

## Preliminary Brief

## Seeking Expression of Interest

### P1336 Global Sedimentary Basins Data Integration and Uncertainty Quantification B

## Executive Summary

The AMIRA P1336 Global Basins program focuses on advancing the exploration of global sedimentary basins, particularly for critical minerals that are essential for the energy transition and reducing CO2 emissions. The P1336B project will develop predictive models for drainage systems and sedimentary infill by addressing significant knowledge gaps, supporting resource exploration and green energy initiatives.

Collaboration with both industry and academia, particularly the DARE Research Hub, will enhance these outcomes, ensuring a robust and innovative approach to data integration and uncertainty quantification.

## Background

The [DARE Centre](#) is an [Industrial Transformation Training Centre](#) (DARE ITTC) incorporating five Universities and eight industry partners and supported by the Australian Research Council (ARC).

The Chief Investigator group at DARE Centre boasts a diverse range of expertise in data science, engineering, environmental science, and applied research. The team includes experienced academics who specialise in areas such as statistical modelling, machine learning, environmental analytics, and domain-specific applications in water, minerals, and biodiversity. This multidisciplinary approach allows the DARE Centre to tackle complex problems with innovative, data-driven solutions, advancing research in their respective fields.

Leveraging the extensive industry collaboration experience gained from the DARE ITTC, the newly proposed DARE Research Hub will expand upon this foundation by prioritising two main objectives: firstly, delivering tailored solutions to industry challenges; and secondly, implementing these solutions within the business environment.

Compared to the existing DARE ITTC, the DARE RH will have enhanced research capacity, particularly at the postdoctoral and research engineering levels. This additional capacity will enable the new Hub to facilitate the *translation of research outcomes* more effectively into tangible industry applications and enhance its responsiveness to emerging industry research needs.

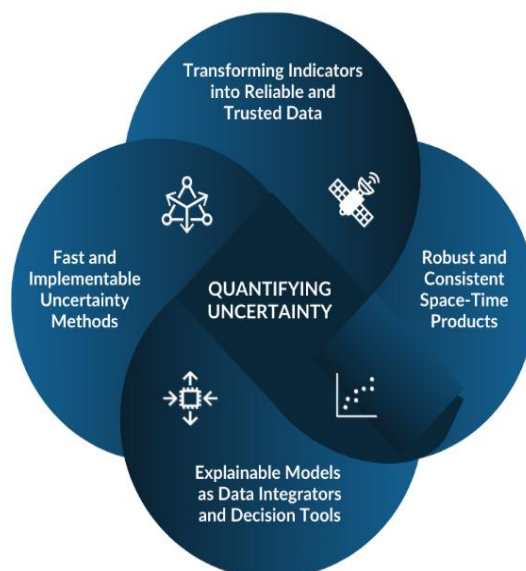


Figure 1. Four Grand Challenges identified by the DARE Research Hub.

## The Proposal

The DARE team, led by Professor Willem Vervoort at the University of Sydney, has made an offer that a consortium of sponsors under the P1336B project, which will form part of the Amira Global Basins Program- Australian Spoke can provide a collective partnership to the newly proposed DARE Research Hub. The DARE Research Hub will be working across priorities provided by a series of sponsors and industry partners, one of which may be the Amira P1336B Basins Project. This provides an opportunity for a well-developed team, which has

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been a successful Industrial Transformation Training Centre, to focus their efforts on basin-led challenges. In addition, the project sponsors would have access to the broader DARE Research Hub investigators and partners, providing opportunities for cross-sector learning and insights.

Benefits to major partners include:

- Co-design a main case study for the Grand Challenges and potential co-supervision of Postdocs & Research Engineers
- Priority access to Research Translation Liaison team
- Feature session at annual flagship event
- HDR placement & potential co-supervision
- Access to learnings created from the DARE work with other industry partners in grand challenges.

The Global Sedimentary Basins project is a major research initiative focused on improving our understanding of the structure and architecture of sedimentary systems and their potential resources. This is particularly important for resources related to the development of green energy initiatives.

Ultimately, this will require large-scale predictive models of the evolution of major drainage systems and upstream catchments (sources) and how they link through space and time with the infill of sedimentary basins (sinks) and mineralisation. Such predictive models will be similar in complexity to Global Circulation Models used in Climate Science and will combine geology, hydrology, and (Paleo) climate science

Due to differences in sampling approaches, analysis techniques, and protocols, available global data are of varying quality. They have been acquired over many decades using a broad range of technologies and are stored in various formats and different languages. There is a clear need to develop easy-to-use workflows that create trusted data that can be used across the minerals industry.

Basins in Australia can offer unique case studies as they represent data-rich environments that provide sufficient data for developing, testing, and evaluating different methodologies. Australia hosts some of the best-preserved and accessible Palaeo-Meso and Neo-Proterozoic basins on Earth. These

basins host a broad range of resources, including critical minerals and clean energy resources such as white hydrogen.

Proposed tightly integrated work packages are:

### 1. Smart tools for discovering, organising and sharing legacy data

Harnessing the power of large language models, this work package will build on the SAFE and FAIR data principles and collaborating with Microsoft (or another major player) will focus on workflows to classify and organise data by data type, interpret file formats and produce tools to match data to standard formats. In addition, it will map and report the discovered data. Rather than working on the provision of static, cleaned dataset the focus of DARE is developing tools and workflows which will enable continual integration of new datasets of varied quality in an reliable and informed manner. This component has opportunities to collaborate and deliver outcomes with SMEs or start-ups that aim to specialise in this area to provide greater impact and faster uptake across the industry. In addition Amira will be able to make these tools available across Data Metallogenica and CollaborateORE platforms and in effect the central knowledge hub for the Global Basins Program.

(This will link into Grand Challenge 1 of the proposed DARE RH)

### 2. Integration and harmonisation of datasets

The discovered datasets from work package 1 will require harmonisation, to represent the same depth intervals, or to represent information in the same units. In addition, the data can be 'multi-modal', for example text and core images. Using novel Machine Learning, integration of multi-modal datasets, will allow spatial and depth harmonisation beyond the information of single datasets, or only text based datasets. Where data are missing, data will be potentially matched using global analogs.

Using well-understood but novel spatial prediction methods, disparate datasets from a range of sources will be integrated into consistent spatial data sources.

This work package will produce both the workflows for data integration and harmonisation, and the final data products.

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(Linking into Grand Challenge 2 of the proposed DARE RH)

### 3. Fast uncertainty quantification for data products and models

Harmonisation, gap filling and integrating data from different sources and provenance, and providing spatial predictions, introduces uncertainties. However, the aim is not to discard or clean data but to tag and identify the quality and certainty of the data, leading to an informed evaluation of their use and inclusion. Uncertainties can influence downstream model predictions and exploration decisions but can also guide future data collection. Further uncertainties can be introduced during the modelling step. Exhaustive uncertainty quantification using Bayesian methods can be difficult to implement and requires significant computational resources. This work package will develop fast and efficient surrogate approaches that approximate uncertainty and are easier to implement in industry. This will produce workflows that will be demonstrated and extended into the industry. The resulting uncertainties can guide exploration decisions or further data discovery requirements.

(Linking into Grand Challenge 4 of the proposed DARE RH)

### 4. Unveiling Earth's deep-time surfaces – linking data to whole Earth models

Leveraging recent technological breakthroughs in landscape evolution modelling (Science Paper 2023), we will design integrative numerical methods to characterise many aspects of the Earth system, from the role of atmospheric circulation on physical denudation to the influence of mantle convection on erosion and deposition.

This will expose the landscape's evolution and provide continuous metrics related to Earth surface dynamics (e.g., paleo-rivers' catchment distributions, river sediment and water paleo-fluxes, ore-rich sediment-hosted deposits, exhumation history and emplacement depth, as well as stratigraphic architectures).

Building on the Science publication and the proof of concept from a 4-year Industry project (Stellar) with BHP, where the proposed approach was applied to enhance resource exploration across different spatial and temporal scales from regional

(Kupferschiefer redbeds — Polish Permian Basin; Triassic-Jurassic Gulf of Mexico) to the global scale (e.g., porphyry copper deposits preservation).

Integrating interdisciplinary observational geoscience data into the modelling, this work package will produce consistent reconstructions of Earth's paleo-surface to act as an integrative resource for geo-data and to identify potential unexplored regions and facilitate future exploration. In recognition of the ambitious nature of this work, it is proposed that a single basin be selected in consultation with project sponsors, which will enable a proof of concept that can be extended to other basins and more global scales. Further applications on more recent basins linked to other resources can also be explored.

(Linking into Grand Challenge 3 of the proposed DARE RH).

## The opportunity and benefits

Amira Global invites you to participate in an initial round table based upon this EOI document and understanding of the capabilities and opportunities provided by sponsorship of the DARE Research Hub.

- Benefits to sponsors include the ability to inform the final project scope and focus using the DARE capabilities.
- Access to all developed workflows and models with support from the Centre's Translation Liason team.
- Access to data generated, harmonised and used in the projects.
- Access to additional datasets and insights the DARE team has developed from working on grand challenges with other partners,- for example hydrogeological data.
- Workshops with hands-on use of the developed methods and workflows
- Access to the developed IP for ongoing use within sponsor organisations.
- Regular Sponsor Review Meetings
- Attendance to the DARE Annual Flagship event.

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### IP and Commercialisation Arrangements

The DARE Research Hub takes a collaborative, open-source approach to intellectual property management wherever feasible. Their guiding principles ensure that project-generated IP will remain accessible to all project partners under non-exclusive, royalty-free licenses, supporting ongoing innovation and industry collaboration (excepting Student Thesis, if applicable).

### Project Budget & Sponsorship Model

The DARE ITTC is applying for funding from the Australian Research Council which will provide matched funding of \$5M against their total Industry funding from multiple partners.

The total Cost for the P1336B consortium to be a Major Partner in the DARE RH is \$1,500,000 over 5 years ( plus Amira development and Management fees).

Note that sponsors are required to be members of Amira Global and remain so for the duration of the project. Australian-based companies should also note that this project may be eligible for the Australian Government Tax Incentive. Amira Global recommends seeking professional tax advice.

In addition to financial sponsorship, in-kind contributions are required. This may take the form of sponsors providing data for use in developing tools and workflows or industry employees actively participating in the research and workshops.

For this opportunity, we propose a technical working group where each sponsor company can nominate at least one representative, who may be emerging leaders who will champion the project. This working group will work on a regular cadence with the DARE team to troubleshoot and review solutions being developed to ensure they are suitable for industry adoption and use.

### The Project Team

The Chief Investigator group at the DARE Research hub includes experienced academics who specialise in areas such as statistical modelling, machine learning, environmental analytics, and domain-

specific applications in water, minerals, and biodiversity, For projects aligned with AMIRA focus areas, we note the following academics for leaderships roles.

**Prof Willem Vervoort:** A hydrology expert with a focus on water resources, statistical modeling, and environmental data science, Willem is at USYD and is the DARE Director.

**Prof Mark Jessell:** A geoscientist specializing in 3D geological modeling and structural geology. Based at UWA, Mark contributes to the advancement of mineral exploration through data integration and modeling.

**Dr Tristan Salles:** A computational geoscientist, USYD's Tristan's expertise lies in landscape evolution modeling and its implications for sedimentary systems and natural resource exploration.

**Dr Guillaume Pirot:** A System Engineer and Hydrogeological Modeller, his work at UWA focuses on understanding subsurface water systems and integrating conceptual and spatial uncertainty into geological modelling .

**Prof Sally Thompson:** An environmental engineer and hydrologist. Sally's research focuses on ecohydrology, water systems, and the interaction between vegetation and climate processes and is based at UWA.

### How to Express your Interest

An EOI Response form accompanying this project brief is available. **Please return it to Hayley McGillivray by 10/11/2024.** Alternatively, you can complete the form online at the following [Link](#).

Note that completing and returning the Expression of Interest response form on the following page does not imply a commitment to sponsor the project. However, respondents who express genuine interest are expected to be actively involved in the design of the proposal and have a better-than-even chance that their company will sponsor the project once a suitable proposal has been prepared.

A formal proposal for this project will only be prepared if sufficient positive interest is expressed by the industry.

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### Further Information

For further information about this initiative, please contact:

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Amira Global Senior Program Manager Position

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## EXPRESSION OF INTEREST Response Form – Amira Project Outline

Please note that if insufficient positive interest is shown by industry, project development will cease  
Completion and return of this form does not imply any commitment to sponsor

Based on the project outline I received for the potential new Amira Project P1336B: [Global Sedimentary Basins Data Integration and Uncertainty Quantification](#) my response is below:

### My Company's Interest in this Project is as follows:

I would like to be contacted to discuss how the proposal could be modified to become more useful to my organisation

I would like to receive a formal proposal along the lines outlined

Not interested

If you are able to explain why, it would help us better focus our efforts on delivering initiatives of value.

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### Any other comments:

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### Contact details or details of the person with potential interest in this project:

Name: .....

Position: .....

Company: .....

Address: .....

E-mail: .....

Phone: .....

Please mark the appropriate boxes and return the form to:  
[Hayley.mcgillivray@amira.global](mailto:Hayley.mcgillivray@amira.global)

