Natural Resources Canada | Ressources naturelles Canada

Geological Survey of Canada

A Generational Transition

Presentation to CCCESD | Tuesday, October 29, 2019

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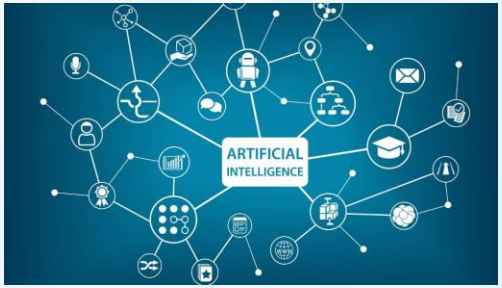
Canada

Context

- Earth Science (Geo) data and knowledge have been part of the Government of Canada mandate since 1842. The **Geological Survey of Canada (GSC)** provides Canada with a comprehensive geoscience knowledge base contributing to economic development, public safety and environmental protection.
- We are currently in a period of **transition**—transition to a new government, to new technologies available to support geoscience work, and to new minerals needed to support a green economy. This comes with a number of challenges, but also opportunities.



Three concurrent paths forward

- **Canadian Minerals and Metals Plan (CMMP)**
  - Developed by federal and provincial/territorial governments in consultation with stakeholders from all aspects of **mining**
- **CMMP - Pan-Canadian Geoscience Strategy**
  - Being developed by federal and provincial/territorial geological surveys in consultation with stakeholders in **geoscience**
- **Next Generation Geoscience**
  - Modernizing **geoscience** within the GSC and the federal government as a whole

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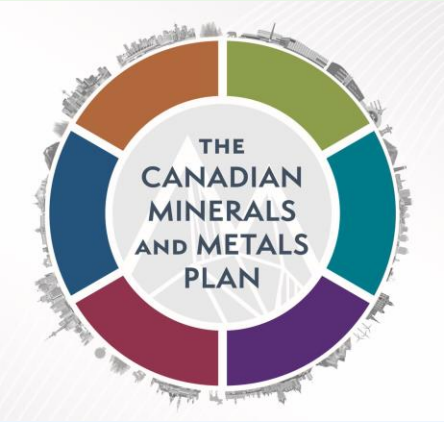
Canadian Minerals and Metals Plan (CMMP)

- Developed by federal and provincial/territorial governments in consultation with stakeholders from all aspects of **mining**, to promote a minerals industry in which Canada is a global leader economically, socially, and environmentally.
- Signed by federal government and most provincial/territorial governments.



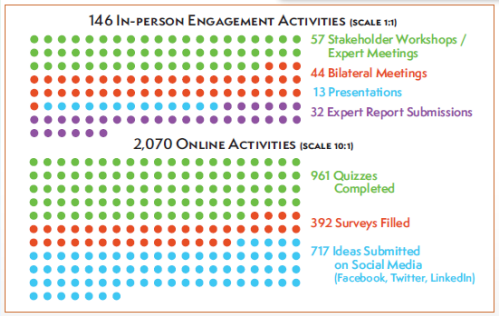
THE VISION*

CANADA IS THE LEADING MINING NATION

Canada is home to a competitive, sustainable and responsible minerals industry that benefits all Canadians. The country is a global leader in mining-related science, technology, social and environmental practices with a clear and predictable regulatory environment, innovative clean technology solutions, and best management practices. It boasts a skilled and diverse workforce, an attractive investment climate, partnerships with Indigenous Peoples, and strong relations with communities.

Canadian Minerals and Metals Plan (CMMP)

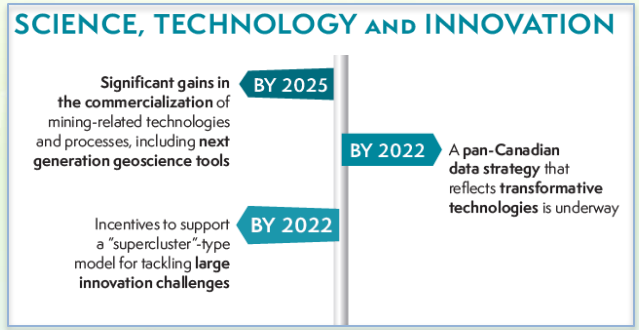
- Based on extensive consultation with stakeholders, the plan has six strategic directions, and relies heavily on **geoscience**.

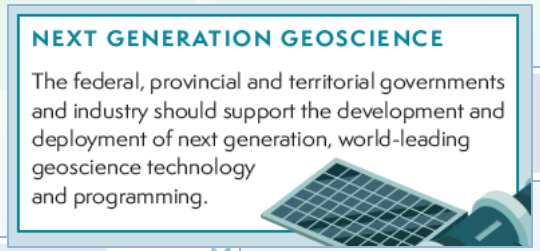


The 6 pillars of CMMP

Canadian Minerals and Metals Plan

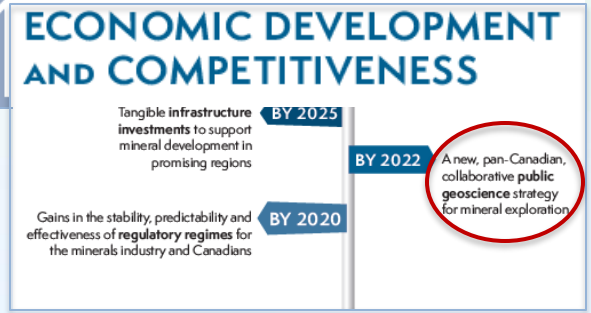
- Leveraging existing geoscience, and further developing governmental capacity/collaboration/modernization for geoscience, is a key recommendation of the plan.

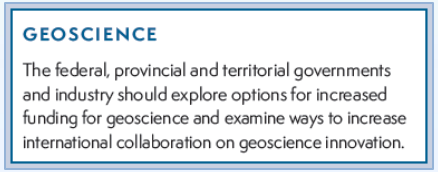




✓ State-of-the-art public geoscience

World class, innovative public geoscience





Public geoscience that supports economic, social and environmental goals

Three concurrent paths forward

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Pan-Canadian Geoscience Strategy

- The federal and provincial/territorial Ministers of Energy and Mines are the principal ministers responsible for government geoscience through their surveys and the Intergovernmental Geoscience Accord. They are united in calling for action.
- As one of several pan-Canadian actions under the CMMP, the **Pan-Canadian Geoscience Strategy (PGS)** will support the development and deployment of next generation, world-leading geoscience.

BY 2020 A pan-Canadian **Mining Value from Waste** research program is established to reduce the footprint of mine wastes and improve environmental performance

BY 2022 A new, pan-Canadian, collaborative **public geoscience** strategy for mineral exploration

BY 2022 A **pan-Canadian data strategy** that reflects **transformative technologies** is underway

Pan-Canadian Geoscience Strategy

Why the need for a Pan-Canadian Geoscience Strategy now?

- Fragmented geoscience ecosystem.
- Academia is calling for a rallying research plan and an earth science structuring program (e.g. Lithoprobe in 1980s-90s, Earthscope in the US).
- Many stakeholders called for major new geoscience investments through the CMMP consultation process.
- Northern communities want to be involved in the science that informs northern development.
- Canadian Federation of Earth Sciences (CFES) is keen to advance a national geoscience research plan, but lacks ways and means.
- The federal Chief Science Advisor (Dr. Nemer) is eager to break down silos and bring Canadian science together in a unified way ('ecosystem approach').

Pan-Canadian Geoscience Strategy

Possible scope of the strategy (under development by the National Geological Surveys Committee)

- Key topics: minerals geoscience +/- water geoscience, energy geoscience, public safety and climate change geoscience
- Cross-topic themes for collaboration: data integration/interoperability, digitalization, foundational geoscience, seamless mapping across provincial/territorial borders

Note: Development of the strategy will include leveraging existing engagement under CMMP, and conducting further geoscience-specific engagement at an early stage in strategy development, so that stakeholders have an opportunity for meaningful contributions.

NGSC preliminary meeting on development of a Pan-Canadian Geoscience Strategy | October 2019

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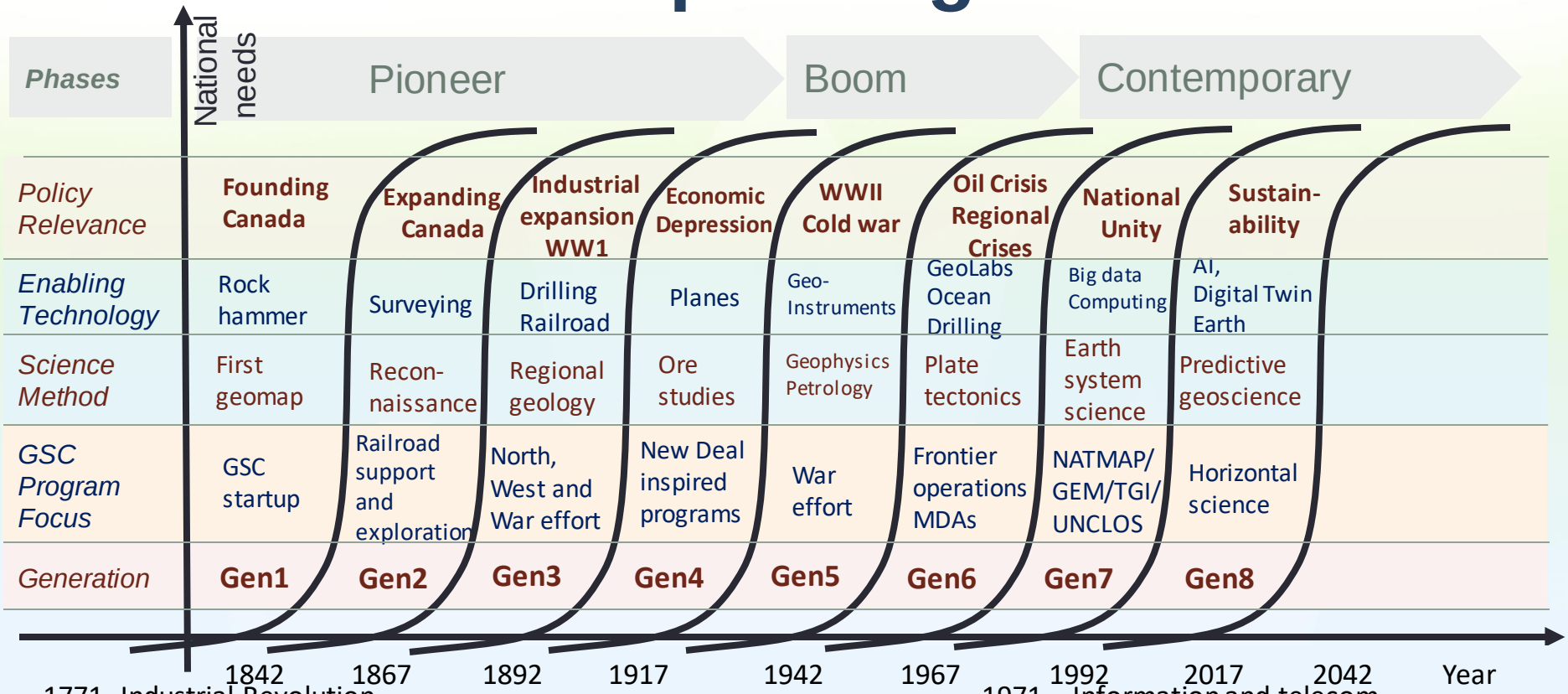
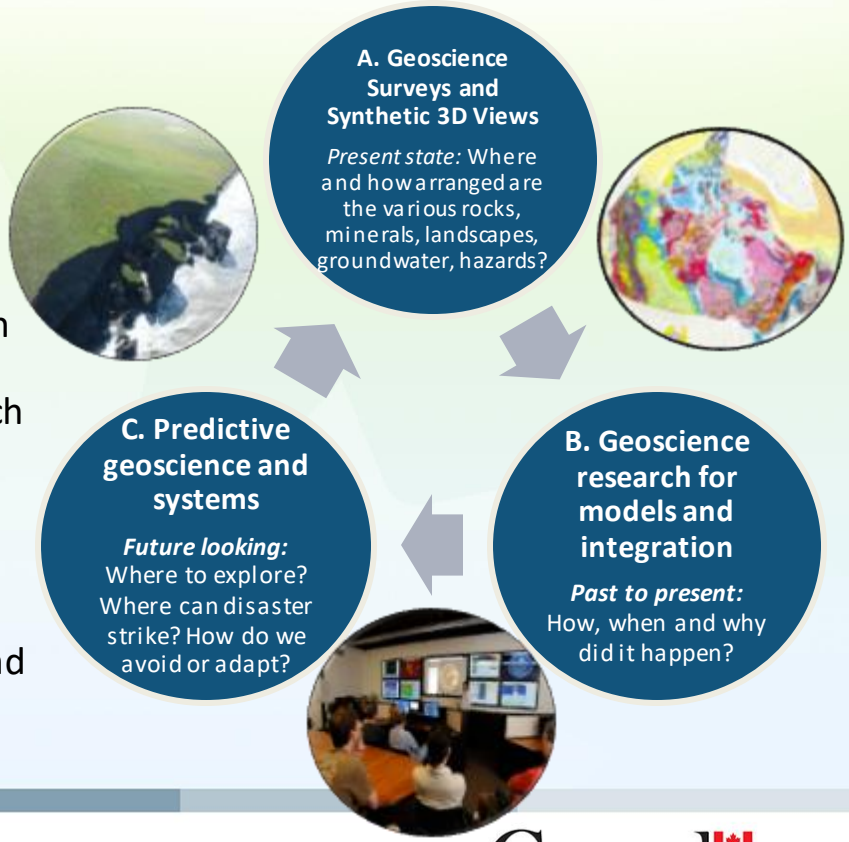
Evolution of public geoscience



Public geoscience functions

As Canada's longest-standing scientific organization, the GSC brings **foundational knowledge** to its **partnerships with experts in other disciplines** to tackle some of Canada's 21st century challenges, such as:

- Searching for deeply hidden resources
- Better understanding climate change and its impacts
- Studying the effects of natural resources development on groundwater, air and soil
- Looking to the past and future using a variety of tools such seismic survey, drones, 4D modelling, AI, etc.
- Providing support for evidence-based decision making, including for provinces, territories and communities and communicates its science and its benefits to Canadians
- Building partnerships with Indigenous people, by integrating traditional knowledge, transferring science and capacity building

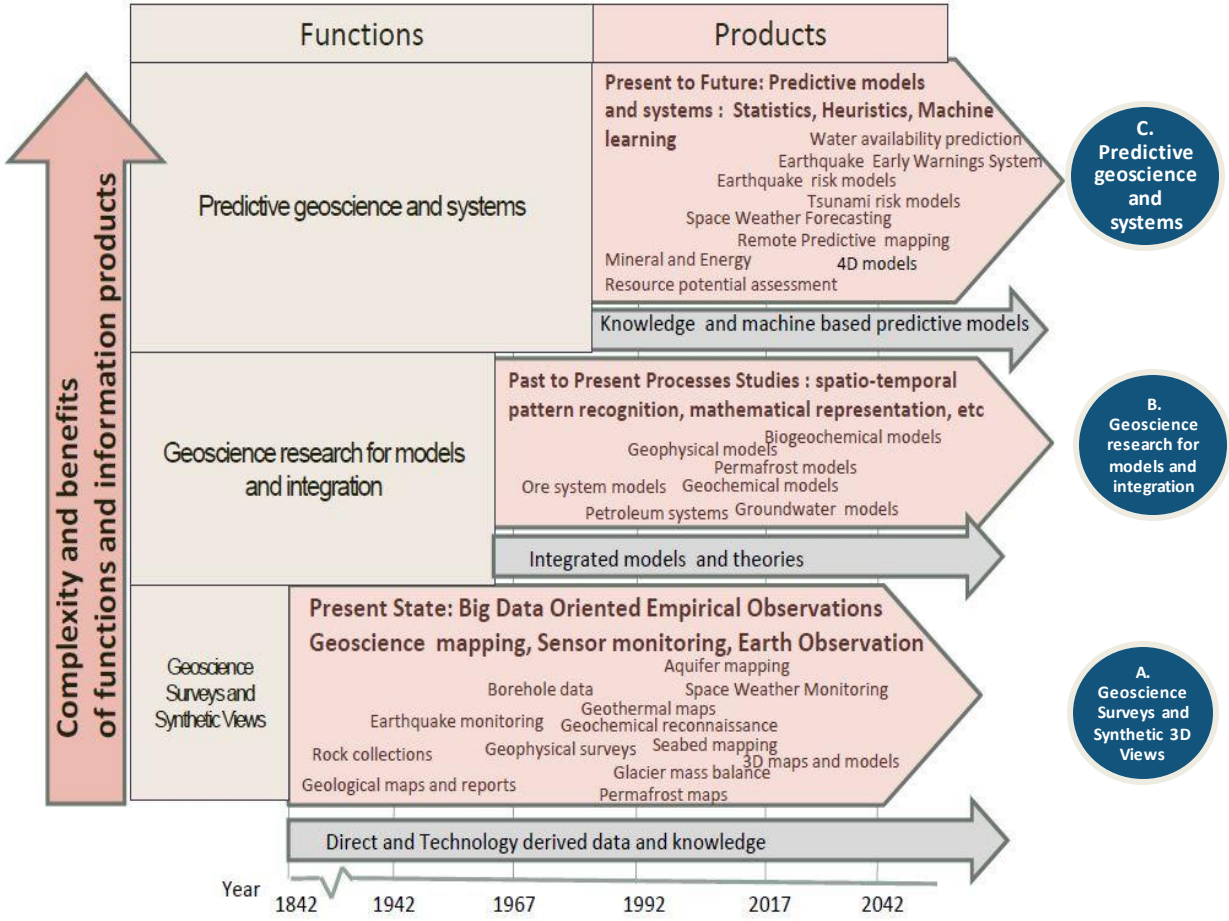


Next generation geoscience – the vision

We are in a world of breakneck technological innovation: robotics, artificial intelligence, communications, big data, etc.

Vision: Predictive Geoscience

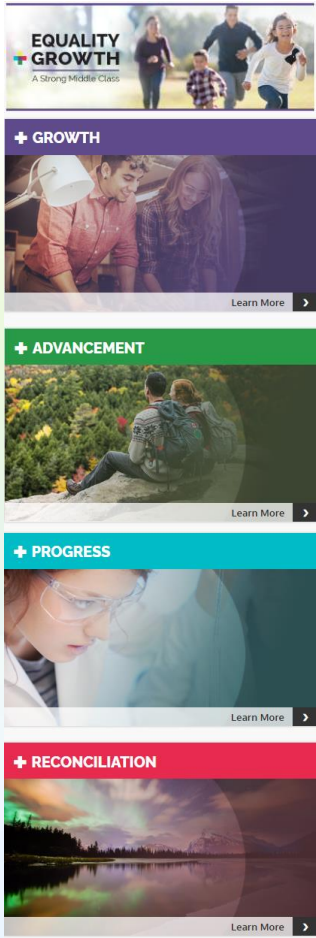
- Develop cutting-edge digital tools to **increase our capacity for prediction and integration** across disciplines.
- Resulting information will support public and private sector **evidence-based decision making** (e.g., mining, infrastructure, hazard reduction, environmental sustainability).



Next generation geoscience – how to get there?

Outcome	Rationale	Areas of focus	
Enabling the world's leading public geoscience to support economic, social, and environmental sustainability.	Next generation geoscience is needed to inform public policy, reduce the risks associated with mineral discovery, increase the effectiveness of exploration efforts, encourage private sector investment, inform land-use planning, helps building a thriving northern and remote economy and promote a globally competitive mineral industry.	**Digital Geoscience**	Digital geoscience corresponds to the digital revolution. It will drive the new GeoEconomy by developing a new generation of Earth system-based knowledge and geospatial applications. This will: • Generate new foundational Earth science knowledge, predictive models and open data using emerging digital technologies. • Support science-policy integration, Indigenous reconciliation, and economic development • Enable Canada's natural resource related geoeconomic sector to grow and prosper. • Implement geoscience innovations in government to modernise organizations and knowledge base such as the GSC. • Use initiatives for strengthened collaboration to become more horizontal in approach.
		Mineral Potential Assessment	New geoscience knowledge and tools that enable industry to adopt innovative exploration approaches to enhance efficiencies of discovery.
		Arctic and Northern Knowledge Development	Innovative geoscience knowledge to inform land-use and infrastructure decision making in Arctic and Northern Canada for Northerners and with Northerners (incorporating Traditional Knowledge).
		Pan-Canadian Geoscience Strategy	A comprehensive pan-Canadian framework that delivers integrated geoscience, from Canada's federal-provincial/territorial governments, academia and industry, incorporating Traditional Knowledge with Indigenous Peoples, to Canadians.

Next generation geoscience – how to get there?



New Vision for Science (Budget 2018):

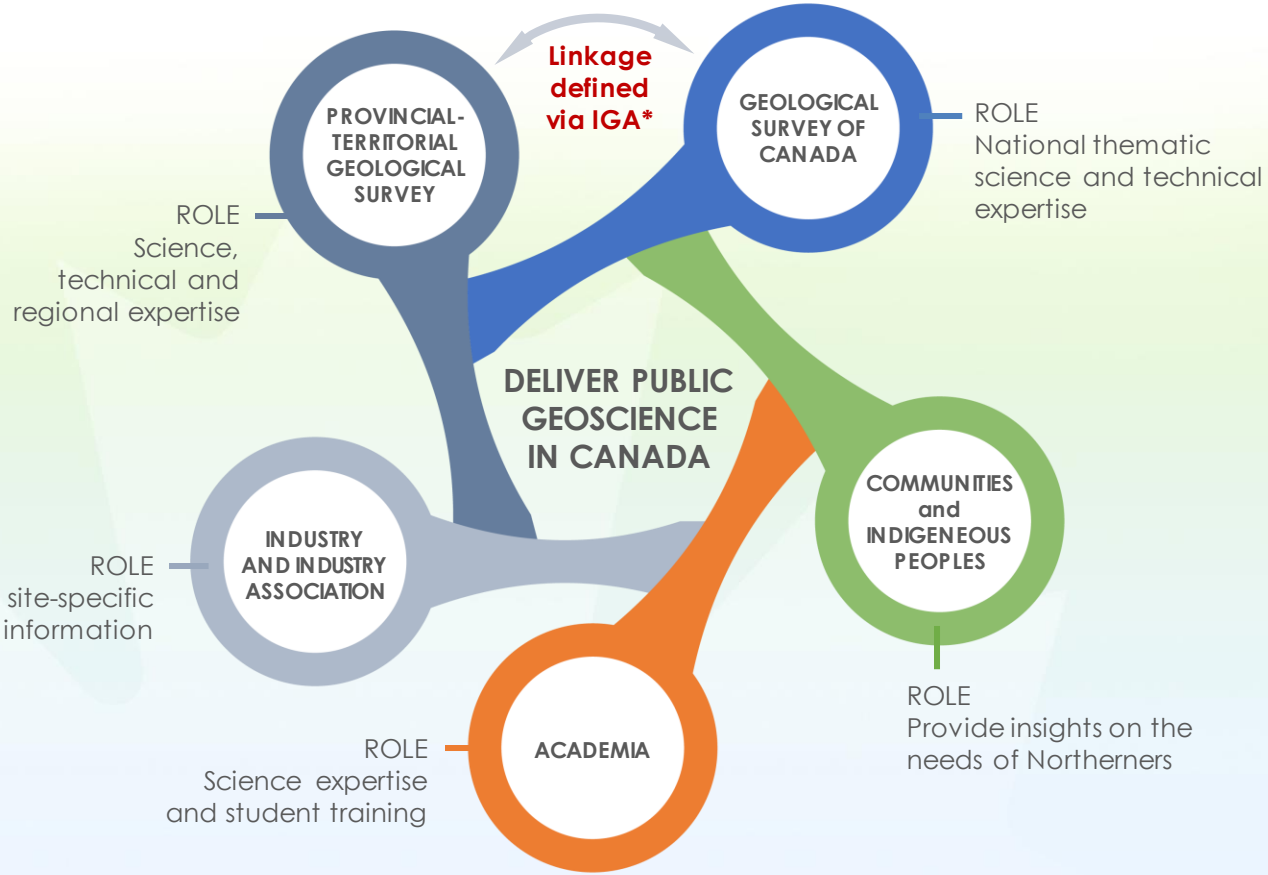
- **Strengthen science; strengthen evidence-based decision making; and strengthen the culture of curiosity in Canada**

  Informed by Minister of Science Kristy Duncan, recommendations from Canada's Fundamental Science Review (C. David Naylor & panel), interactions between Minister and researchers and students working in facilities across the country

Highlights:

- Approximately $4B in new funding for **basic science** over the next five years to support academic research
- $2.8B investment in new federal government science infrastructure to create a new approach to science that is **horizontal**, **interdepartmental**, **partnered**, **excellent**
- Investment in new, shared **infrastructure** and **information technology management** capacity
- **Open Government**

Next generation geoscience – collaboration will be critical



*The **Intergovernmental Geoscience Accord** (IGA) defines the complementary roles of Canada's geological surveys, as well as mechanisms for cooperation and collaboration

Next generation geoscience – mineral potential assessment
Targeted Geoscience Initiative (TGI)

- **Collaborative Approach:** With decreasing availability of near-surface mineral deposits, TGI was developed as a collaborative (industry through Industry Advisory Group) federal geoscience program that provides industry with new geoscience knowledge and innovative techniques to enhance effective targeting of mineral deposits at depth.
- **Ore System Research**: TGI is a thematic program that integrates geoscience data and knowledge about Canada's major mineral systems from locations across the country.
- **Results:** Understanding of geological processes that lead to mineral deposition and modelling 3D geological structure at depth to identify potential ore deposits, supporting the mineral industry.

Research focused on Canada's key economic minerals

GOLD

NICKEL-COPPER-PGE

URANIUM

VOLCANIC AND SEDIMENTARY

PORPHYRY

Next generation geoscience – mineral potential assessment

Targeted Geoscience Initiative (TGI)

TGI will deliver…

- ✓ TGI synthesis volume
- ✓ Grant program report
- ✓ TGI booklet
- ✓ International, peer-reviewed geoscience
- ✓ > 200 HQP supported

Next generation geoscience – mineral potential assessment

Progress on mineral potential modelling

Mineral Intelligence Engine

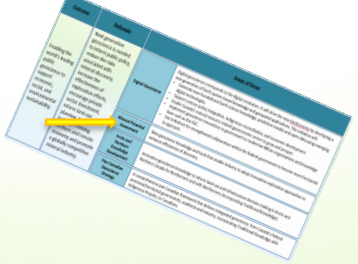
Open Source machine learning workflow

Collaborative (e.g., platform independent; one flat-table for sharing)

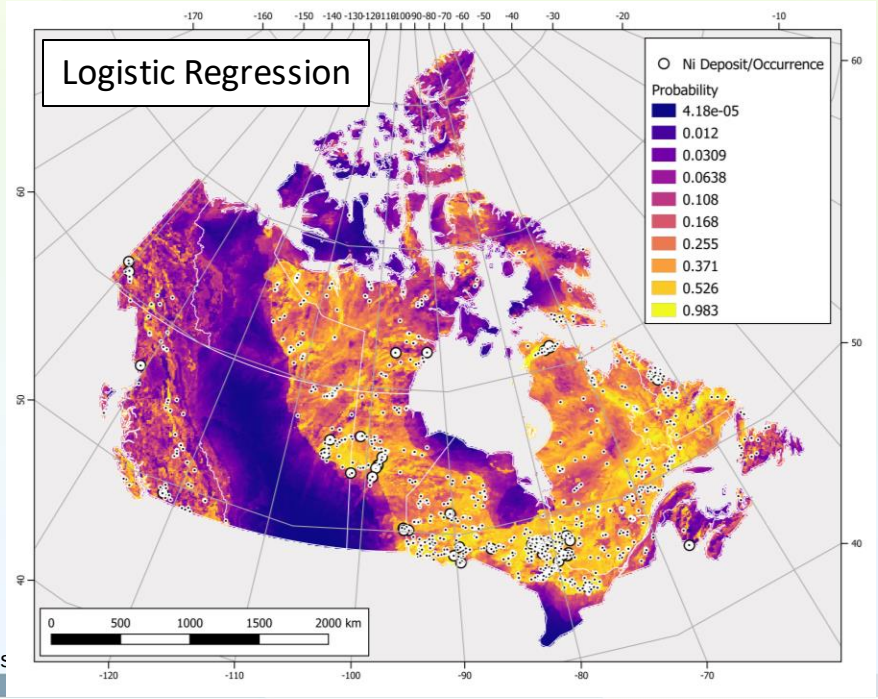
Flexible (e.g., users select evidence layer(s); filter to areas with more/different data); sensitivity analysis on-the-fly

Dynamic (e.g., scripted; update with new data; static source data)

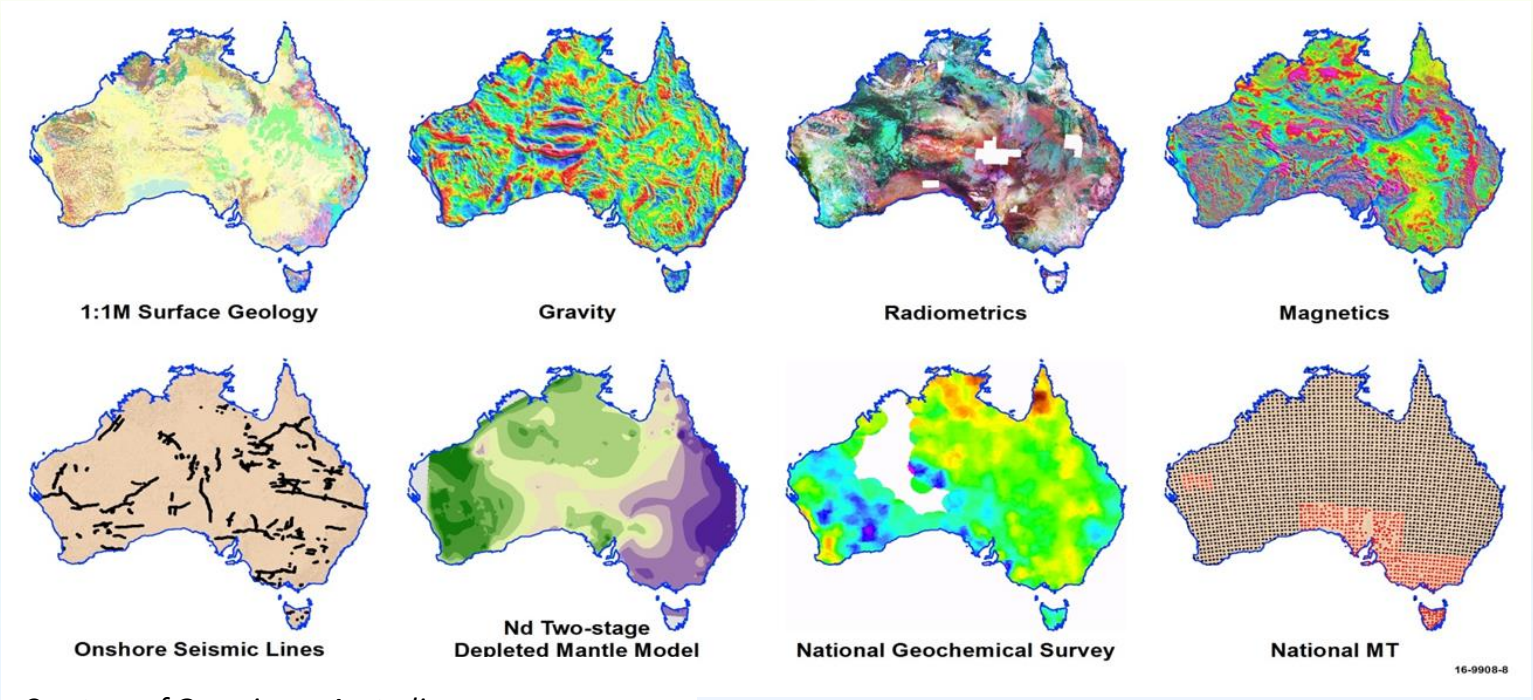
Mineral intelligence project: Leading the way using data-driven innovation



- Direct detection
- Traps
- Architecture
- Sources
- Drivers

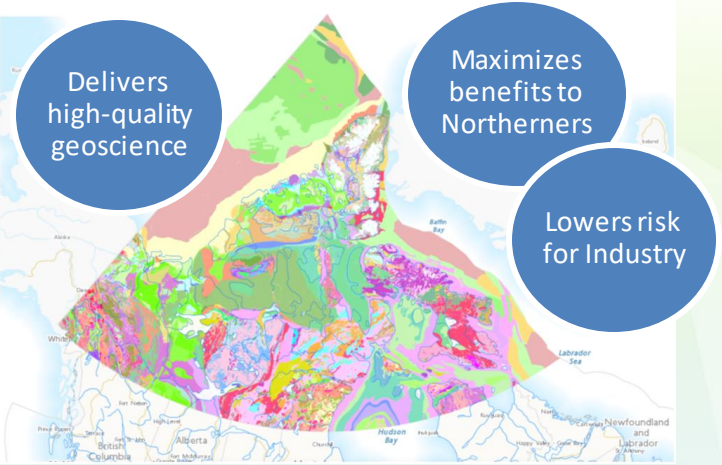


Establishing a national framework?



Courtesy of Geoscience Australia

Geo-Mapping for Energy and Minerals program (GEM)



NRCan finds the haystacks…

By 2020, GEM will deliver…

- ✓ **Foundational regional knowledge** that can be used by industry, northerners and their institutions (more than 400 maps published and ~2000 publications).
- ✓ A coherent **geological framework of the North**, available to the public via a variety of media including an interactive Canada 3D online portal.
- ✓ Several synthesis volumes and many HQP supported.

INVESTMENT EXPLORATION DISCOVERY DEVELOPMENT

…and industry searches for the needles.

Barriers to northern development

Vast and remote location raises costs, requiring greater certainty in resource potential estimates.

Lack of infrastructure, and climate risks to existing & planned infrastructure, limits access to resources.

Northern and Indigenous communities want to help define the research questions.

Uncertainty regarding cumulative effects of development hinders social license and environmental impact assessment.

In the North, "foundational" isn't enough.

Unlocking Northern development *requires* ***new knowledge*** *and* ***new tools*** *to answer evolving questions. We need to do things differently and we need to do different things.*

Unlocking northern development

New knowledge and tools, focused in areas of high potential for development…

1. **Refine geological knowledge regarding the immense untapped resource potential** in the Arctic & North.
2. **Enhance understanding of rapidly changing landscapes and coasts,** to support economic diversification via critical infrastructure.
3. Develop and provide **new public geoscience** to inform environmental assessments.
4. **Leverage innovative data-driven predictive methods** to forecast cumulative impacts in a changing climate.
5. **Co-develop research priorities and products** with Northerners and Indigenous peoples.

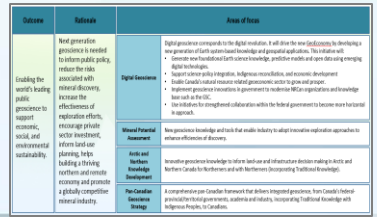
Aligned with:

- Northern MTPs
- CMMP
- ANPF

The right KNOWLEDGE can UNLOCK the economic and land-use POTENTIAL of the NORTH

Conclusion

- **Public geoscience** in the federal government has evolved over its long history and continues to be relevant.
- Geoscience strongly contributes to government priorities with impactful results for the **economy**, the **environment** and **public safety**.
- The Geological Survey of Canada's path forward will be influenced by the **Canadian Minerals and Metals Plan**, **Pan-Canadian Geoscience Strategy**, and **next generation geoscience**.
- **Next generation geoscience** can underpin work under the CMMP and PGS, as it supports the fast-growing Canadian demands for digital data, Earth process research, and predictive, actionable, decision-support systems, and in doing so spurs a new generation of geoscience and technology economic assets for Canada.

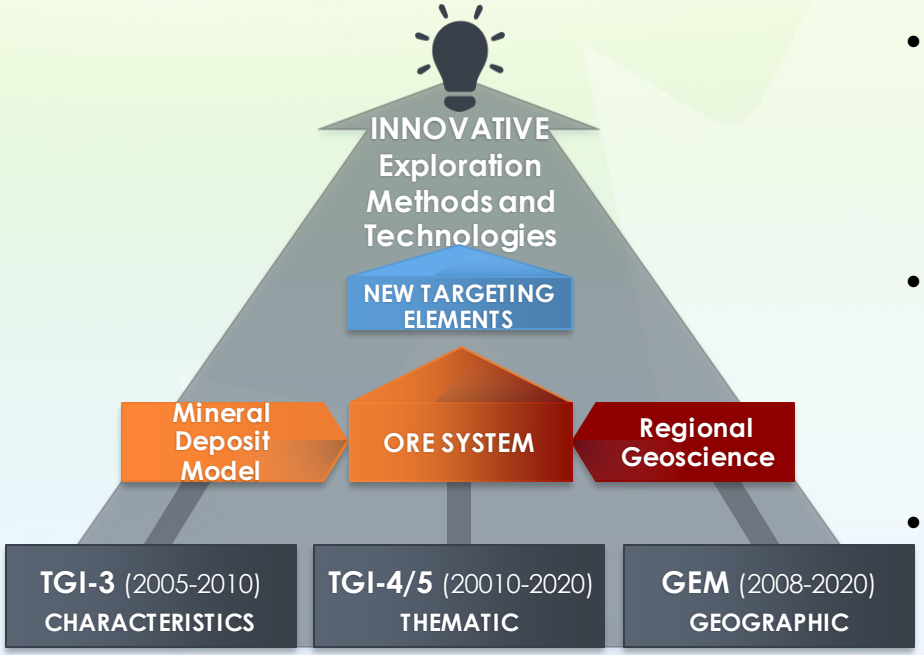


Our questions for you

- How do you see the role of universities in the Pan-Canadian Geoscience Strategy and next generation geoscience vision?
- Would universities team up to help develop a national geoscience plan, or would they contribute individually?
- What role (if any) do you see organizations such as the Council of Canadian Academies, Geological Association of Canada, or Canadian Federation of Earth Sciences playing in scoping the plan?
- Where are the obstacles to achieving a whole-of-Canada way forward for geoscience?

ANNEX

Next generation geoscience – mineral potential assessment



- An **ore systems approach** decouples results from geography and moves us from a retrospective to predictive environment
- For **mineral potential modelling**, it also allows us to transform from a qualitative expert-based approach to a (semi-) quantitative data modelling approach
- Advances in **data/geo analysis** (e.g. AI) are rapidly transforming our ability to target the key data that informs the models.