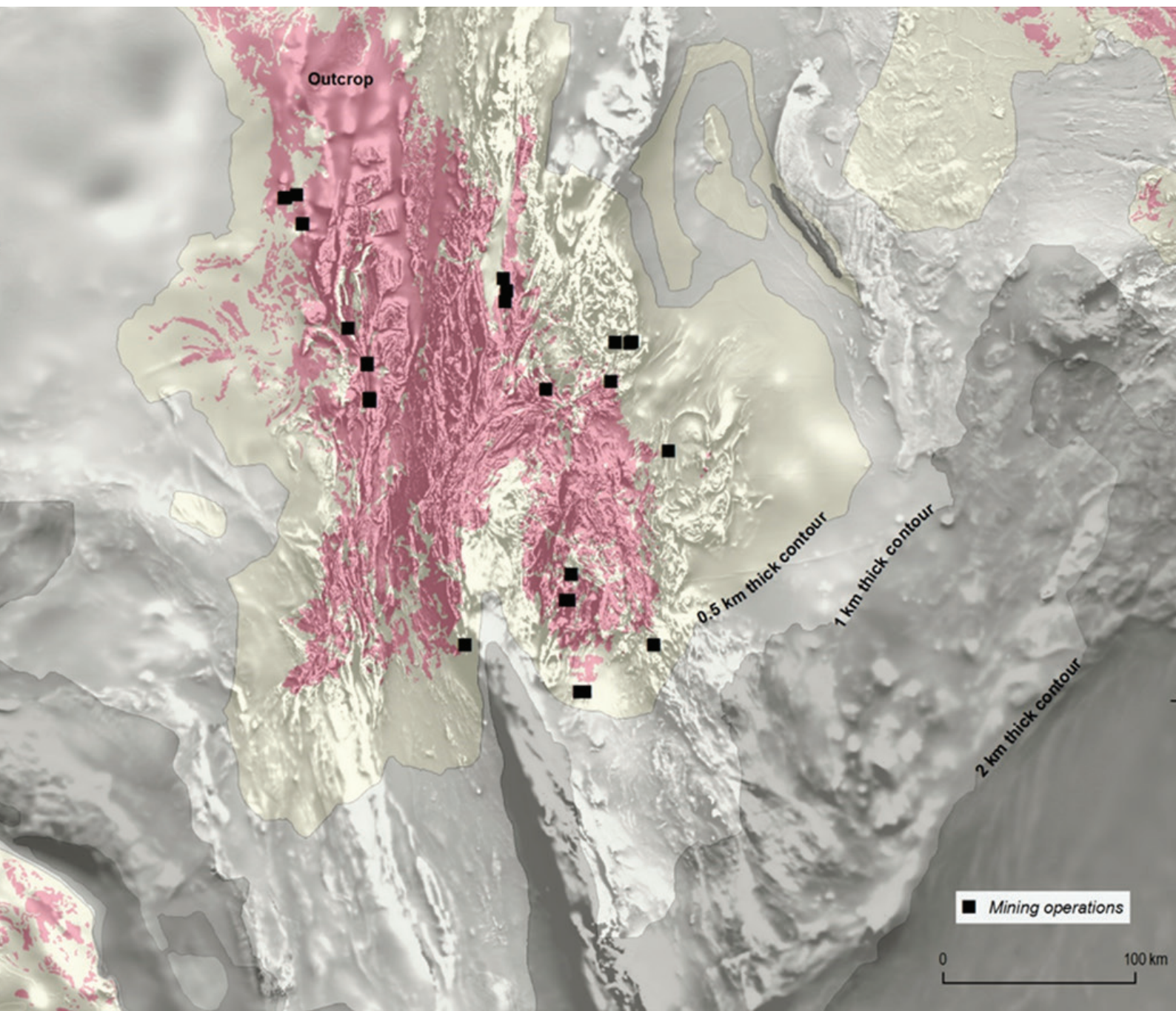


UNCOVER: UNFOLDING THE VISION FOR EXPLORATION GEOSCIENCE TOWARDS A BRIGHTER MINING FUTURE IN AUSTRALIA

Summit 2014 and Next Steps

July 2014



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← Frontispiece

An illustration of the extent of the poorly explored covered regions of Australia compared with the distribution of relatively well-explored outcrop (in pink). Main image shows the detail of a part of North Queensland with the region's geological character of outcropping rocks and basement beneath cover imaged by variability in magnetic response. Major mining operations are clustered either on the outcrop or in shallow cover immediately adjacent to it. Image courtesy of Geoscience Australia 2014.

Reference: Operating mines on PreCambrian outcrop and Phanerozoic cover shaded by 0.5 first vertical derivative magnetic map of Australia (Geoscience Australia; de Vries, S., N. Fry, and L. Pryer (2006), OZ SEEBASE Proterozoic Basins Rep., 80 pp

FORWARD

It is with great pride as patron of the initiative that I introduce this UNCOVER progress report. There is little that compares in importance to the future prosperity of Australia through what is a very important strategic application of our science capability.

We must consider how we wish to use and shape Australia's current success in harnessing the opportunities presented by the urbanisation and industrialisation of emerging economies, like China, to give us the best path into the future. From a national mineral resources perspective, we need to consider what the mix of commodities of greatest value will be over time, what exploration methods will be used to discover them and what technology the mines of the future will need and use. We must not allow our past success to create complacency in terms of what the nation must do to ensure this future.

Given the long lead times, often exceeding 20 years, between ore-deposit discovery and mining production, Australia must act now to implement the measures necessary to create the pipeline of projects that will propagate our success into the future. Unfortunately, as the task of finding new deposits has become undeniably tougher, we are already on a trajectory of a significantly reduced mining inventory. This should only strengthen our resolve to step up and do what is necessary.

The most recent analysis of non-ferrous global exploration expenditure by SNL Metals Economics Group, published in March 2014, reported that: Latin America attracted the largest share of global expenditure (25 per cent); Eurasia (including Russia and China) attracted the second largest share; and Africa ranked third, drawing 17 per cent of global metals exploration budgets. By contrast, both Canada's and Australia's share was 13 per cent. On this measure, as a share of global metals exploration expenditure, Australia has lost eight percentage points in the 17 years to 2013.

One of the factors behind the decline in Australia's standing as an exploration investment destination over the past decade or so is the belief that the continent has reach a level of exploration "maturity" that significantly diminishes the likelihood of further major discoveries. This could not be further from the truth.

The 80 per cent of our continent that is covered by regolith and sedimentary basins is in fact largely unexplored. This is essentially due to the limits of our geoscience knowledge of these areas and our ability to explore them effectively. By developing the appropriate geoscience knowledge and technologies it is to be expected that several new provinces of mineral wealth can be discovered and developed across the country, and hence this actually represents an untapped exploration opportunity of more than 7½ million square kilometres. As the frontispiece to this report illustrates, significant areas of prospective terrain can be identified under relatively shallow depths

of cover, which is well within the current economically-viable mining window down to a few hundred metres.

Minerals exploration is intrinsically high-risk. The exploration process is scientifically complex, lengthy, and expensive, and rewards for the effort may only materialise decades later if at all. Using international data, the Colorado School of Mines concludes that it takes 500-1,000 grassroots exploration projects to identify 100 targets for advanced exploration, which lead in turn to 10 development projects, only one of which becomes a profitable mine.

Australia's only substantial advantage on the international stage is to reduce the technical risk of exploring here compared with elsewhere. Even a modest betterment in the turnover rate and quality of exploration targets at the grass roots stage can lead to a substantial improvement in the overall value and risk equation of exploration and mining development for explorers, especially if it closes the gap between the exploration investment and the commissioning of a new mine.

The goal of the UNCOVER initiative is to focus Australia's relevant geoscience effort on providing the knowledge base and technology that will substantially increase the success rate of mineral exploration in Australia.

UNCOVER's strategy is to provide an effective forum for a national-level conversation to ensure that government, funding agencies, policy developers, relevant government geoscience research agencies, surveys, relevant technology developers and the relevant geoscience research community at large are all clearly aware of the geoscience knowledge needs of the minerals exploration industry:

- so that the geoscience research, survey work and technology development can all be focused on the important questions and can be integrated to leverage the different contributions to maximum effect: and
- so that the industry can remain interactive in the prosecution of these questions and the effective deployment of the new knowledge.

I look forward to working with you as the UNCOVER patron and promoting it with the utmost sense of urgency. I encourage explorers, geoscientists and organisations from across the sector to consider carefully the strategy and approaches and emerging geoscience priorities as outlined in this report and to identify the role you can play to better define and progress this initiative for the good of the nation.



**The Honourable
Martin Ferguson AM**
Patron of UNCOVER

SUMMARY

Following the inaugural UNCOVER Summit, this report presents the current status of the UNCOVER initiative and a path forward for the immediate future. It outlines the strategy that underpins it and the implementation approach.

Modern mining technology can already reach to depths greater than our ability to explore effectively from the surface. This continent remains 80% unexplored in fact, with the problem compounded by an order of magnitude because of barren cover. Other than the oceans it is perhaps the greatest discovery frontier on the planet. Not only does the geology present an enormous hidden opportunity, but it is likely that no other country is able to organise its scientific resources to address this complex challenge - the way Australia can.

UNCOVER is concerned with more effective application of precompetitive knowledge recognising the complementary compound growth benefits of making a smarter investment in both national survey data and science.

The importance of UNCOVER to Australia’s future economy could not be overstated and the results will depend critically on how effectively our national effort is coordinated.

However, in 2014, Australia is at a critical junction.

With the wrong approach we will continue to head towards a critical decline in the mining industry with three quarters of the (non-energy) mining reserves exhausted well inside 20 years. Alternatively, the prize is as great as the opening up of several new mineralised provinces in Australia over the next generation, resulting in the relative contribution of mining to the economy greatly increasing from even the present day

“boom times”. Over the last decade especially, there has been a dramatic drop in green fields exploration investment in Australia – diverted elsewhere including substantially, other nations in the first world.

The key is to coordinate the nation’s intellectual capacity and focus our effort on the right things. Based on consultations so far, a working set of 15 science topics are emerging as priorities and are identified in this report along with a plan to progress them.

Whilst it is not an explicit objective of UNCOVER to address, land access and associated costs will continue to discourage explorers. In this century, we will see a progression towards development by complementary social license as much as with permission. UNCOVER and other initiatives of The Academy of Science will show, to the community at large, what the geoscience knowledge needs are. This will lead to an improved understanding of the value of, and what the associated choices are for, our natural resources – soil, water, minerals, and landscape.

UNCOVER must operate with a sense of urgency, visibility and transparency across the sector and to all levels of government. Essentially, it is a national umbrella for a new three way equal partnership of the science community with industry and geological surveys.

We recently welcomed the Honourable Martin Ferguson AM as Patron and we thank him for his opening message in the forward of this report.

Finally, following discussions at the Summit, UNCOVER’s leadership team has been bolstered with the addition of further industry members on both the executive and the newly formed inaugural geoscience committee.

Australian Mineral Ore Reserves and Future Potential

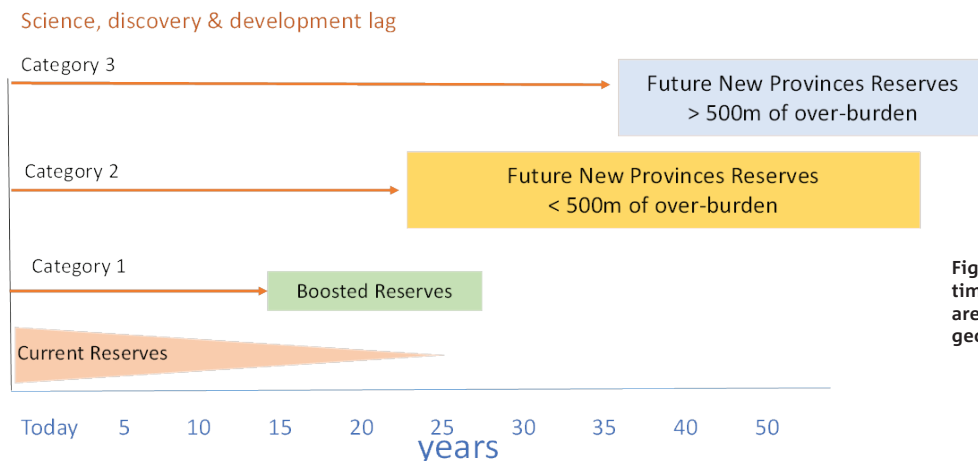


Figure 1 Illustration of the relative time lag and target future potential area of the three categories of geoscience priorities.

THE UNCOVER GAME PLAN & THE ECONOMIC IMPERATIVE

Emerging science priorities are identified in consideration of the likely impact on exploration success in Australia and also, importantly, the relative timeframes of conducting that research, implementing the outcomes in industry leading to discovery and then the development lag to the commissioning of new mines. For discoveries relying on new science, this process takes on average 30 years.

Put simply, for the industry of the future – a generation from now - we must commence the work today.

There is surely no greater economic legacy that can be created by the government and geoscience community of today.

In this report, and illustrated by the following two figures, we have broken the challenge down into three areas based on the difficulty and immediacy of the science and the part of Australia's future mineral endowment that each is likely to unlock.

Fortunately there are several science activities (referred to as Category 1 Priorities) that are relatively easy to implement (some of which are already underway) that will help reverse the impending decline in Australia's Mineral Reserves base over the next 20 years.

But we have already lost significant traction and the easy-to-implement Category 1 activities will not be enough. To limit the impact of a looming but inevitable mining production decline 15 to 25 years out we must progress the tougher science challenges that now face us. A second class of activities (category 2) are reasonably easy to identify and by their nature leverage the science knowledge and data created by the first set of activities and by what the science community has achieved already. This second set of science activities

will aid the discovery of some (but certainly not all) of the hidden mineral deposits particularly beneath the relatively shallower parts of the cover (nominally less than 500 metres depth) and will inevitably require some fundamental science.

There is then the real prize in exploration geoscience – the reliable prediction and detection of a large range of major buried mineral deposits again in the shallower covered areas but also in the more deeply covered terrains. This challenge leads to science activities (Category 3 Priorities) that are by nature longer term and will require long-term cross-community collaboration and will involve a substantial amount of fundamental science. Breakthroughs in science of category 3 will open up a larger search space but also a greater challenge to mining economics. UNCOVER will share this journey with those science and engineering groups that are addressing this challenge such as CRC ORE, CRC MINING and initiatives of the Australian Academy of Technological Sciences and Engineering.

As a fundamental, underpinning knowledge base that will provide a context for and tie together all the different parts of the scientific effort, it will be important to understand the basic structural architecture of the continent, even beneath deep cover.

Success will derive from industry uptake of a comprehensive package of scientific knowledge of outstanding quality created from integrated research and survey work focused on resolving the scientific questions that are important for mineral exploration success. This will require participation by industry, government and academia with effective and committed collaboration across the whole of that sector working towards a common, focused goal. Achieving this is the goal of UNCOVER, as laid out in its strategy.

Australian Geoscience Research Priorities and relative Impact

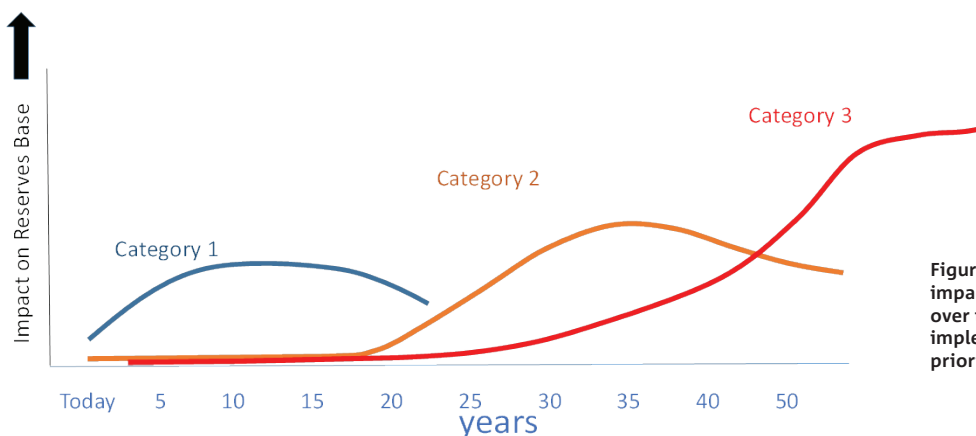


Figure 2 Illustration of the projected impact on the Ore Reserves base over time as a result of successful implementation of the geoscience priorities.

UNCOVER MILESTONES

KEY MILESTONES AND ACTIVITIES FOR UNCOVER TO DATE

2010	Theo Murphy Think Tank and report – Searching the deep Earth: the Future of Australian Resource Discovery & Utilisation
2011	Exposure Draft UNCOVER vision
2011/12	Exposure draft roadshow meetings (8 meetings Australia wide)
2012	Release of UNCOVER vision
2012	UNCOVER adopted as basis for the Research Initiative component of the National Mineral Exploration Strategy -, Standing Council on Energy and Resources (SCER)
2013	Engagement Survey of industry, researchers and surveys (70 face-to-face interviews and 177 online submissions)
2013	UNCOVER Mineral Systems workshop (50 participants from industry, research and surveys)
2014	UNCOVER Summit (170 participants from industry, research and survey)
2014	Post Summit formal submissions (30)
2014	Depth of Cover Geophysical Techniques. UNCOVER workshop on state-of-the-art and future directions - geophysical methodologies for characterising the cover

NEAR TERM MILESTONES ENVISAGED

2014-15	Production of a series of reports defining each of the geoscience priorities and the work required to address them and expected outputs - generated from a series of workshops
2015+	UNCOVER endorsed work programs at the state surveys and Geoscience Australia in line with better defined UNCOVER geoscience priorities
2015-16	Generation of several new collaborative research project proposals addressing the geoscience priorities including headline projects
2015-16	Adoption of UNCOVER priorities by research funding organisations such as ARC and other commercial providers

UNCOVER STRATEGY AND APPROACH

UNCOVER's intent is to substantially increase the rate of discovery of economically significant mineral deposits, resulting in the development of new Ore Reserves in Australia and creating substantial value for the nation. The initiative will do this by increasing the effectiveness of Australia's geoscience research effort in exploration geoscience and facilitating adoption by industry. A national collaborative approach between industry (explorers and technology providers), researchers and government surveys is needed in order to define and focus the effort on specific priorities that will have the greatest impact on the success and speed of discovery.

The scale and depth of collaboration required to precisely define the work that needs to be done has until now not occurred. UNCOVER's strategic approach is to provide a forum for that collaboration to be effective.

UNCOVER's purpose through that national-level conversation is to ensure that government, funding agencies, policy developers, relevant government geoscience research agencies, surveys, relevant technology developers and the relevant geoscience research community at large are all clearly aware of the geoscience knowledge needs of the minerals exploration industry,

- so that the geoscience research, survey work and technology development can all be focused on the important questions and can be integrated to leverage the different contributions to maximum effect, and
- so that the industry can remain interactive in the prosecution of these questions and the effective deployment of the new knowledge.

Given the challenges, and their timeframes, that we face, UNCOVER must operate with an urgent purpose. For UNCOVER to be successful it is important to have broad community ownership: industry, government, and academia. There needs to be intensive and extensive cross-sector collaboration while maintaining prime visibility to government. The following must guide the approach in order to maximise the effectiveness of the initiative.

Working to a common goal

To achieve success it is important for the different sectors all to be working towards a common goal. This will draw industry, survey teams and geoscience researchers together under a single platform by providing a focus point for defining the key science

questions, which will in turn inform the data collection priorities and vice versa.

A significant advance has already been made in this respect in that the Council of Australian Governments' (COAG) Standing Council on Energy and Resources (SCER) has formally released its National Mineral Exploration Strategy, largely based around the vision expressed by the UNCOVER initiative.

Industry focussed

To help the research and survey communities focus their effort on the genuinely important questions, we need to build mechanisms to capture sufficient weight of shared knowledge within industry and end-users for the purpose of defining those priority science questions that genuinely impact the success rate of exploration for major economic deposits. It will also be important to build mechanisms that allow industry to remain interactive in the prosecution of those questions and in effective deployment of new knowledge.

Identify, prioritise and influence

Through discussion and consultation, hosted by the UNCOVER geoscience committee, identify which of the current research and survey programs meet the priorities and help define innovative new programs that will create critical knowledge.

It is important for the discussions and consultations to be genuine two-way collaborations with a transparent chain leading to programs, defined in a national context, that are formally endorsed by UNCOVER, through the geoscience committee.

- Open and clear articulation from the industry about the scientific and technical issues that genuinely impede their success.
- Serious discussion with the researchers and surveys so as to define and refine the important scientific questions, resolution of which will provide the new knowledge necessary.
- Hard-nosed discussion as to whether those questions are indeed amenable to resolution in a reasonable timeframe.
- Identification of the capability needed to address the questions and who is best placed to be involved. Frequently this might involve broad-scale collaborations involving a range of industry and academic researchers together with the surveys. On other occasions it might involve a specific, small, targeted team. It might require a new program or a better focus of resources into an existing program. We should look first to our own capability in Australia

but be willing to draw on international skill when necessary.

- Provide formal UNCOVER endorsement for these programs and raise the public profile of the importance of the work. Advise government, government agencies, funding bodies such as the ARC, and universities that these scientific questions are of strategic national importance and that resources should be focused to resolve them.
- Facilitate coordination of these initiatives so that they are complementary in nature.

Quality of science

As already noted, the goal of the UNCOVER initiative is to focus Australia's relevant geoscience effort on a targeted outcome. Thus there is the inherent aspiration that the science undertaken as part of this initiative will be a significant component of the knowledge used to make decisions regarding investment of tens or even hundreds of millions of dollars. Hence the science that we undertake and deliver has to be extremely robust and of the highest possible quality.

Future skills

Addressing these new challenges will inevitably mean that new skills will be required by geoscientists in research, survey and industry. Part of the role of the UNCOVER Science Committee will be to identify and anticipate the necessary new skills and part of the role of the Networks/Communications Committee will be to work with universities to incorporate these skill sets into future tertiary education design.

Dynamic approach

It is inevitable that the most effective approach for the UNCOVER initiative five years hence will be different from the most effective approach today, not least because of the varying demands imposed by the natural mining cycles that occur. However, UNCOVER is a strategic initiative about building an effective knowledge base and so the fundamentals of the initiative will remain valid.

As with most initiatives, to be effective this must be a learning process and it will be important for UNCOVER to be willing to change its structure (including the composition of the leadership group) and approach as the geoscience community learns how to deal with this shared challenge.

External references

Finally, UNCOVER will be strengthened by establishing relationships with some initiatives on related subjects that, whilst not making them an implicit part of

UNCOVER itself, will help keep the focus around the geoscience. In particular:

- Work of the Standing Council of Energy and Resources in promoting its National Mineral Exploration Strategy.
- Work of the National Committee for Earth Sciences (NCES) at the Academy of Science, which seeks to maintain the health of Australian geoscience and to promote the value of geoscience in general to society.
- Work of the Academy of Technological Sciences and Engineering, which has recently formed a Minerals group that is expected to help bring the overlay of economics and engineering to the choices UNCOVER makes.
- Other groups such as CRC ORE that seek to improve the economics of developing increasingly lower-grade and deeper mineral deposits.
- The Exploration Investment and Geoscience Working Group (EIGWG) of SCER (previously known as the Chief Government Geologists Committee - Team Australia).
- Other groups as the initiative unfolds.

KEY EXPLORATION GEOSCIENCE BARRIERS AND KNOWLEDGE NEEDS FOR ATTRACTING A GREATER INVESTMENT IN AUSTRALIA

Exploration Process Step	Barrier	Key geoscience knowledge
1. Selection of a region (100 km+ scale)	<p>With few exceptions, available regional data is of insufficient density and fit and the exploration models based on those data are not good enough to enable a practical evaluation, and therefore justification, of the next stage of exploration – being target generation within a region at camp scale.</p> <p>The basis of assessing potential and fertility of a region is limited largely to extrapolated extensions of known provinces. The confidence of extending this into areas of unknown geology beneath cover reduces exponentially with distance – both horizontally and vertically.</p>	<p>Predictive exploration models informed by a sufficient density of precompetitive data appropriate to the application.</p> <p>At this stage, models tend to be more generic.</p>
2. Identify a target within the region (1 – 10 km scale)	<p>Geological (including mineralogical), geophysical, and geochemical signatures of desirable targets are poorly known or the technology to acquire them beneath cover does not exist or is ambiguous.</p>	<p>Direct and remotely sensed analytical tools to acquire signatures and signals of mineral deposits and their broader geological setting and modelling methods to integrate those signatures. Demonstration of their usefulness in a wide range of deposit styles and their variants.</p>
3. Detect ore system (1 km scale)	<p>Lateral footprints and their characteristics are currently thought to be limited to hundreds of metres or less for most deposit styles, making an economic search for non-outcropping mineralisation problematic due to the number of drill holes needed for an effective economic risk based search.</p>	<p>Specific models for a variety of deposit types describing in 4D their geochemical dispersion and geophysical and geological characteristics allowing effective vectoring towards ore.</p>

Science priorities must always clearly link and be informed by these barriers and others that emerge over time. Each of the four of the UNCOVER vision topics are linked in this way to better data, knowledge and tools.

- increasing the rate and usefulness of precompetitive data programs including a closer association with the science as a basis for design and vice versa.
- Developing new tools for exploration beneath cover.
- Developing new knowledge from existing and new data, that informs improved exploration models for major deposits beneath cover and closes the gaps that occur when moving between scales with decreasing target size and increasing probability of success.

EMERGING GEOSCIENCE PRIORITIES.

UNCOVER is concerned with hosting a sustained conversation between industry, surveys and researchers so that collectively we may be more effective in the work we are doing, maximise the value from the enormous science achievements of the past and identify new opportunities in what and how we progress. That conversation is gathering pace, including formal submissions made around the Summit, and already several priorities are coming through consistently. Hence those priorities can now be regarded as a workable starting set. All of these are in need of better definition and a process to confirm, add and remove particular parts as we evolve.

The following tables, firstly in short summary form and then with more detail, summarise those 15 starter topics, separated into three categories by increasing scientific challenge but potentially greater reward. None of these projects is new and indeed some progress is already being made. For the mining industry though, the impact is not being felt and the projects need to be designed to be more effective. In part this will come through greater intensity and in part through smarter approaches.

The compilation of existing data and knowledge, bringing together the work of geological surveys, research and industry exploration, is itself an enormous but essential task. Future science research will be significantly better designed with the benefit of this historical knowledge and will also help adapt the approaches adopted in the research to be a closer match to the approaches and needs of industry.

Central to the success of advancing the set of geoscience priorities and others that will follow, is an expectation that each of the sectors will over time, through closer collaboration, evolve their approaches:

Industry – An increasing appetite to share current knowledge and that which field tests the success of new ways of exploring as the science delivers;

Research – An increasing appetite for producing scientific outcomes that are based on data types and scales relevant to the explorers; and

Survey – As custodians of the knowledge base that will inform the discoveries of the future with an increasing appetite to seek design criteria from the science and see their work being used to advance the science.

	Category 1	Category 2	Category 3
Value & Risk	Easy to implement. Immediate term impact < 15 years	Higher scientific challenge. Medium term significant impact <30 years	Greatest scientific challenge. Longer term and greatest impact 30+ years
Clarity	Easy to define	Challenging	Unclear
Geoscience priorities and results	Compilation of existing datasets and knowledge from 50 years of research and survey work into accessible, fit-for-purpose formats. Surveys and drilling programs targeting key knowledge gaps. A base set of atlases and exploration knowledge references.	Use existing knowledge and new category 1 outputs as a basis for smarter and more richly informed survey and science projects for better informed exploration models. Address the medium term barriers to discovery in a widened search space under cover.	Produce the next generation of tools for the prediction and detection of buried mineral deposits across a wide range of mineral styles appropriate to Australia. Increase the search space and range of target types in areas of increasing depth of cover and distance from outcrop.

Table 4. Summary of Emerging Geoscience priorities.

Category 1 Priorities	
(1a) Characterising the cover	Compilation of current data: (1) Depth of cover; (2) Chemistry of groundwater; and (3) Physical properties of cover such as density, porosity, magnetic susceptibility, conductivity. (4) Stratigraphic drilling and re-sampling as appropriate in key areas extending basic geological knowledge of prospective shallow cover areas and key structural blocks.
(1b) Lithospheric Structure	(5) Extend seismic surveys to define key structural elements of Australia.
(1c) 4D Metallogenesis	(6) Compilation of all current relevant data and knowledge especially in 3D (GIS format) in order to later inform the 4D.
(1d) Distal footprints	(7) Compile current knowledge, the characteristics and proxies such as geophysical and geochemical responses, of all relevant major deposit styles into an atlas of mineral-system-scale maps – identifying what we do, and would like to know.
Category 2 Priorities	
(2a) Characterising the cover	(8) Depth-to-basement and cover-characteristics imaging from targeted airborne electro-magnetic surveys. (9) Build on current understanding of processes that occur within the cover that can be used to improve interpretation of existing remote sensing or geochemical data or developed as a proxy for use in exploration and therefore extend the search space.
(2b) Lithospheric Structure	(10) Extend the national tomographic network in order to complete the interpretation of the base of the continental lithosphere and zones of depleted mantle that can be associated with major structural elements as major deposit forming fluid pathways.
(2c) 4D Metallogenesis	(11) Document current models of 4D history interpretation and association with major deposit formation and identify gaps to inform survey design and research opportunities. Include results from key knowledge gap filling programs such as new geochemical signatures of particular events and age dating.
(2d) Distal footprints	(12) Build exploration models, including deposit formation, fertility measures and critical components at regional- to deposit-scale, for each of the major deposit styles using existing technology.
Category 3 Priorities	
(3a) Characterising the cover	(13) Develop next generation of geophysical tools that can image through increasing amounts of cover for an increasing number of deposit styles.
(3b) Lithospheric Structure	(14) Characterise the lithospheric architecture, the interactions with subduction zones and basin development over time and understand the connection to structural architecture at the camp scale for major deposits. This topic feeds into future endeavours in theme (3d).
(3c) 4D Metallogenesis	No current priorities: To be defined in future once 3D data sets are improved.
(3d) Distal footprints	(15) Extend the footprint of all major deposit styles in Australia as far as possible and connect their characteristics to ore deposit forming processes operating at the camp and regional scale.

Table 5. Detailed Geoscience Priorities

ADVANCING THE PRIORITIES.

UNCOVER will facilitate the continued definition of geoscience priorities in four ways:

1. Continue to engage with industry to identify their barriers and as much of a consensus as possible on possible solutions;
2. Encourage attendance from all sectors to discuss and workshop each of the science topics towards better defined work programs;
3. Formally endorse programs that address the priorities; and
4. Endorse key success metrics following definition of the priority projects.

Each of the State surveys and Geoscience Australia advise that there are already programs in place to digitise historical datasets, including the derivation of GIS data. UNCOVER is an opportunity for industry members to assist the surveys in defining the outputs of this work.

These datasets are key inputs into future science research projects and, through UNCOVER, research groups should be familiarising themselves as soon as practical as the data is available. Likewise, the design of stratigraphic drilling programs would benefit from extensive consultation with both industry and researchers.

Each Category 2 topic requires an in-depth series of workshops, and in some cases proof of concept tests, to precisely define the work required, who is best placed to do it and potential funding models.

The Category 3 projects by their nature require a number of years to define properly and in all cases there is work to be done in the category 1 and 2 pursuits as a precursor. This will ensure that not only have we defined the state-of-the-art and where the gaps are but have also clearly identified the scope. By their nature they are also more likely to involve greater international collaboration than the others.

SIGNIFICANT ECONOMIC MINERAL DEPOSIT STYLES IN AUSTRALIA

UNCOVER must be implicitly concerned with the discovery of economically significant mineral deposits; deposits that produce long-life major mining reserves, are able to sustain a cash flow across two or more metal price cycles and have pre-development market values in excess of one billion Australian dollars. Deposits of this nature will attract the level of exploration investment required and will create substantial value for Australia. The exploration process, by its nature based on the new data and knowledge that UNCOVER will promote, will undoubtedly also lead to the discovery of less valuable deposits but the primary focus must be on economically significant deposits.

A good starting point for major deposit styles that have been shown to be hosts for economically significant mines, or have high potential to host such mines, in Australia are listed below (Table 3).

Deposit Type	Example
Sediment hosted lead zinc	Mt Isa
VMS base metal – precious metal deposits	Mount Morgan
Iron Hosted Copper Gold (IOCG) and it's variants	Olympic Dam
Banded Iron oxide iron	Hamersley
Magmatic Nickel	Kambalda
Porphyry copper / gold / molybdenum	Cadia
Orogenic gold	Kalgoorlie
Sediment hosted Uranium	Ranger
Magmatic exo-Skarn hosted tungsten	Yet to be discovered
Magmatic rare earths	Yet to be discovered

CURRENT PUBLIC ACTIVITY AND CAPABILITY

The government's investment in related infrastructure and exploration geoscience programs across the surveys and research is already substantial, amounting to an annual investment of close to three hundred million dollars. UNCOVER's challenge is not only to justify new investment but also to show it will improve the effectiveness of the existing investment and extract full value from the enormous past investment that Australia has already made.

STATE AND FEDERAL GEOLOGICAL SURVEYS.

Observations were reinforced at the UNCOVER Summit this year that the state and territory surveys and Geoscience Australia have moved considerably towards aligning their work with the needs of industry compared to recent years. Adoption of the UNCOVER vision by the surveys was formalised by SCER in December 2013. The surveys have been "first movers" in this regard and their various programs of improved data compilation and access and new mapping, geophysical surveys, drilling and collaborative research will only be strengthened as UNCOVER progresses.

AUSCOPE.

The AuScope vision is to be "A National Geoscience and Geospatial Infrastructure System to transform our Understanding of the Structure and Evolution of the Australian Continent". Formed in 2007 as a key identified need of the National Collaborative Research Infrastructure Strategy (NCRIS) the infrastructure that has now been established and has an excellent fit to the aspirations of UNCOVER in all six of its main components:

- AuScope grid and interoperability;
- Earth composition and evolution;
- National virtual core library;
- Earth imaging and structure;
- Earth simulation and modelling; and
- Geospatial framework and earth dynamics.

CSIRO

CSIRO maintains a highly valued exploration geoscience team as part of the Minerals Down Under flagship program. That team provides high quality science and technology into a number of existing key research and development projects such as CRC Deep Exploration Technology and is expected to play a central role in many of the future projects.

UNIVERSITY BASED.

Australian trained economic geologists are held in very high regard around the world and have been for over a generation. Our university graduates are in fact prized by both industry and research for their unique mix of high-quality science, practicality and hard work. This is also exemplified by a highly ranked publication record in economic geology that is well out of proportion to our numbers compared with elsewhere. Over recent years we have established strong and enduring connections with the world's best geoscience research groups.

SYDNEY UNIVERSITY

A collaborative project under way, centred at the University of Sydney with SEIF funds, is utilising supercomputing power to develop the next generation of big data analytics tools – applied to geoscience data including the localisation of major mineral deposits. This project was initiated with reference to the UNCOVER vision.

In addition to the geoscience departments, Australia has two ARC-funded Centres of Excellence operating in UNCOVER space:

- Centre of Excellence in Ore Deposits (CODES) at the University of Tasmania; and
- Centre of Excellence for Core To Crust Fluid Systems (CCFS) at Macquarie University.

Although housed on campus at the University of Western Australia, the Centre of Exploration Targeting (CET) is 100% funded by industry and collaborates extensively both here and globally. The Capricorn distal footprints project, which exemplifies the UNCOVER vision, is a collaboration between CET, Monash University, Curtin University, the CSIRO, the Geological Survey of Western Australia and industry.

DEEP EXPLORATION TECHNOLOGIES CRC

DET CRC was created in a similar way that UNCOVER should aspire to for its geoscience projects. That is, that industry was engaged to identify a problem followed by a process that brought in researchers and surveys together to propose solutions and then a vehicle – in this case a CRC to design and prototype a next generation of drilling and related geochemical and geophysical tools.

A challenge for UNCOVER is to build on the DET CRC achievements and its adoption in both science research and industry.

LEADERSHIP

Implementation of UNCOVER is tasked to three committees or leadership groups each with a defined role as set out below:

EXECUTIVE

Relatively small group with representation from Industry, Surveys, Geological Societies (AGC), Universities, AMC, AMEC and CSIRO.

- Leadership group
- Set and review strategy and its effectiveness
- Ensure proper governance of initiatives principles
- Engage government
- Engage key groups such as CSIRO, Auscope, ARC, GA, Chief Government Geologists
- Derive and monitor success metrics
- Ensure sufficient momentum is occurring
- Appoint and work with subcommittees

CURRENT COMMITTEE MEMBERS ARE:

Phil McFadden, FAA (Chair)

Chris Pigram, Geoscience Australia (GA)

Gavin Lind, Minerals Council of Australia (MCA)

Will Robinson, Association of Mining and Exploration Companies (AMEC)

Michael Asten, Australian Geoscience Council (AGC)

Jonathan Law (CSIRO)

Suzanne O'Reilly FAA, National Committee for Earth Sciences (NCES)

Paul Agnew, Rio Tinto

Robbie Rowe, Industry independent

Steve Hill, Exploration Investment and Geoscience Working Group(EIGWG)

Dean Collett, Industry independent

Chris Lewis, Projects Manager, Australian Academy of Science

GEOSCIENCE COMMITTEE

Representation from leaders and young scientists, across sector and geographically, UNCOVER 4 vision topics.

- Drive the UNCOVER process as described by the strategy document
- Promote UNCOVER across sector

- Monitor science activity and recommend endorsement of science projects
- Identify gaps and opportunities
- Report on success metrics including uptake in industry
- Encourage effective and ongoing collaboration on specific projects
- Capture learnings
- Work closely with network committee to organise collaborative events.

CURRENT GEOSCIENCE COMMITTEE MEMBERS:

Steve Beresford, (Chair) 1st Quantum

Robert Hough, CSIRO

Graeme Broadbent, RioTinto

Jon Hronsky, Western Mining Services

Paul Hodkiewicz, BHP Billiton

Richard Lilly, Glencore

Tim Debacker, Frogtech

Karol Czarnota, GA

Phillip Blevin, Geological Survey NSW

Richard Blewitt, GA

Andrew Tomkins, Monash University

Bruce Gemmill, UTas – CODES

Cam McCuaig, CET - UWA

Caroline Forbes, University of Adelaide

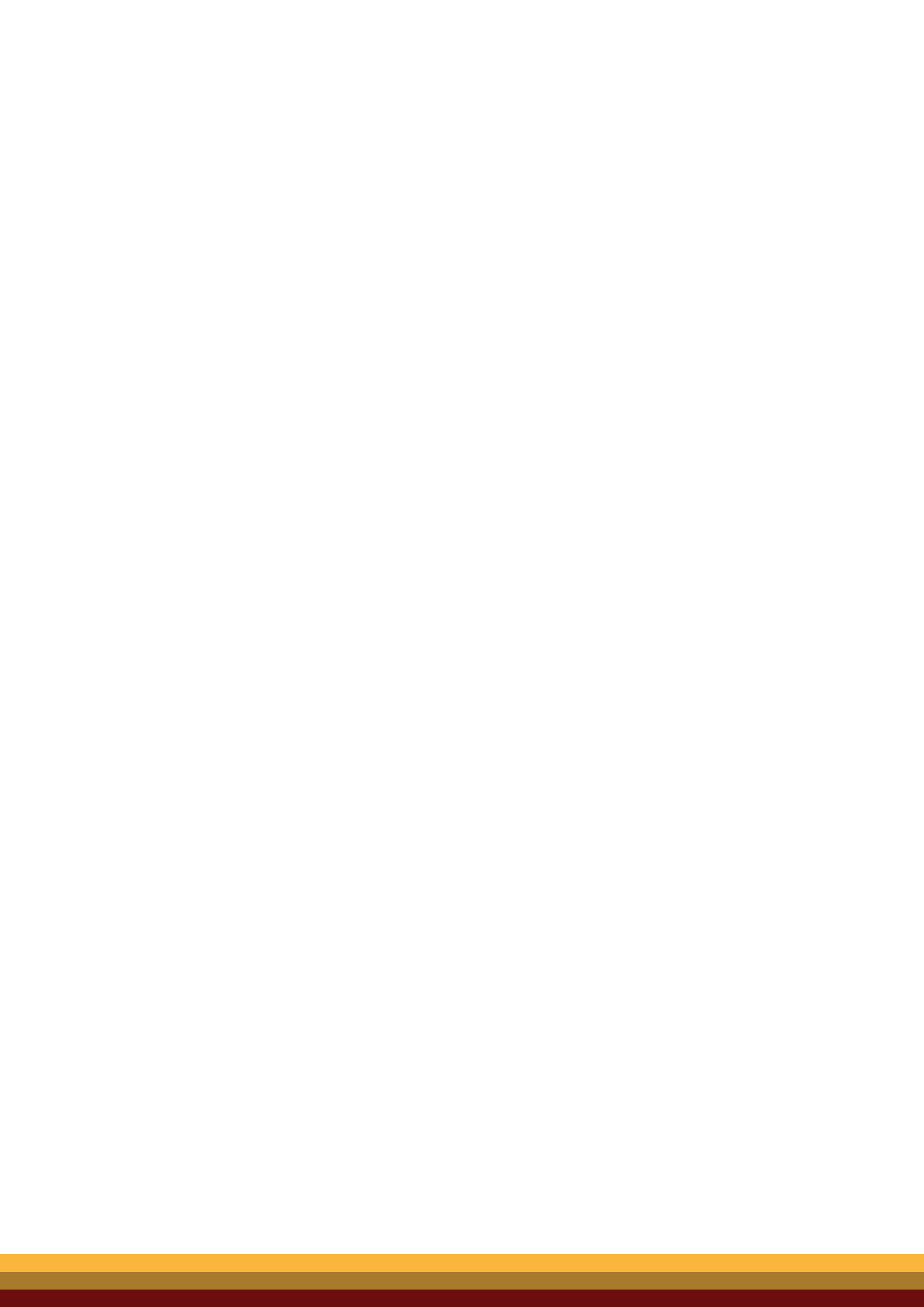
Ian Tyler, Geological Survey Western Australia

Roric Smith, Evolution Mining

NETWORK AND COMMUNICATIONS COMMITTEE:

Representation from across sector and geographically.

- Work closely with geoscience committee to promote UNCOVER across sector
- Encourage participation across the community including ambassadors
- Communicate activity including publishing work that exemplifies what UNCOVER sets out to achieve.
- Lobby government and societies and organisations
- Organise collaborative events and promote involvement



MORE INFORMATION

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