to improved research translation and deployment, will likely be assisted by new research funding arrangements from the National Innovation and Science Agenda, and the introduction of a national impact and engagement assessment in 2018. Researchers should also be integrated more strongly into state-based exploration incentive schemes.

Exploration companies may benefit from embedding researchers and students in their teams, or embedding industry personnel in research organisations. The trade will promote a two-way exchange and cross-fertilisation of ideas, benefitting the exploration workflow. The process will both give students and researchers valuable practical experience and ready students for the future exploration workforce.

## The way forward

The Academy makes the following key recommendations for government, industry, and other stakeholders in order to support the UNCOVER initiative and increase Australia's minerals exploration success.

1. Governments should work with industry to assist in the establishment of a management entity that will coordinate implementation of the UNCOVER vision and Roadmap and drive technology priorities to most effectively deliver the initiative.
2. Non-invasive geoscientific data collection should be carried out over the whole continent to further scientific knowledge.
3. International standards for geoscience data should be developed and implemented to ensure data is findable, accessible, interoperable, and reusable.

4. A number of test facilities for technologies should be established nationally so researchers can test new or international technologies in well-defined real-world Australian conditions.
5. METS Ignited should be guided by the technology requirements identified by UNCOVER when establishing collaborative programs with the METS industry and SMEs to accelerate the development of exploration technologies.
6. The national impact and engagement assessment process should ensure universities put in place meaningful incentives for academics to collaborate with industry.
7. Efforts need to be taken to attract the best students to exploration and the mining industry through industry exchange programs and modern, industry-relevant, collaborative (university-government-industry) courses such as the National Exploration Undercover School.