

Submission

2016 National Research Infrastructure Roadmap

Capability Issues Paper

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Questions:

Question 1: Are there other capability areas that should be considered?

- Whilst the Geosciences and Solid Earth Science are considered in the document they are only included in the Environment and Resource Management. This approach undervalues the research impact that geosciences have internationally as well as the importance of the resources and energy industry to the Australian economy. The inclusion of a capability area that focuses on the geosciences would serve a significant portion of the research community's needs, have strong support from Government geological agencies and industry. It would also better align with the Federal Government's stated Science and Research Priorities which address both Energy and Resources.
- The geosciences which include geophysics, geochemistry, geodesy and field geology provide a connection between the traditional STEM sciences and the Resource and Environment Management sectors.
- The outcomes of the AMIRA International Roadmap for Exploration Under Cover need to be considered in this document. The roadmap will deliver a consensus view from key stakeholders on what needs to be done if undiscovered mineral wealth in areas of cover is to be found in Australia. AMIRA International has completed Stage 1 and has commenced Stage 2 of a Roadmap for Exploration Under Cover. This initiative has brought together Australia's mineral exploration industry, suppliers, government geological survey organisations, the research community and UNCOVER to design a longer-term integrated national research and accelerated data compilation and acquisition programme through an unprecedented national scale collaborative effort. One of the key outcomes from this initiative will be options on the type of vehicle that should be best used to undertake the research programmes. This will include recommendations on suitable management and governance arrangements to best deliver on the Roadmap vision. This is likely to be a decade long research programme funded from a variety of sources that will have significant research infrastructure requirements including:

Focus Area Themes	Infrastructure required (with links to the relevant themes from the AMIRA Roadmap for Exploration Under Cover)
Depth-to-basement and cover-characteristics, imaging from new targeted airborne National (20km) electromagnetic (AEM) surveys	Data acquisition – new geophysics Major, national significance acquisition of AEM data across Australia to infill to minimum (20km?) data, prioritized by gap analysis and setting up of a cross stakeholder working group to direct programme and sequence AEM data collection.
Acceleration and completion of national AusLamp long period magnetotellurics (MT) (55km spacing) programme	Data acquisition – new geophysics Acceleration of National AusLamp long period MT (approx. 55km spacing) programme. MT programme is progressing but is not

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	<p>adequately resourced to deliver data in required time frame</p> <p>3D conductivity and resistivity maps and specific defined depth layers of continent with 0.5 degree resolution. Data will feed into research leading to deeper understanding of lithospheric architecture and re-fertilisation/metasomatism by melt and fluid events. Also providing data for a key link through crust of structure and architecture.</p> <p>Infill data over selected tier 1 mineral camps to be linked to Theme 4 distal mineral footprints for possible direct detection of fossil mineral systems. Locations also informed by data compilation and prioritised from results of Themes 4 (spacing) & 6 (Economic Search Space).</p>
Acquire approx. 4km grid of gravity over continent	<p>Data acquisition – new geophysics</p> <p>Uneven coverage across continent of gravity data especially in areas of extensive cover where most needed. Acquire ~4km grid of gravity over continent. (4GR Survey)</p> <p>Infill current grid as required to minimum ~4km spaced surface gravity data to assist with full lithospheric structure construction. Combined with ASA and MT surveys new infill data is to provide key link between upper mantle/lower crust architecture and upper crustal near surface environment. Detailed (compared to now) gravity maps and data layers for use in new inversions and models.</p> <p>Integrate with other geophysical and known geology layers (Theme 1.10) via new inversion software to create automated 3D geology maps and link in to lithospheric structure development.</p>
Targeted and prioritised cover/paleosurface horizons and basement re-sampling and new sampling via Onshore Stratigraphic drilling initiative	<p>Data acquisition via drilling</p> <p>Next generation 3D paleosurface, cover, basement point data, for updating new maps and layers.</p> <p>Increased continuity and confidence in layers derived from:</p> <ol style="list-style-type: none"> 1. National re-sampling programme, where drilling exists and sample quality is applicable OR 2. Targeted onshore stratigraphic drilling programme. New drilling programme to collect multiple data sets described under separate themes including geology, sedimentology, paleosurfaces, elemental geochemistry, isotope geochemistry, hydrogeochemistry, geochronology, petrophysics, geotechnical, geothermal <p>Products of resampling and drilling programmes will be used and include seamless national maps and layers populated and available in standard format via accessible online portal.</p> <p>List of locations for new multiple data requirements from cover basins and basement to be informed by and prioritised from results of Themes 4 (spacing) & 5 (Economic Search Space).</p>
Data Acquisition – Australian Seismic Array ASA	<p>Data acquisition – new geophysics</p> <p>Step change, order of magnitude improvement of detail and resolution of lithospheric architecture through integrated</p>

Focus Area Themes	Infrastructure required (with links to the relevant themes from the AMIRA Roadmap for Exploration Under Cover)
	<p>national seamless (depth) maps and layers:</p> <ul style="list-style-type: none"> • Maps in 2D slices and 3D layers of all crustal structures • Maps in 2D slices and 3D layers of entire Lithosphere Mantle-Surface incl. Moho <p>Data will feed into research leading to deeper understanding of SCLM structure and composition and SCLM to lower crustal relationship through crust to current surface and relationship to mineral systems.</p> <p>Acquisition programme prioritised by data gaps, prospectivity and collaboration with other data acquisition programmes to ensure maximum efficiencies. Proposed set up of multi-stakeholder ASA working group to review and provide feedback on priority on major multi-year acquisition programme.</p>
<p>Targeted geochronology data acquisition of mineral occurrences and priority basins and concealed basement via Stratigraphic Drill Programme</p>	<p>Data acquisition from existing samples.</p> <p>Data acquisition via drilling</p> <p>Anticipated gap in geochronology and isotope data from mineral occurrences (separate from studied mines) and no data from covered environments.</p> <p>Specific mineralisation dating data to be significantly expanded via new data acquisition to include mineral occurrences, increasing spatial data away from deposits and major prospects to better inform fertility and metallogenesis of trans-lithospheric faults/lineaments especially under cover.</p> <p>List of provinces and locations for new geochronology and isotope data requirements from cover basins and basement from either <u>existing samples</u> in sample repositories OR via <u>Theme 1 Stratigraphic Drilling</u> programmes to be informed by data compilation and prioritised from results of Themes 4.3 (spacing) & 6 (Economic Search Space). Followed by prioritised geochronology acquisition programme.</p>

Question 2: Are these governance characteristics appropriate and are there other factors that should be considered for optimal governance for national research infrastructure.

- Optimal governance model for national research infrastructure facility is one in which managed by a non-for-profit organisation. An existing entity would be desirable in order to keep costs down, however one could be created with an independent board, established to manage and develop that facility or capability. This governance model promotes independence and is at arm's-length from institutional politics and facilitates strategic decision making for the benefit of the entire research community.

Question 3: Should national research infrastructure investment assist with access to international facilities?

- We strongly believe that it makes sense, where appropriate, that national research infrastructure investment should assist with access to international facilities. International collaboration must be fostered and nurtured to ensure that our scientists are at the forefront of R&D in geosciences, mining and chemical engineering. Accessing international facilities is one way of assisting with this endeavour.

- Where the case cannot be made for Australia developing its infrastructure capacity, and there are existing international facilities that can be accessed, then it is appropriate and prudent to fund access such facilities with research infrastructure funds.

Question 4: What are the conditions or scenarios where access to international facilities should be prioritised over developing national facilities?

- Non-strategic, capital cost, specific and unique research community needs, ready availability of access of international facilities, impact and return on investment.

Question 5: Should research workforce skills be considered a research infrastructure issue?

- Yes. Operational workforce *should* be considered a research infrastructure issue but we believe that the funding of research staff and the undertaking of research should not. We believe that funding researchers and research through infrastructure schemes such as NCRIS will reduce the ability of these schemes to fund the research infrastructure requirements of the entire national research community. Furthermore, it will complicate the relationship between NCRIS and research funding sources such as the ARC and will run the risk of focussing on funding expensive research projects rather than the development of research infrastructure capability that serves the wider Australian research community.

Question 8: What principles should be applied for access to national research infrastructure, and are there situations when these should not apply?

- National research infrastructure should broadly follow existing NCRIS guidelines - access for nominal or at no cost to Australian researchers, data made widely and freely available as soon as possible, industry access should be available but at some reasonable cost recovery but must ensure that access to the infrastructure does not compete with Australian STEM and other suppliers to industry.

Question 9: What should the criteria and funding arrangements for defunding or decommissioning look like?

- The capability must be able to demonstrate broad community support and usage for continued support.
- The capability should be able to show that it acts as a strategic leader for its represented community.
- The capability should be linked back to the Federal Government's priority areas and as such should be informed by the sector plans of the relevant Industry Growth centre requirements

Question 12: Are there international or global models that represent best practice for national research infrastructure that could be considered?

- The EU is investing heavily in science to improve the capabilities in sustainable processing. Their funding models should be examined and the best practices adopted in Australia.

Environment and Natural Resource Management

Question 18: Are the identified emerging directions and research infrastructure capabilities for Environment and Natural Resource Management right? Are there any missing or additional needed?

- There is a need for a new national initiative or programme for a combined geochronology dating and isotopic analysis of mineral occurrences and strategic sequences across Australia. This recommendation has been identified as a priority from the AMIRA International Roadmap for Exploration Under Cover as it benefits all the sectors in the geoscience community and specifically delivers on the high priority Roadmap theme 3.5 Targeted geochronology data acquisition of mineral occurrences & priority basins and concealed basement via stratigraphic drill programme. It will significantly advance geoscientific understanding of the continent and also provide real data to be used in exploration mineral targeting,

especially useful when extending mineral provinces undercover. This would need to be coordinated between the State and Territory geological surveys, Geoscience Australia and research groups. A possible mechanism to manage this in the first instance may be the entity that will be proposed by the AMIRA International Roadmap that will be responsible for managing research programmes outlined by the Roadmap. However, it would seem logical that the ultimate custodian of this information be Geoscience Australia.

- The link between understanding the solid earth (geosphere) and its relationships to the hydrosphere/biosphere/atmosphere will be critical to research and application in this space over the coming decades - this link is not adequately identified in the current document
- The current section on the Solid Earth (6.2.4) does not adequately consider the need to understand the dynamic evolution of the earth, from the core to the crust, in order to sustainably discover, utilise and manage its contained resource systems. The consideration of earth resources is underwhelming.
- In-situ mining and metal recovery is potentially a low impact way of extracting resources with a minimal footprint. Successful development of such technologies that span many scientific disciplines will be a new paradigm for the mining industry and Australia could lead this direction if Australian industry had further R&D financing incentives to invest in the necessary research and development.

Question 19: Are there any international research infrastructure collaborations or emerging projects that Australia should engage in over the next ten years and beyond?

- Australian scientists should be encouraged and incentivised to develop links with the EU funding programmes such as the Horizon 2020 initiatives
- No doubt there are other projects that should be considered.

Question 20: Is there anything else that needs to be included or considered in the 2016 Roadmap for the Environment and Natural Resource Management capability area?

- As the AMIRA International Roadmap for Exploration Under Cover has identified, Australia needs to develop an integrated distributed network of geophysical and remote sensor deployments and geochemical sampling and analysis that will form a geological telescope - looking inward not outward - supporting research that will assist in mineral discovery in areas of cover, new energy systems (unconventional gas, waste storage and geothermal) as well as the underlying fundamental research that facilitates our understanding of how the earth works and how it supports life and society.
- AMIRA International is currently looking to lead an In-situ Metal Recover (ISMR) Roadmap – ISMR is potentially a low capital and smaller footprint route for extracting the necessary metals that drive modern technologies.

Underpinning Research Infrastructure

Question 30: Are the identified emerging directions and research infrastructure capabilities for Underpinning Research Infrastructure right? Are there any missing or additional needed?

- The emerging underpinning research infrastructure directions are generally good. Of particular relevance to the Geosciences are the requirements for, (1) high performance computing, high capacity networks and secure fast storage, (2) increased capacity and precision in the geospatial and earth monitoring space, and (3) digitisation of data to support national scale research programmes that rely heavily on historical data, such as the programmes that come out of the AMIRA International Roadmap for Exploration Under Cover, will be critical.

Other comments

If you believe that there are issues not addressed in this Issues Paper or the associated questions, please provide your comments under this heading noting the overall 20 page limit of submissions.

There is a strong view amongst many in industry that this is an exercise simply to find ways of reducing government investment. The government of today, on behalf of future Australians, needs to inject substantially more into all scientific areas, especially fundamental science. Of course for any investment like this, researchers need guaranteed tenure to be creative. They need time to think and develop ideas. The Australian people, and above all the Government, need to support science and scientists as these people are creating future wealth. Regrettably, there is a lack of real strategic vision in this country. The Federal Government's National Innovation and Science Agenda, albeit an important initiative, does not provide this. The blame for this probably can be directed at the three year election cycles, which do not allow for effective strategic planning.