Strengthening ASEAN Cooperation in Minerals

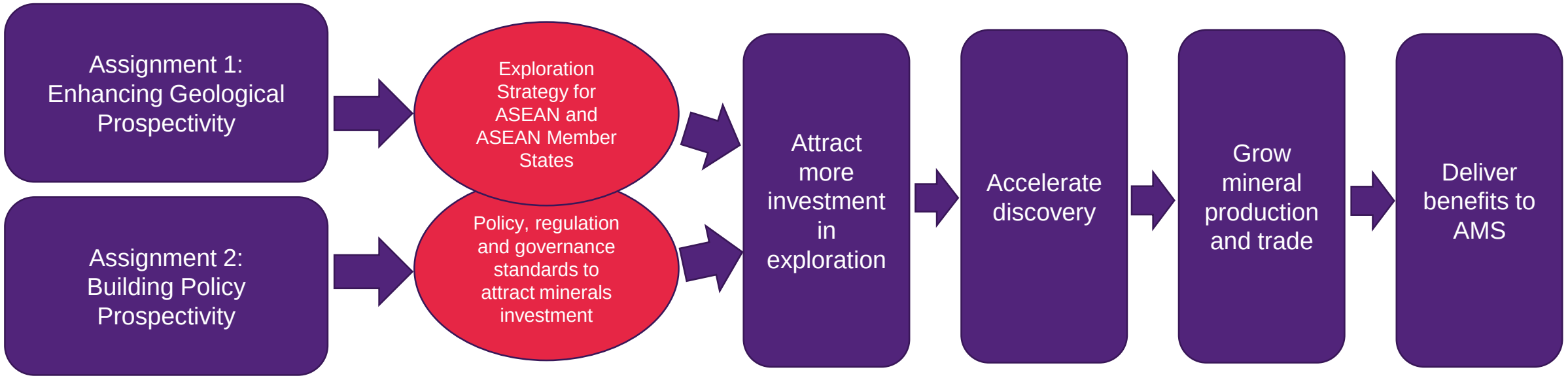
Extension Assignment 1:

Enhancing Geological Prospectivity – Developing an ASEAN Mineral Exploration Strategy

Workshop 3: 31 January 2022

Project logic

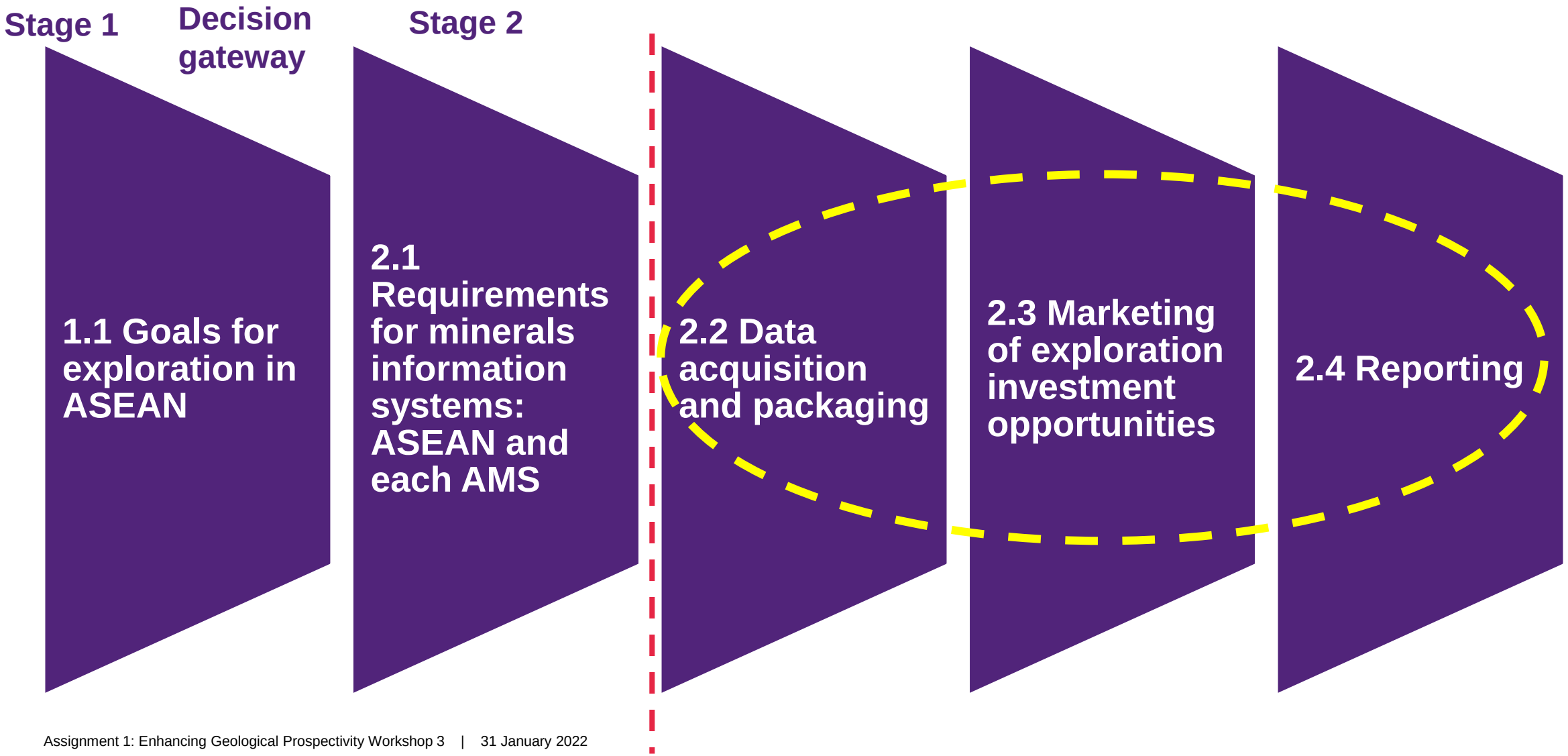
Two additional studies to implement recommendations of AMDIS and DPAMC reports



While geologic and economic evaluations are always requirements for exploration, in today's globally competitive economy where mining companies may be examining properties located on different continents, a region's policy climate has taken on increased importance in attracting and winning investment.

Fraser Institute Annual Survey of Mining Companies 2020 (published February 2021)

Components of Assignment 1: *Enhancing Geological Prospectivity*



Enhancing Geological Prospectivity

Output: An Exploration Strategy for ASEAN and ASEAN Member States to turn around the decline in exploration investment and increase discovery

Stage 1:

1.1 Goals for exploration in ASEAN

1. Benchmark AMS against world best practice in encouraging exploration investment
2. Develop draft achievable goals for AMS applying to commodities, type of companies, expenditure and discovery
3. Test the draft goals with the ASEAN Secretariat and AMS; establish support

Note: If the draft goals are not acceptable to the AMS the project can be terminated at this stage

Recommendations: Goals for exploration for ASEAN

	DESCRIPTION OF GOALS
1.	**Availability of pre-competitive data** Make basic geoscience information available online, where available, including mineral occurrence data, 1:250,000 or 1:100,000 geological map sheets, surface geochemistry (soil or streams samples), airborne geophysical datasets, and drill hole databases.
2.	**Provision of tenure data** Provision of tenure data in an online format is a goal.
3.	**Types of companies investing** Attract a cross-section of mineral explorers from junior to major exploration and mining companies. Importantly, a track record of sustainable exploration and development is preferred.
4.	**Exploration expenditure** Each nation should aim, at a minimum, to increase their proportion of global exploration expenditure by approximately 5% per year (for discussion).
5.	**Exploration activities** Implement a system to record drilling and development study activity for the mineral exploration activities happening in the country.

Enabling and assessment goals

- Goals 1 and 2 are ‘enabling’ goals that will encourage exploration investment
- Goals 3 to 5 are metrics that allow assessment of the success in attracting quality mineral exploration investment

Challenges

- Institutional and technical capacity constraints
- Regulatory and internal institutional coordination

Enhancing Geological Prospectivity

Output: An Exploration Strategy for ASEAN and ASEAN Member States to turn around the decline in exploration investment and increase discovery

Stage 2:

2.1 Requirements for minerals information systems: ASEAN and each AMS

1. Assess global leading practice in minerals information systems - as required to supplement content of AMDIS report
2. Assess current capacities of minerals information systems in each AMS and ASEAN - as required to supplement content of AMDIS report
3. Prepare minimum requirements for mineral information systems in each AMS and ASEAN

2.2 Data acquisition and packaging

2.3 Marketing of exploration investment opportunities

2.4 Draft report, workshop and final report

Availability of Pre-Competitive Data – Content

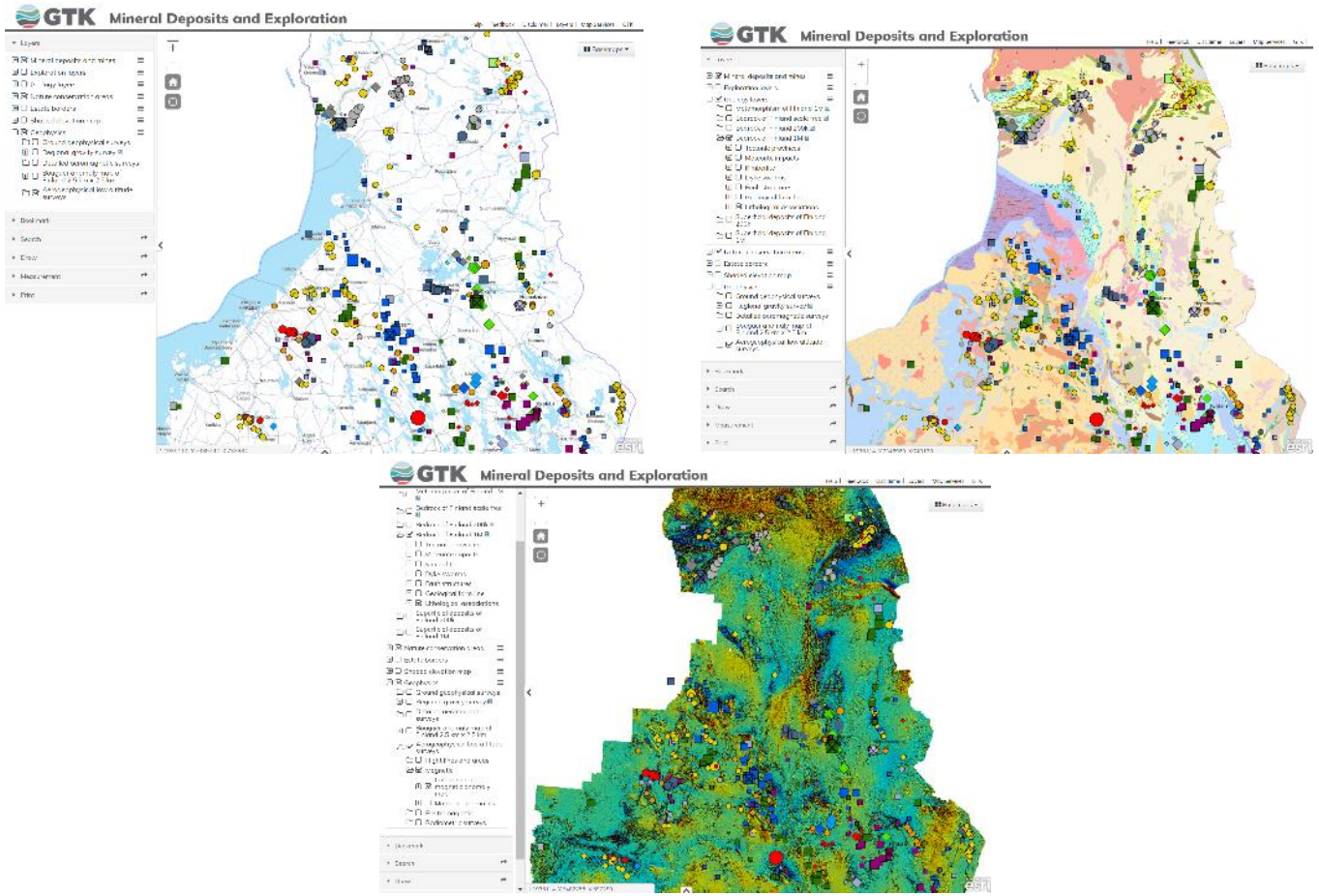
Compilation and delivery of pre-competitive data is critical to allow investment decisions to be made

Source of data

- Exploration companies
- Geological surveys
- Universities and other scientific bodies

Types of data

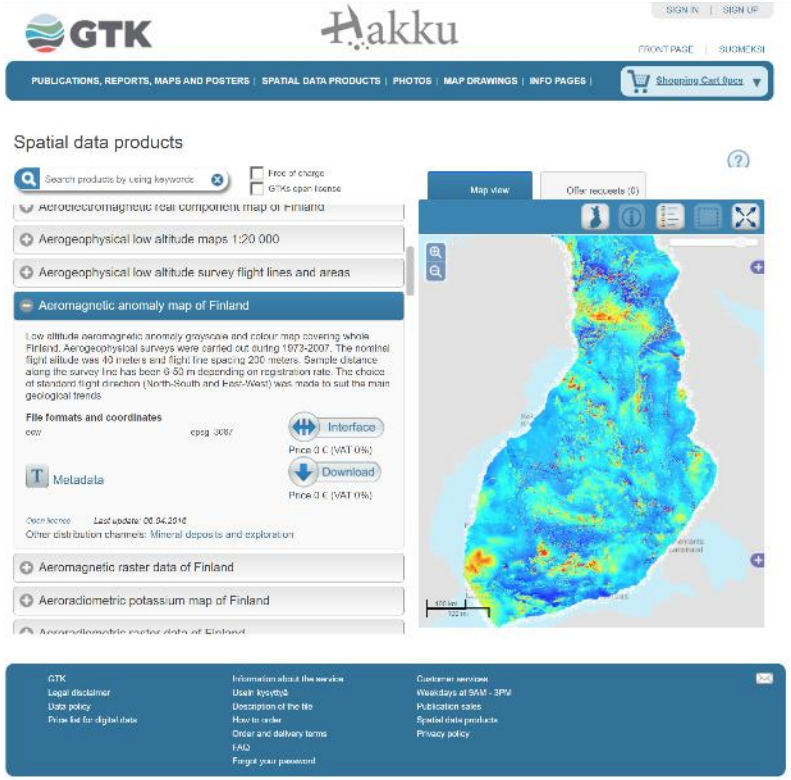
- Mineral occurrence database
- Geological mapping
- Drill hole compilation
- Geophysical data
- Surface geochemical sampling results



Availability of Pre-Competitive Data – Delivery Mechanism

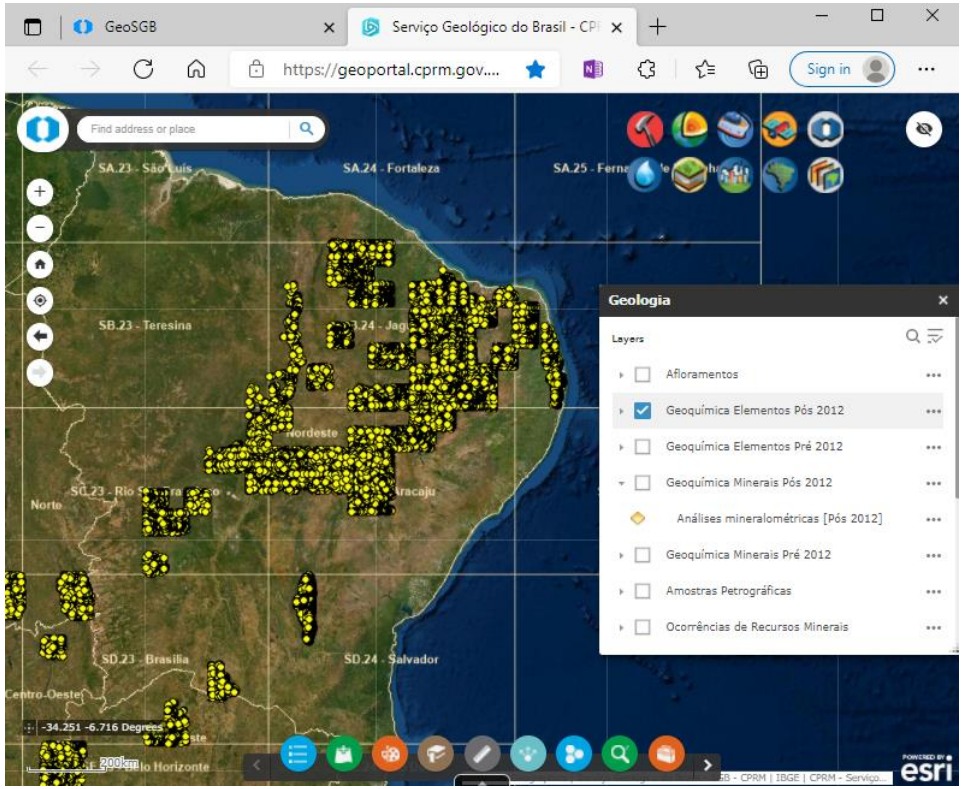
A delivery mechanism is important

Download



https://hakku.gtk.fi/en/locations/search

Web GIS



https://geoportal.cprm.gov.br/geosgb/

Comparison Jurisdictions

	Brazil	Finland	Ontario	Peru	South Australia
Fraser Institute 2020 Investment Attractiveness Index	38	10	20	34	7
Precompetitive data provision					
Geology 250K	✓	✓	✓	✗	✓
Geology 100K	✓	✓	✓	✓	✓
Geology 50K	✓	✗	✓	✓	✗
Drill hole database	✗	✓	✓	✓✗	✓
Surface Geochemistry	✓	✓	✓	✓	✓
Airborne Geophysics	✓	✓	✓	✗	✓
Mineral Occurrences	✓	✓	✓	✓	✓
Tenure Information					
Current tenure map	✓	✓	✓	✓	✓
Downloadable GIS Tenure	✓	✓	✓	✓	✓
Exploration Expenditure (2020)					
Expenditure (USD M)	208.5	82.5	451	364.1	80.2
Expenditure (Global %)	2.5	0.99	5.42	4.37	0.98
Exploration Activities (2020)					
Drill holes	1383	467	N/A	937	378
Significant drill hole intervals	205	112	N/A	87	175
Development studies	14	1	N/A	5	0

✓ refer to the data being readily available, ✗ - data is not provided, and ✓✗ - only some aspects of the data are available or the data is not of high quality.

AMS Online Data Availability

	Brunei Darussalam	Cambodia	Indonesia	Laos	Malaysia	Myanmar	Philippines	Singapore	Thailand	Vietnam
Precompetitive data provision										
Geology 250K		✗	✓	✓✗	✓	✗	✓✗		✓	✓✗
Geology 100K		✗	✓	✗	✗	✗	✓✗		✗	✗
Geology 50K		✗	✓	✗	✗	✗	✓✗		✓	✗
Drill hole database		✗	✗	✗	✗	✗	✗		✗	✗
Surface Geochemistry		✗	✗	✗	✗	✗	✗		✓✗	✗
Airborne Geophysics		✗	✗	✗	✗	✗	✗		✓✗	✗
Mineral Occurrences		✓✗	✓	✓✗	✗	✗	✗		✓✗	✗
Tenure Information										
Current tenure map		✗	✓	✗	✗	✗	✓		✗	✗
Downloadable GIS Tenure		✗	✓	✗	✗	✗	✓		✗	✗
Exploration Expenditure (2020)										
Expenditure (USD M)		3.4	94.8	4.4	2.2	24.8	29		0.6	2.2
Expenditure (Global %)		0.04	1.14	0.05	0.03	0.3	0.35		0.01	0.03
Exploration Activities (2020)										
Drill holes		1131	84	9	N/A	20	23		N/A	158
Significant drill hole intervals		0	47	0	N/A	3	3		N/A	54
Development studies		0	2	0	0	0	0		0	1

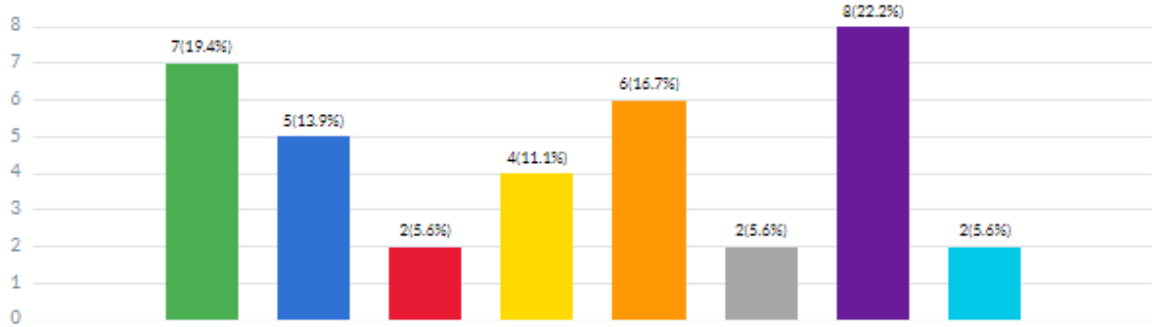
Minimum Information Requirements

1. **A 1:1 million-scale geology layer**
2. **A 1:250,000-scale geological layer**
3. **Airborne geophysical datasets (magnetic and radiometric)**
4. **Remote sensing imagery**
5. **Surface geochemical data (soil and/or stream sediment samples)**
6. **Drilling information**
7. **Mineral deposit information**
8. **Geochronological samples**

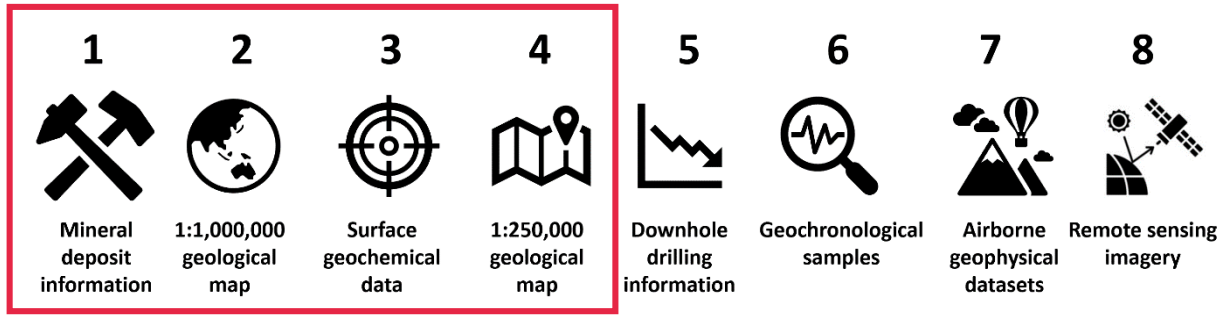
Online Survey Results

Data for Inclusion in the Revised AMIS Database

Geological data sets in digital format from various AMS; Several of the AMS have more than one data set



- A 1:1 million-scale geological layer (e.g., rock unit name, lithology, age estimate, geological structures)
- A 1:250,000-scale geological layer (e.g., rock unit name, lithology, age estimate, geological structures, and possibly explanatory notes/accompanying report)
- Airborne geophysical datasets (magnetic and radiometric)
- Remote sensing imagery (including freely available data sets)
- Surface geochemical data (soil and/or stream sediment samples)
- Drilling information (including the location of the drill holes and a link or name of the report of the results)
- Mineral deposit information (e.g., name of the deposit, main commodity, style of deposit)
- Geochronological samples (from universities or research organizations)

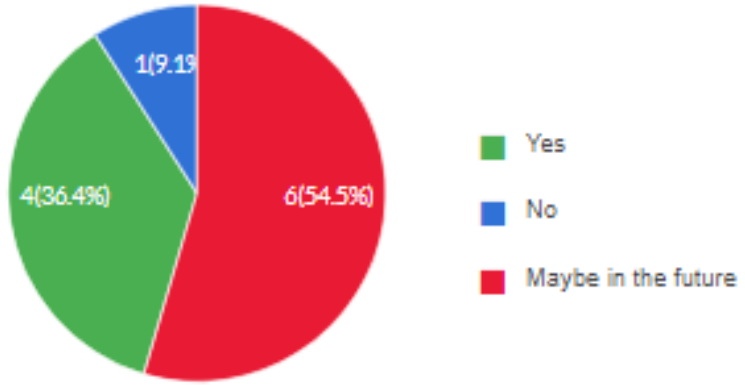


List of prioritized geological data sets; 1 = highest priority and 8 = lowest priority

Revised List of Minimum Information Requirements

1. **A 1:1 million-scale geology layer**
2. **A 1:250,000-scale geological layer**
3. **Surface geochemical data (soil and/or stream sediment samples)**
4. **Mineral deposit information**

Plans to collect the recommended information



Most AMS agree that any future data acquisition and/or digitization is realistic to complete by **2023 – 2024**, depending on the budget constraints

- The mineral deposit information and the 1:1 million-scale geological layer are considered reasonable to make available in the AMIS database
- But 1:250,000-scale geological layer and surface geochemical data less so
- Drilling information is highly valuable, but the survey indicates only three AMS have this data and only two have it in digital format

Data Acquisition
Data Packaging

Mineral Exploration Companies

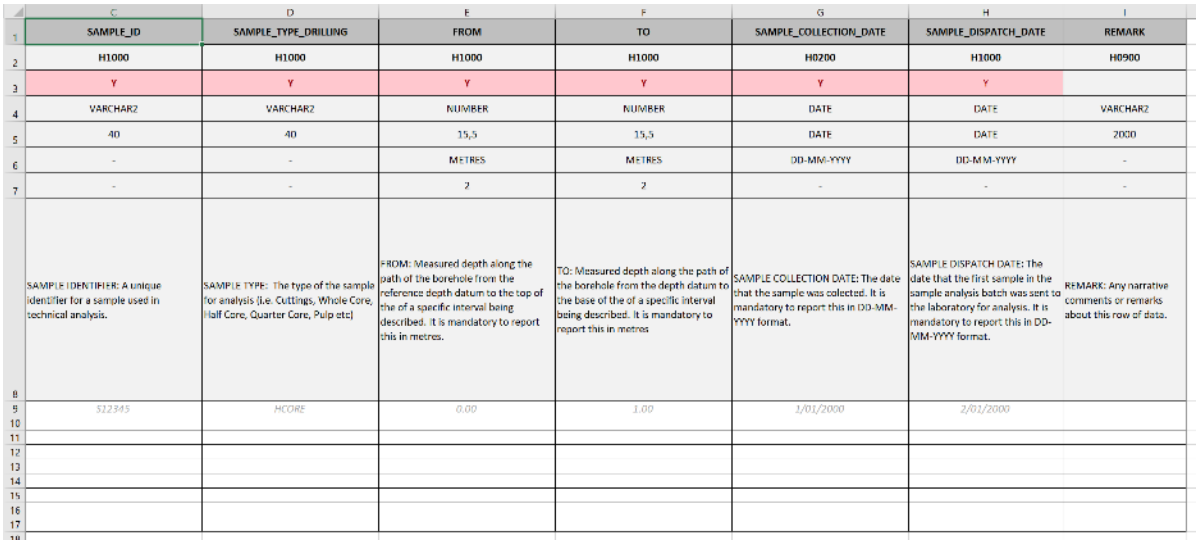
Examples of systemic processes for data submission by mineral exploration companies by:

- The Northern Territory Geological Survey (NTGS) in Australia
- The Geological Survey of Queensland (GSQ) in Australia

Government mining agencies should:

- Work towards implementing ***a regulatory framework that requires mineral exploration companies to report and submit geoscience data*** on an annual basis to the relevant government agency
- ***Provide templates or data format instructions to explorers*** in order to receive data of a consistent quantity and quality that will be suitable for import to the agency's database

Screenshot from the GSQ's Excel spreadsheet template for mineral exploration data submission



	C	D	E	F	G	H	I
1	SAMPLE_ID	SAMPLE_TYPE_DRILLING	FROM	TO	SAMPLE_COLLECTION_DATE	SAMPLE_DISPATCH_DATE	REMARK
2	H1000	H1000	H1000	H1000	H0200	H1000	H0900
3	Y	Y	Y	Y	Y	Y	
4	VARCHAR2	VARCHAR2	NUMBER	NUMBER	DATE	DATE	VARCHAR2
5	40	40	15,5	15,5	DATE	DATE	2000
6	-	-	METRES	METRES	DD-MM-YYYY	DD-MM-YYYY	-
7	-	-	2	2	-	-	-
8	SAMPLE IDENTIFIER: A unique identifier for a sample used in technical analysis.	SAMPLE TYPE: The type of the sample for analysis (i.e. Cuttings, Whole Core, Half Core, Quarter Core, Pulp etc)	FROM: Measured depth along the path of the borehole from the reference depth datum to the top of the of a specific interval being described. It is mandatory to report this in metres.	TO: Measured depth along the path of the borehole from the depth datum to the base of the of a specific interval being described. It is mandatory to report this in metres	SAMPLE COLLECTION DATE: The date that the sample was collected. It is mandatory to report this in DD-MM-YYYY format.	SAMPLE DISPATCH DATE: The date that the first sample in the sample analysis batch was sent to the laboratory for analysis. It is mandatory to report this in DD-MM-YYYY format.	REMARK: Any narrative comments or remarks about this row of data.
9	S12345	HCORE	0.00	1.00	1/01/2000	2/01/2000	
10							
11							
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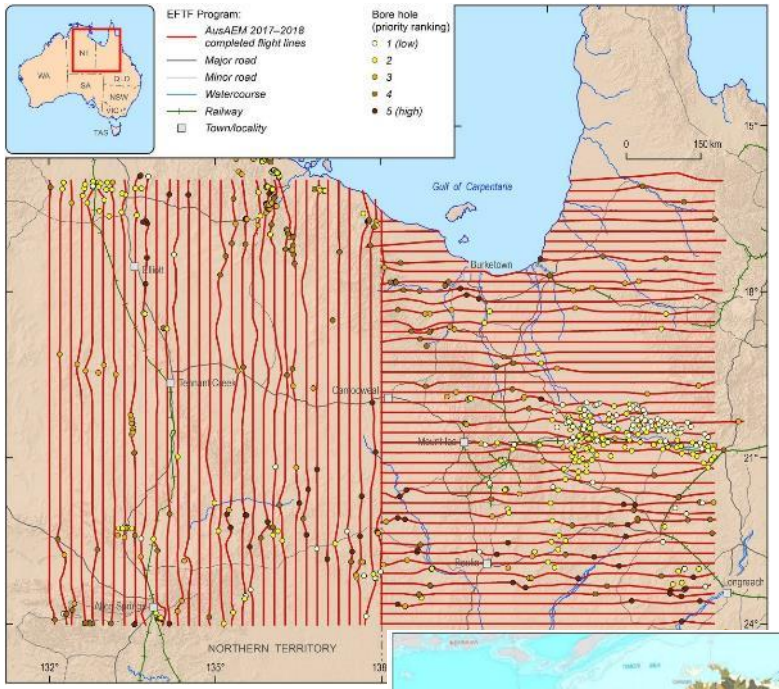
17							

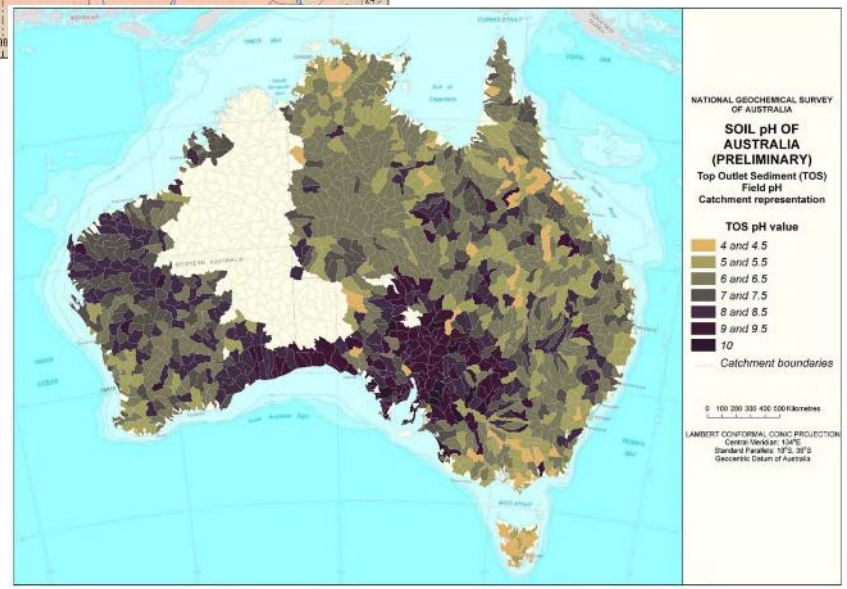
Geological Survey Agencies

- The Geological Survey of Finland (GTK)
- AusAEM (Australian Airborne Electromagnetic Survey - https://www.ga.gov.au/eftf/minerals/nawa/ausaem)
- National Geochemical Survey of Australia

Geological surveys should:

- As a priority ***ensure the country is covered by a set of consistent geological maps at 1:250,000-scale***
- Consider collecting ***aeromagnetic data at a regional scale*** with a preferable line spacing of 400m (or wider at 1000-1500m)
- Consider ***collecting a national stream sediment database***, with an initial focus on districts considered to have high prospectivity or known deposits
- Consider ***jointly funded initiatives such as Collaborative Exploration programs***, or smaller-scale activities that involve collection of fundamental geoscience information by exploration companies





Universities and Other Research Organizations

- Discrete data types or data sets from historic theses (e.g., whole rock Geochem, geochronology), and historical data in general
- Geoscience Letters (https://geoscienceletters.springeropen.com/)
- Leverage the availability of post-graduate students

Universities and other research organizations should:

- Universities should be approached to allow access to their thesis collections ***to aid in compilation of whole rock geochemical or geochronological databases***.
- Collaboration between geological surveys and universities should be encouraged to ***integrate post-graduate research projects into Geological Survey initiatives*** or mapping programs

Affiliated with

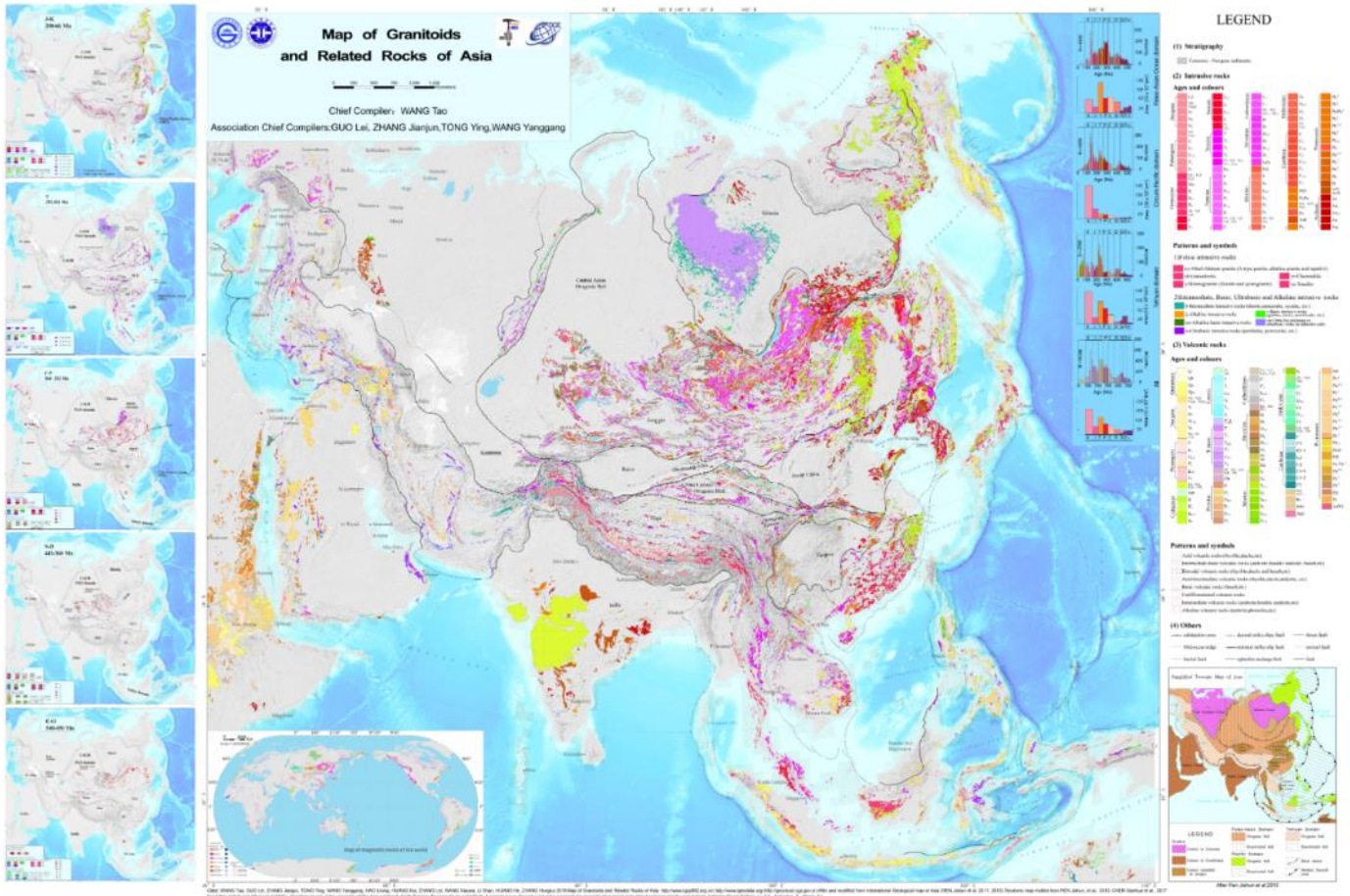
Asia Oceania Geosciences Society
www.asiaoceania.org

Asia Oceania Geosciences Society (AOGS)

International Programs

Examples of geoscience programs completed in the ASEAN region:

- UNESCO International Geoscience Program (IGCP) - https://en.unesco.org/international-geoscience-programme/projects
- United States Geological Survey (USGS) - https://data.usgs.gov/datacatalog/



Recommendations:

- ***Undertake a review of the international programs that have been undertaken in the ASEAN region*** in the past 30 years, with a particular focus on more recent projects that may be able to provide digital data

Drilling Data

- Drillhole information is perhaps the most critical information directly relevant to exploration investment
- All comparison jurisdictions require, typically though the Mining Act, that exploration permit holders provide an annual and a final exploration work report, that includes material information pertaining to the exploration activities – drilling data!

Recommendations:

- Where available, the ***drill data should be digitized*** as a priority and archived
- It is recommended all ***drill data are collected and stored in the appropriate format***, which comprises the following four ASCII files:
  - Collar files
  - Survey files
  - Assay files
  - Geology files

Data Packaging

Two aspects to consider:

1. The digital aspects of how data is formatted and delivered, and
2. The themes, or geographic, deposit model, or commodity focus used to group data to be distributed as a single package

Mentimeter Questions:

1. **What is the geological software that is preferentially used?**
2. **In what format is data preferentially stored?**

Data Packaging

Several typical software packages that are used by exploration companies, and data provided by the AMS should be compatible with these:

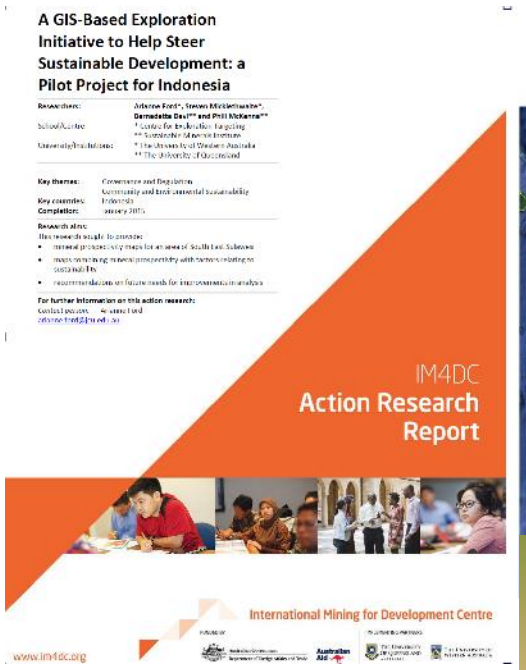
- ***MapInfo, ArcGIS or QGIS*** as digital GIS mapping software options, particularly for vector (e.g. point, polyline or polygon) attributed data
- ***Adobe Acrobat*** to allow save, view, print and comment on a variety of image and text documents in .PDF format
- ***Comma-delimited flat ASCII*** format for tables that allow interrogation of data in more detail, particularly in statistical analysis
- ***Raster gridded datasets*** in typical formats including ERMapper (.ers), Geosoft (.grd), or other common grid formats. These are common for geophysical datasets, and to a lesser extent satellite imagery
- ***Geospatially registered images***, typically in the form of *.Geotif files. These files present an image of a particular dataset, but also allow many software platforms to locate the image in a spatial sense, and hence integrate with other datasets

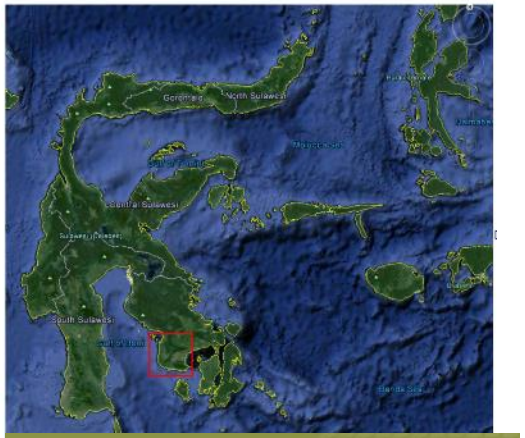
Themed Data Packaging

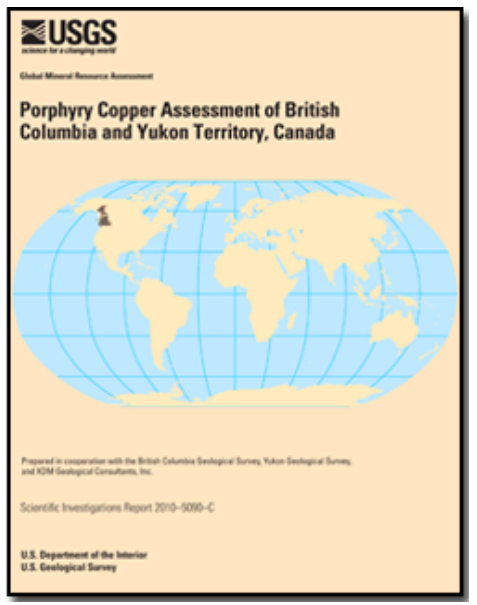
- Scope to provide packages based around a discrete theme that may provide more focus to investors:
  - Particular commodities
  - Districts
  - Deposit types

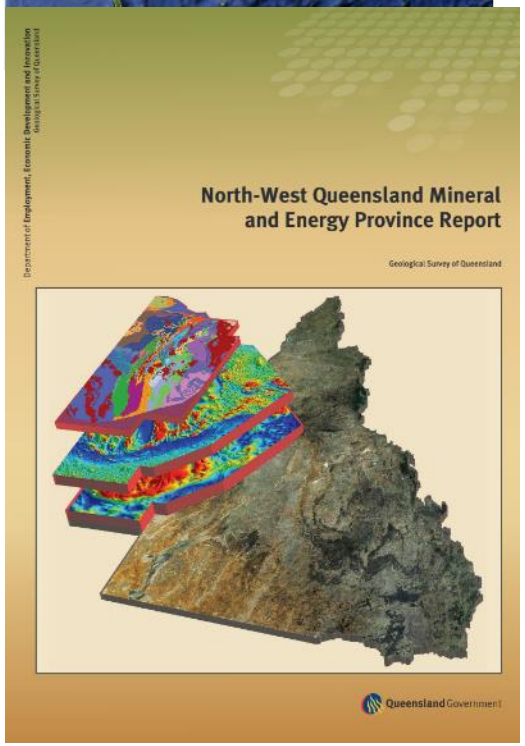
Recommendations:

- Where data has been collected through a project based on a particular theme such as geography, deposit type or commodity, ***AMS and/or ASEAN should consider releasing this data as a specific package***
- Individual AMS or ASEAN should ***consider engaging an external party to compile and release a prospectivity-style data package*** and associated study that will highlight the prospectivity of particular regions









Recommendations – Data Packaging

- As well as utilising the proposed ASEAN-wide AMIS, each AMS should consider if it has the ***capacity to implement its own WebGIS and data distribution portal***. This is particularly relevant for those AMS that hold significantly more data than that considered as the AMIS minimum data requirements
- All data that can be ***spatially registered*** should be, as either vector, image or raster data, in the formats listed above. Informational reports should be stored and distributed as PDF format reports
- Save data ***in English, where possible***, for consistency, with explanatory notes in the local language, if needed
- Commonly used data products should be ***saved in a standardized format***, both within individual AMS and across ASEAN
- **Drillhole Information** is perhaps the most critical information directly relevant to exploration investment. All of the comparison jurisdictions require, typically though the Mining Act, that exploration permit holders provide an annual and a final exploration work report, that includes material information pertaining to the exploration activities.

Marketing – Exploration Attraction

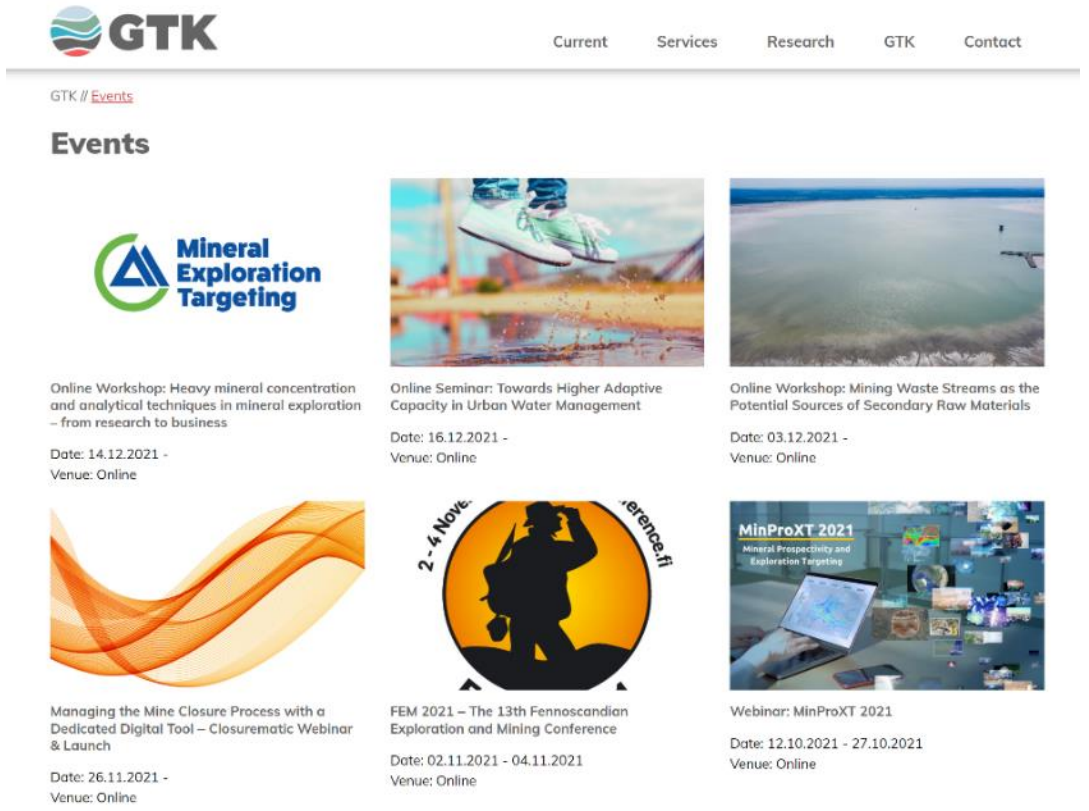
Global leading practices

- The Geological Survey of Finland (GTK)
- The Geological Survey of South Australia (GSSA)

Mentimeter Questions:

1. **What conferences have representatives of your country attended in the last 5 years?**

2. **In what capacity was the attendance (keynote presentation, technical presentation, poster, booth, delegates)?**



International Conferences; Specialist Workshops

- **Prospectors & Developers Association of Canada (PDAC)** in Toronto, Ontario, Canada – in March;
  - https://www.pdac.ca/home
- **AME Roundup** in Vancouver, British Columbia, Canada – at the end of January – beginning of February;
  - https://roundup.amebc.ca
- **Diggers and Dealers Mining Forum** in Kalgoorlie, Western Australia, Australia – in August;
  - https://www.diggersndealers.com.au
- **Mines and Money** – takes place throughout the year in Europe, Asia, Australia and the Americas;
  - https://minesandmoney.com
- **International Mining & Resources Conference (IMARC)** in Melbourne, Victoria, Australia – at the end of January – early February;
  - https://imarcglobal.com
- **NewGenGold** in Perth, Western Australia, Australia – in November;
  - https://www.newgengold.com
- **Procemin-Geomet** in Santiago, Chile – in October;
  - https://gecamin.com/procemin.geomet/index

+ Webinars/Specialist workshops – utilise established webinar series to promote the project

Website, Social Media and Industry Spotlight

- All comparison jurisdictions have up-to-date websites
- Social media posts are often informal but lead to formal and detailed information on the website

Recommendations:

- ***The agencies/AMS web page should be as the 'shop window'*** to showcase the overview, aims and expected outcomes of all programs, with every presentation, social media post, website or article linking back to the webpage for more detailed information
- ***Active engagement on Social Media*** (LinkedIn, Facebook, Twitter) – leverage established networks for widest reach possible
- ***Regular spotlight on a company working in the region***/or allow for this company to regularly update on the progress

Online Presence

Online examples of already available regional initiatives:

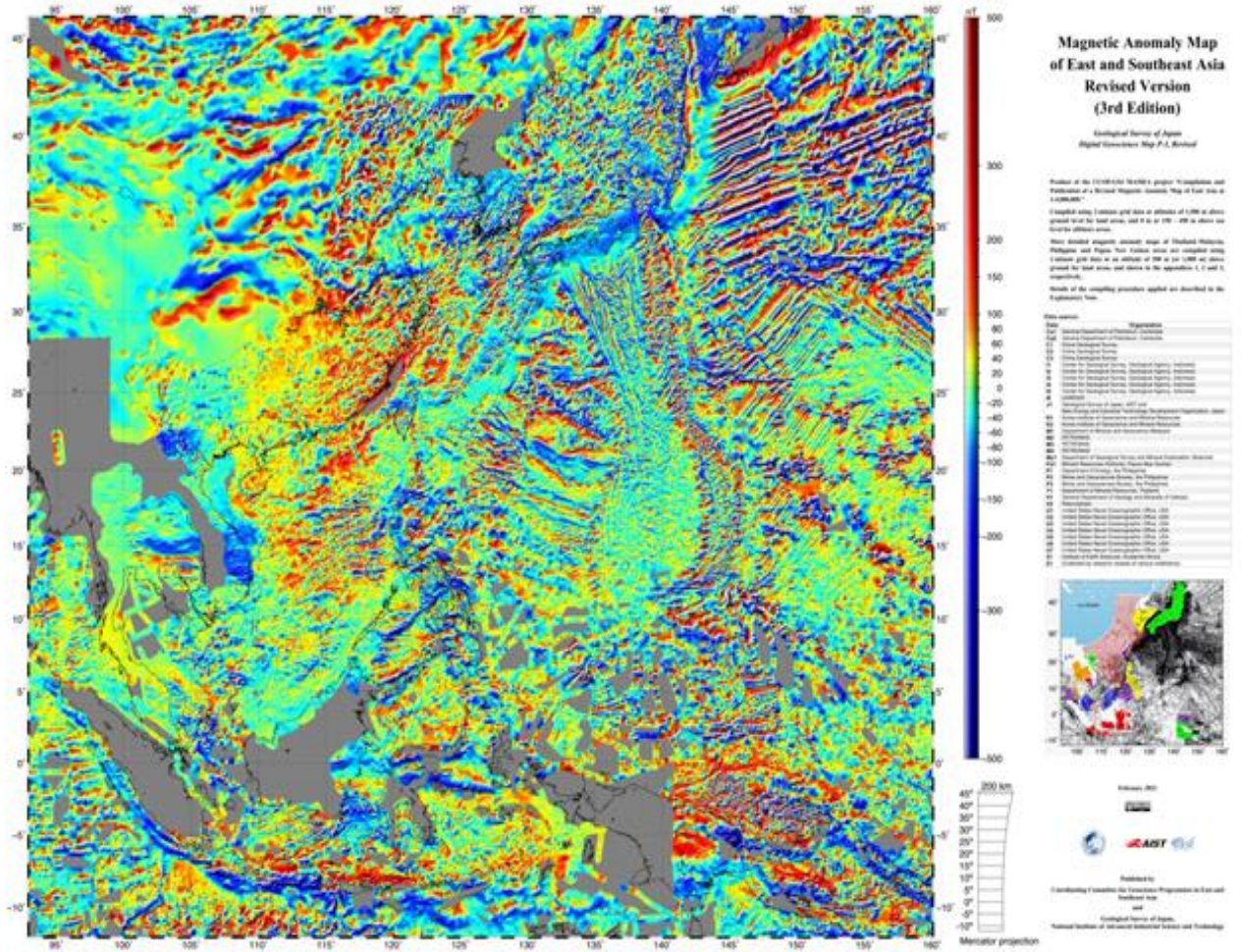
- CCOP and Magnetic Anomaly Map of East Asia (MAMEA) project
- The USGS website

Recommendations:

- ***Write and develop short form articles*** for industry platforms and publications
- ***Use*** Google ***analytics and media reporting*** (where appropriate) to track engagement and impact of marketing activities

OUTCOME

The final product includes a JPEG image file of the magnetic anomaly map of the whole area and three additional image files of more detailed anomaly maps of Thailand-Malaysia, Philippines, and Papua New Guinea (PNG) areas. The product also includes grid data files which were used in making the image files: one file for the whole area with 2-minute grid size, and three files for the detailed areas with 1-minute grid size. The magnetic anomaly data of land areas are converted by mathematical continuation to those with an altitude of 1,500 m above ground for the whole area map, while to 300 m (or 1,000 m) above ground for the detailed maps.



Overall Recommendations

The strategy prepared in this project provides 21 recommendations for AMS and ASEAN across the fields of:

- Pre-competitive data
- Data Acquisition
- Data Packaging
- Marketing – Exploration Attraction

These recommendations have been summarised as a 1-page strategy document included in the report

Appendix 1: ASEAN Exploration Strategy Plan

This simplified plan is designed to provide a step-by-step guide of the Exploration Strategy for ASEAN. It is arranged in a logical order, to allow each country to follow at their own pace and can be used as a measurement of the success of the implementation of the plan. The full plan should take no more than **five years** to implement. It also provides an approximate timeline for implementation.

1) ASEAN agreement to implement the Exploration Strategy as outlined in the document with any additions or amendments agreed to by all parties: **2 months**
2) Each individual AMS to promote and gain government support for the implementation of the Exploration Strategy. It is highly recommended that Geological Surveys or departments responsible for implementing the Exploration Strategy commence a process of education and dialogue to gain full government support. For some AMS this may involve initially;

- "In principle" government support,
- followed by allocation of budgets and
- enactment of appropriate legislation.

The timing will vary between various AMS for item 2 but should be achievable in timeframes of **2-3 months** for the first dot point, **2-3 months** for the second dot point and **6 months to 2 years** for the third dot point.

3) Promotion of the Exploration Strategy to the World exploration community is essential at an early stage. It is recommended that AMS attend one or more of the international forums listed in section 8.2. It is recommended that initially this is via an ASEAN contingent promoting the exploration potential, the availability of geological data and information and changing the perceptions of the exploration community about exploration in ASEAN. ASEAN should be aiming to attend at least one international conference in 2022, at least three in 2023 and consider holding an ASEAN exploration conference in 2024.
4) Geological Surveys in the AMS should be looking to implement the recommendations on data to be supplied to exploration companies. This will include the items listed in section 2.1. The recommendation is to proceed in the order of the dot points listed below but each AMS must decide in the implementation timetable. The list includes is broken down into a logical sequence, in summary:

- AMS to provide basic geoscience information available online, including mineral occurrence data, 250k or 100k geological map sheets. Most of this work is available so a timeline of **1 to 3 months** is suggested.
- surface geochemistry (soil or streams samples) and airborne geophysical datasets, Around **3 to 6 months** to produce some of this data for explorers
- drill hole databases will take longer as each AMS will need to work out how to collect the data, make recommendations for legislative change, collect the data and then make the data available. It is expected that some AMS may be able to produce this information in **6 to 12 months** while others may take **1 to 2 years.**
- provision of tenure data in an online format for ASEAN nations. This will attract explorers if the process is transparent and simple to operate. It is expected that this will take **1 to 5 years** for AMS to apply.
- Geological Surveys undertake prospectivity analysis of important regions and commodities, producing reports pamphlets and information that can be used in marketing**. Ongoing from 6 months to 2 years**.

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Thank you

Discussion

Discussion Topics

- Dissemination of consistent and complete data sets
- Quality and quantity of data depends on capacity
- Resourcing of the recommendations
- ASEAN initiatives vs individual AMS
- Converting technical recommendations into regulatory actions

1. *Current marketing activities of AMS*
2. *Key challenges for marketing*
3. *Opportunities for ASEAN coordination in marketing*