Creating Opportunity…
Canadian Governmental Geoscience Programs Stimulating Economic Development

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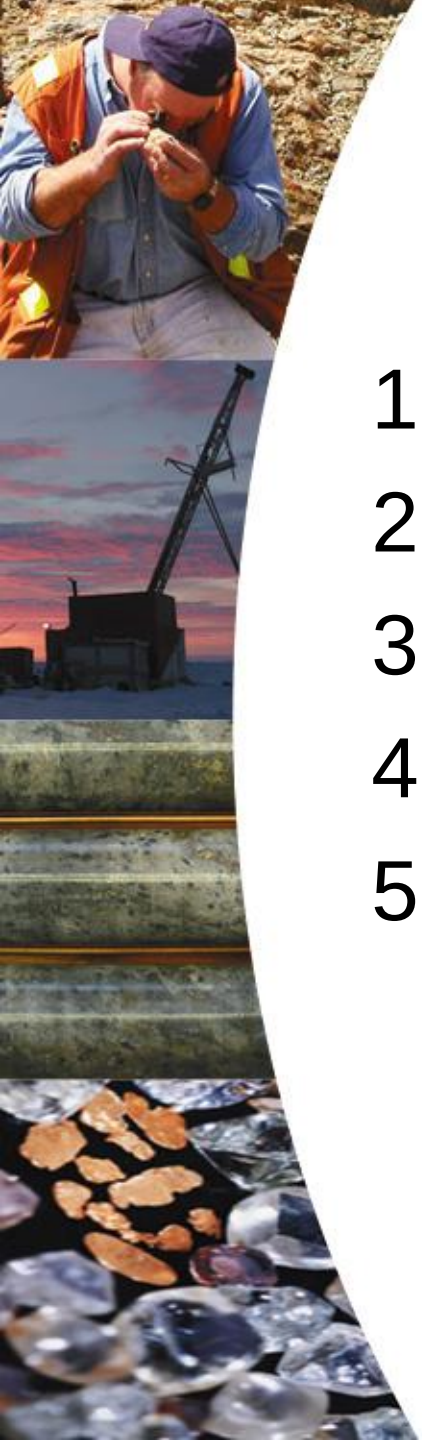


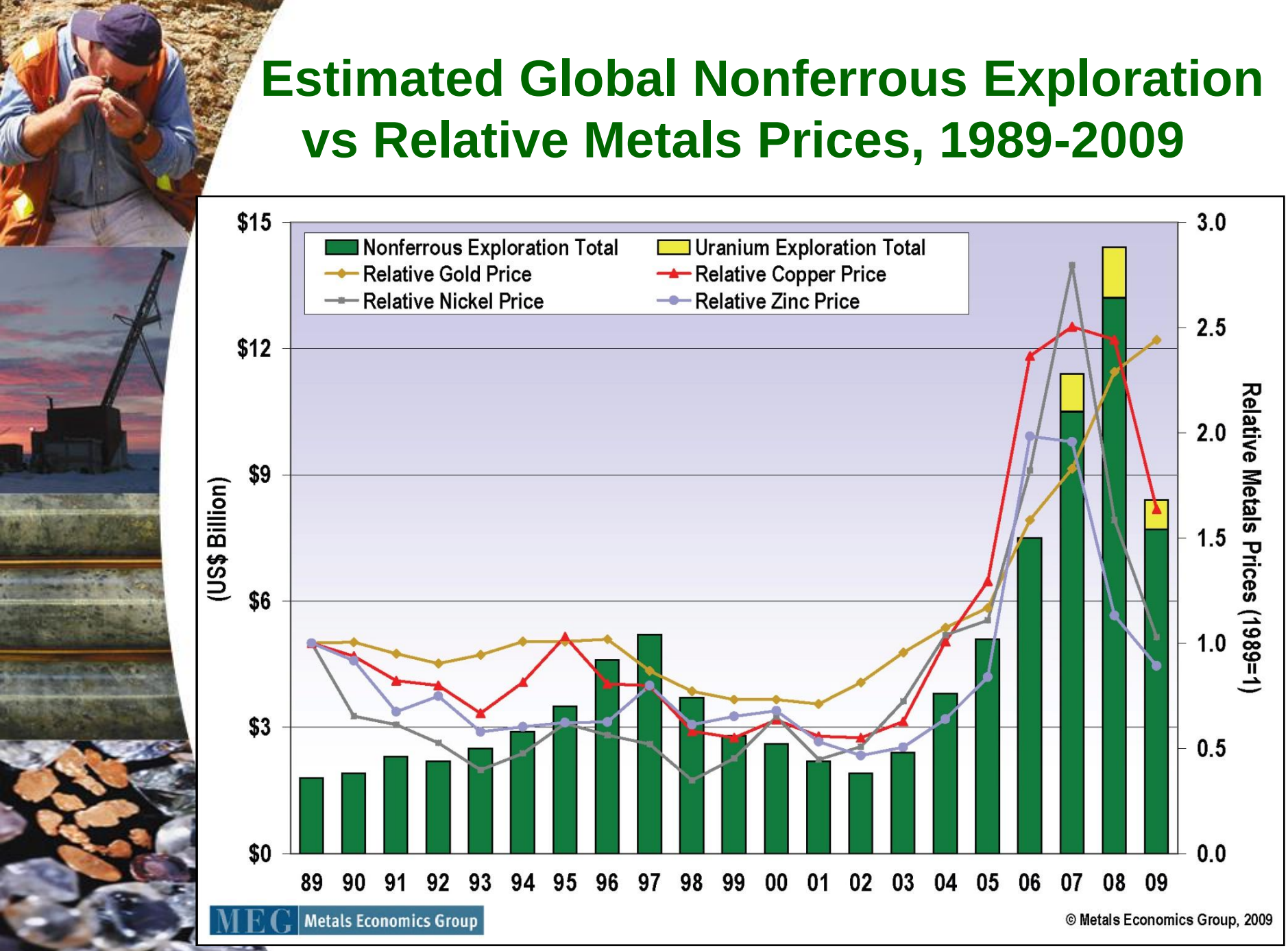
Presentation Outline

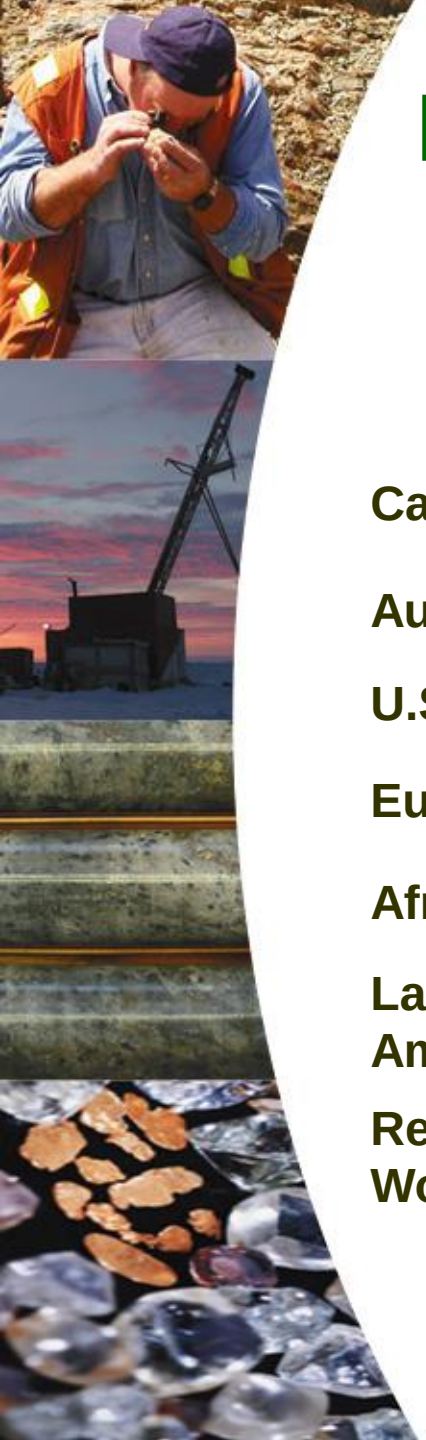
1. Introduction
2. The Canadian exploration industry.
3. What has Canada done right?
4. The role of public geoscience.
5. Summary and Conclusions

Canadian Exploration Players

- Producing Mining Companies
- Junior Exploration Companies
- Prospectors/Syndicates
- Federal and Provincial Governments

Estimated Global Nonferrous Exploration vs Relative Metals Prices, 1989-2009





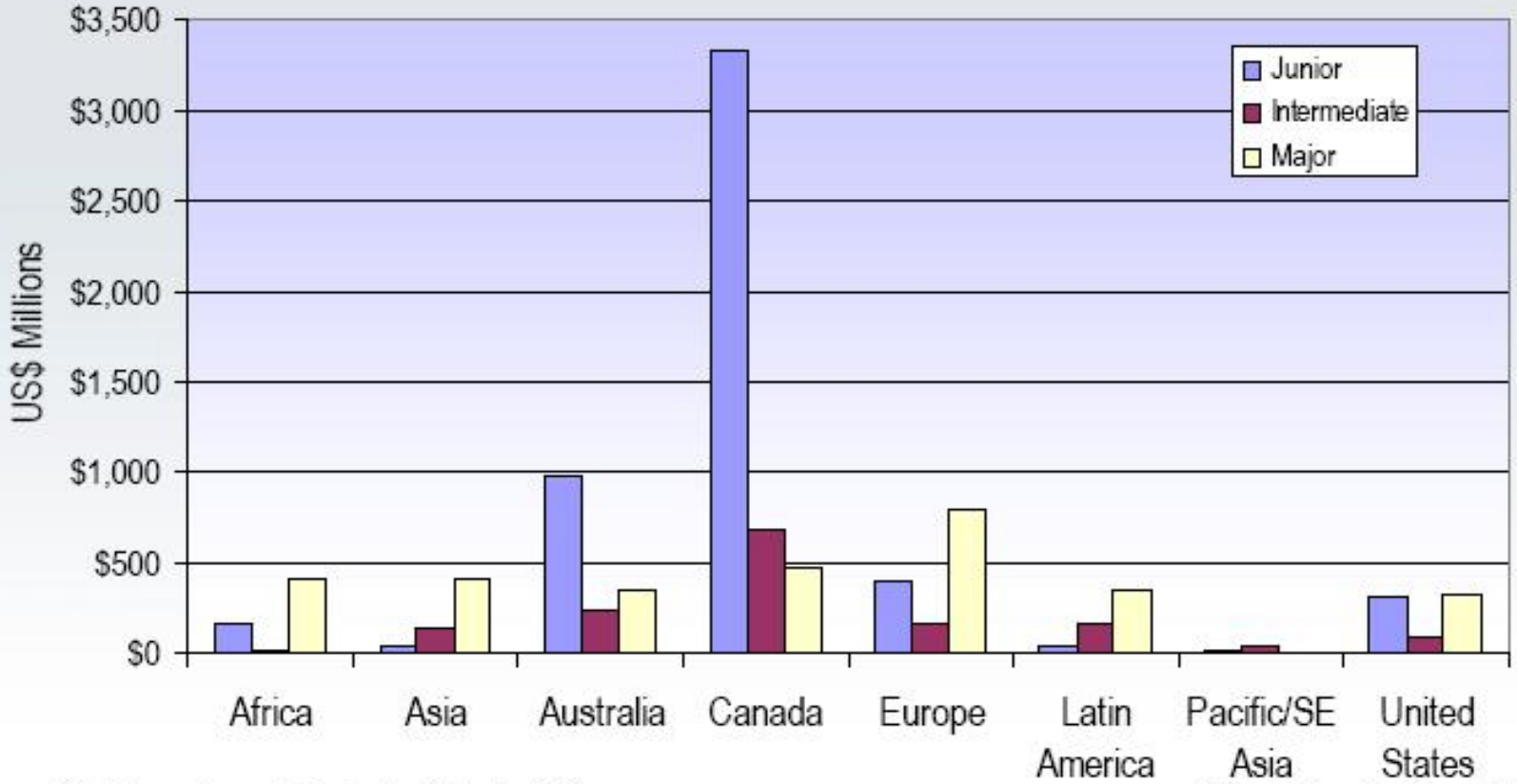
Number of Companies – 2007 Size and HQ Location

	Junior	Interm.	Senior	Gov't.	Other	Total
Canada	1087	21	7	1		1116
Australia	498	21	4	1	3	527
U.S.A	102	5	3			110
Europe	102	6	8		1	117
Africa	29	5	5			39
Latin America	13	13	4		1	31
Rest of World	10	17	8	5		40

•Source: Metals Economics Group

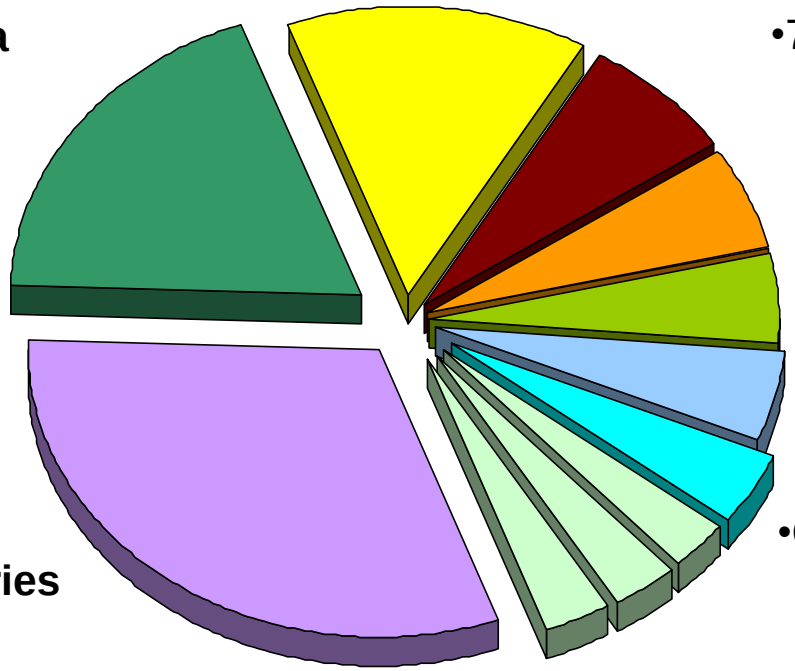
Global Exploration 2007 by Company Headquarters and Type

MEG
Metals Economics Group



Data Source: Corporate Exploration Strategies 2007

Exploration Spending for the Top Ten Countries, 2008
(US$12.6 billion total)



MEG Metals Economics Group

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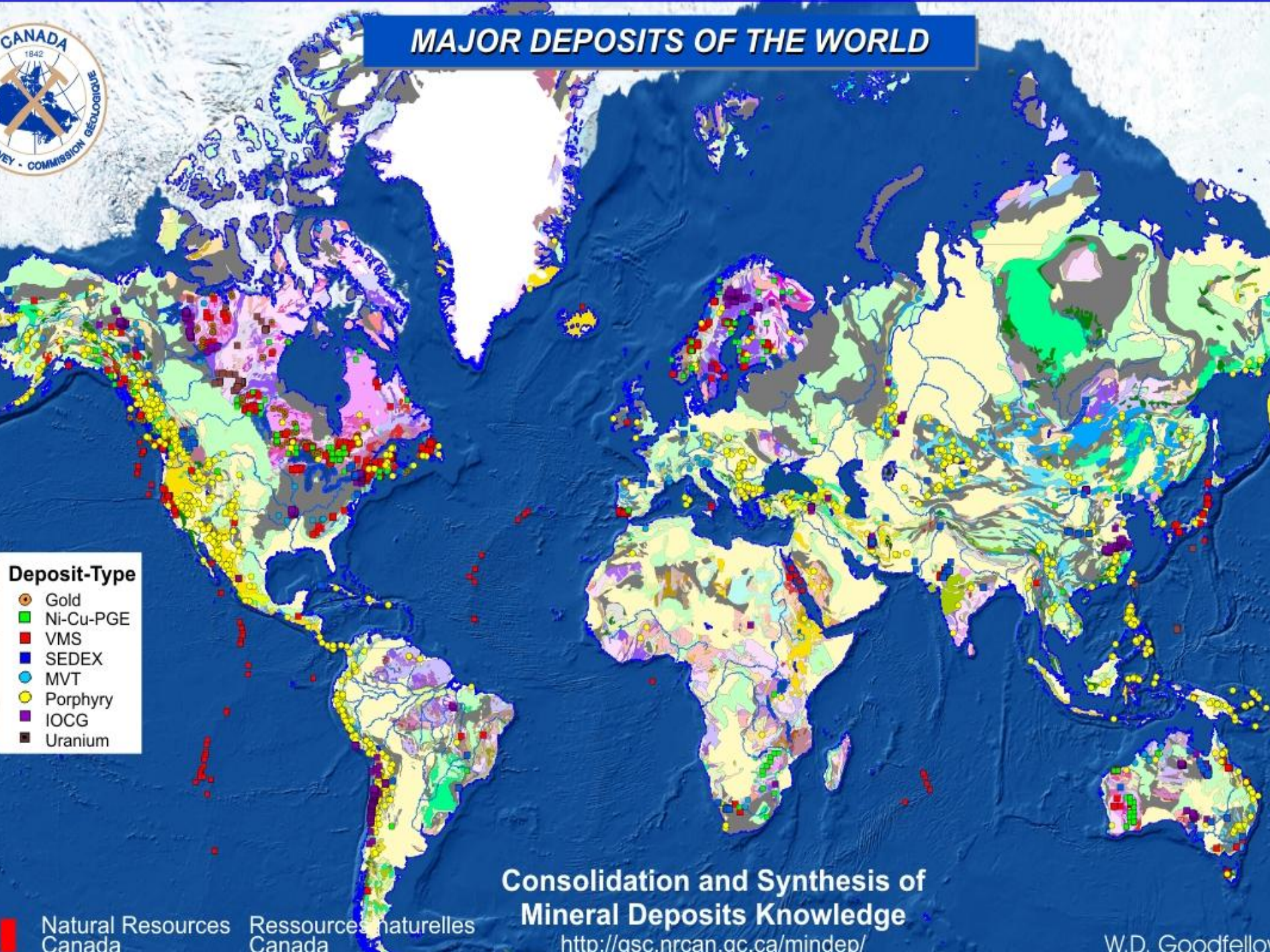
Summary of Canadian Mineral Industry Characteristics:

- Large junior exploration sector
- Majority of capital raised in Canada
- Canada attracts the most exploration spending of any country
- Canadian companies lead in worldwide exploration spending

What is it about Canada that has helped the country to develop a successful mineral industry?

MAJOR DEPOSITS OF THE WORLD



Access to public lands…

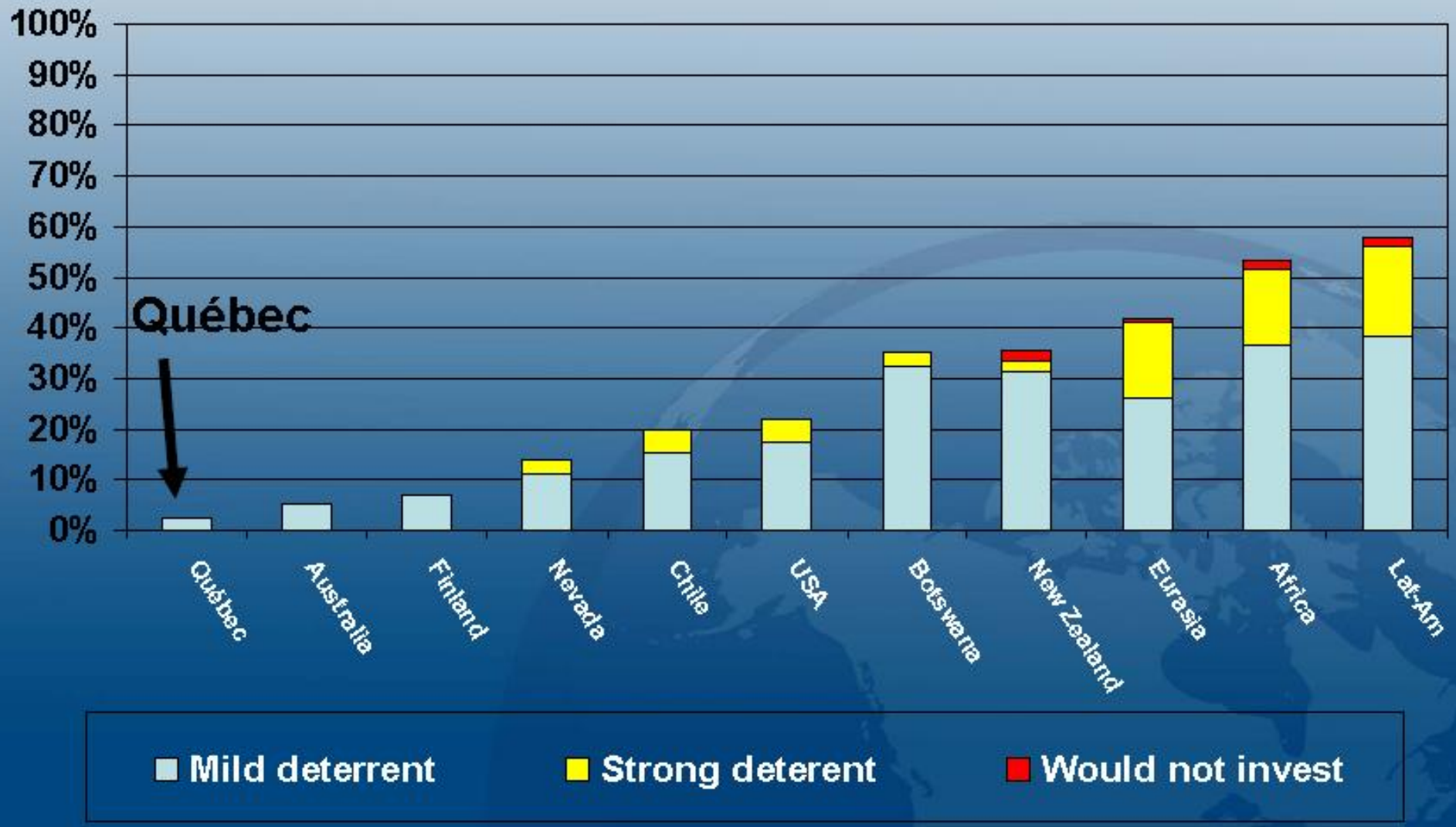
Competitive access to mineral rights and security of title…


STOCK MARK

- *Assessment Files*

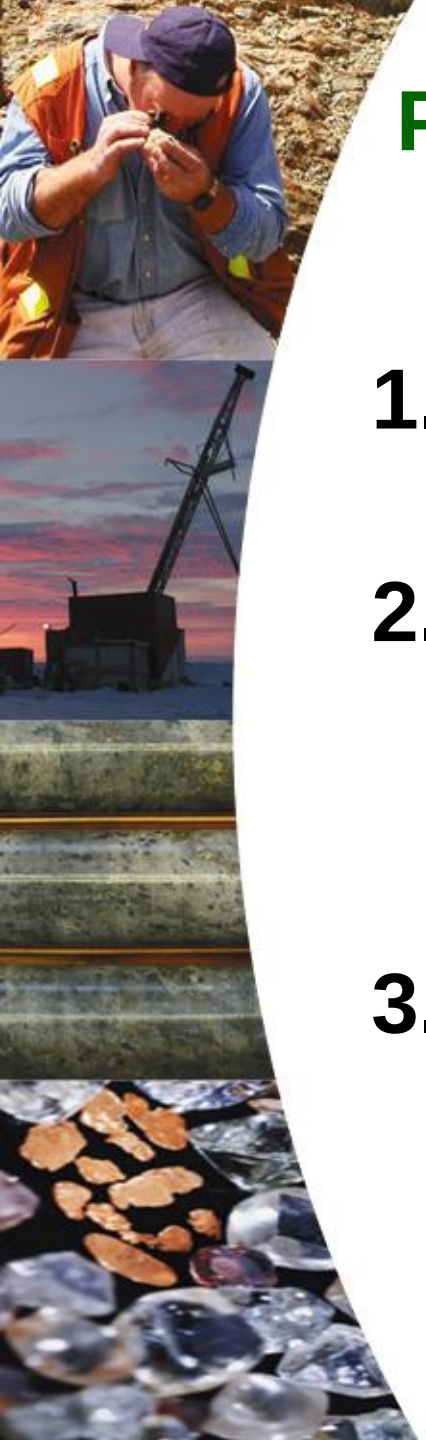
Publically accessible data.

QUALITY OF THE GEOLOGICAL DATABASE
(includes quality and scale of maps, ease of access to information, etc.)



Geological Database

- **Assessment Files:** Company exploration data that becomes part of the public record as work filed in order to maintain claims in good standing.
- **Public Geoscience:** Government acquired geoscientific information that is provided to the public in support of a competitive investment climate.
- **Available at little or no cost!**



Public Geoscience for Exploration: How it Contributes

1. **Focus** – helps identify areas of highest potential for target deposit types.
2. **Improves Efficiency** – no need to duplicate common information or spend time and money on areas of low potential.
3. **Improves Effectiveness** – by providing information at key decision points.

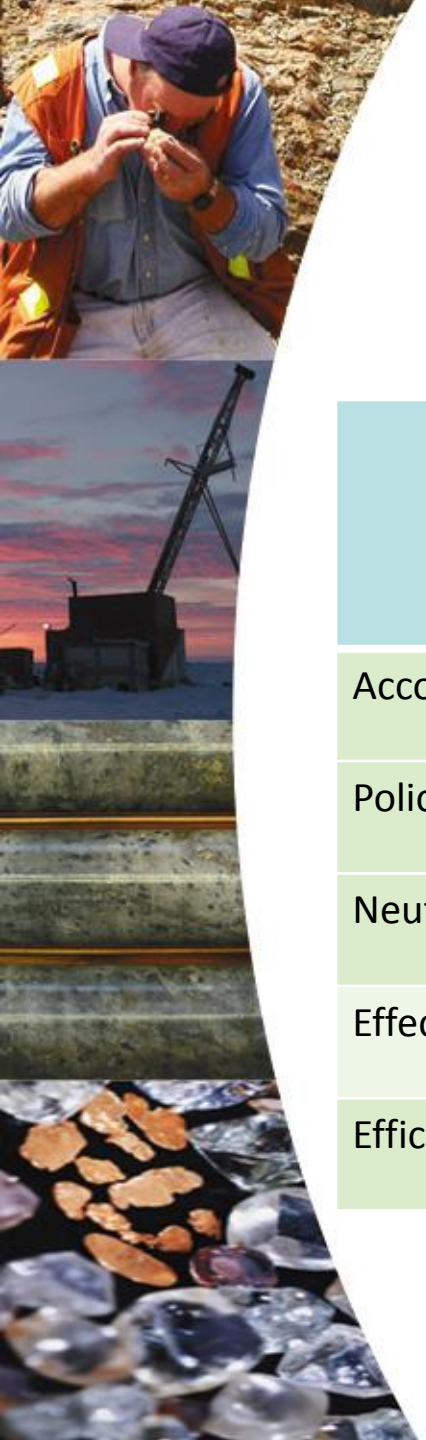
Public Geoscience for Exploration: Is it Government's Role?

Three considerations:

- Most mineral resources are public assets
- Responsible development of these resources is in *the public interest*
- Much geoscience information has the economic characteristics of *a public good.*

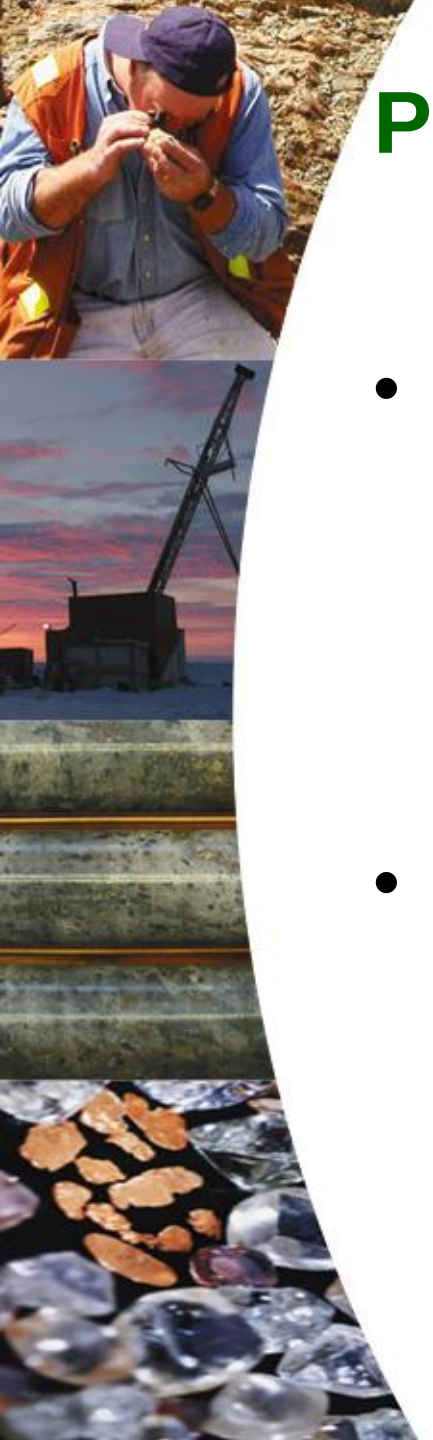
Public Geoscience for Exploration: How is it Best Delivered?

- Most governments opt for in-house geoscience capacity
  - Critical mass of expertise in a 'geological survey'
- Alternative institutional arrangements
  - Integral part of department/ministry *(e.g., GSC, USGS)*
  - Agency or Board *(e.g., Geoscience Australia)*
  - Quasi-commercial state enterprise *(e.g., New Zealand).*



How Is It Best Delivered? Trade-offs

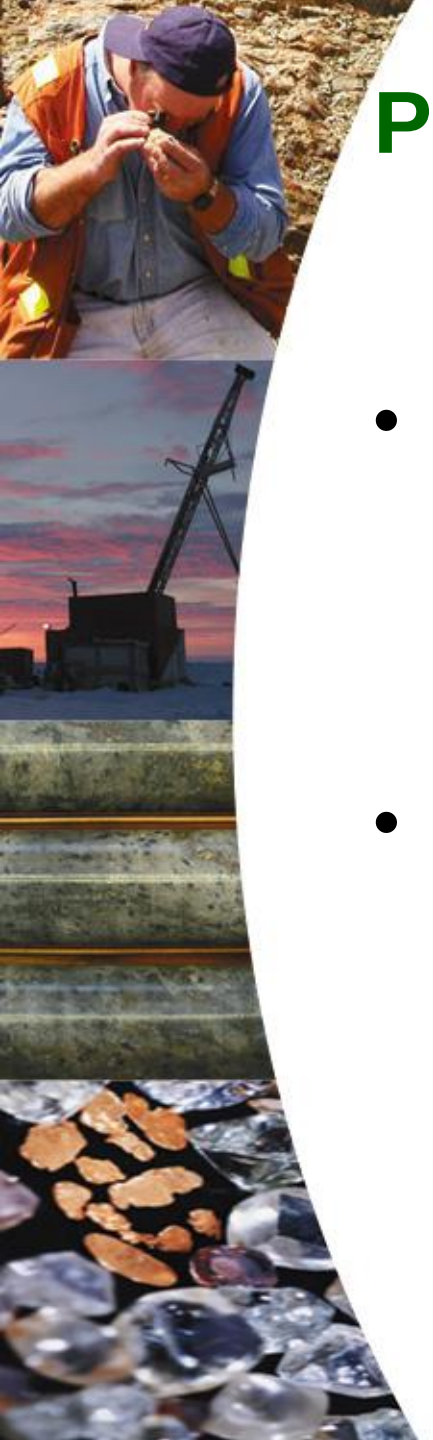
	Ministry	Agency	Government Enterprise	Private Sector
Accountability	****	***	**	*
Policy Input	****	**	*	*
Neutrality	***	****	**	*
Effectiveness	****	***	**	*
Efficiency	*	**	***	****



Public Geoscience for Exploration: What Level of Effort?

- Sufficient to sustain or increase the social and economic benefits from mineral development.
  - But how much is that?
  - What are the opportunity costs?
- Should be based on assessment of geoscience required to support exploration over 10 to 20 years.
  - Relevance
  - Coverage
  - Scale
  - Currency

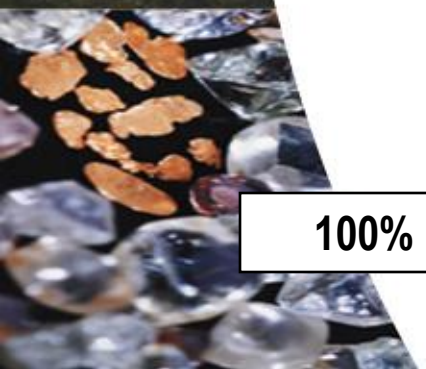
  ("shelf life", "best before date").



Public Geoscience for Exploration: Measuring the Impact

- Rigorous *and accurate* cost benefit analysis is extremely difficult
  - Uncertain assumptions. Attribution.
  - NPV of social benefits?
- Preferred approach
  - Use ***Results Chain*** to demonstrate cause and effect.

Public Geoscience for Exploration: Results Chain

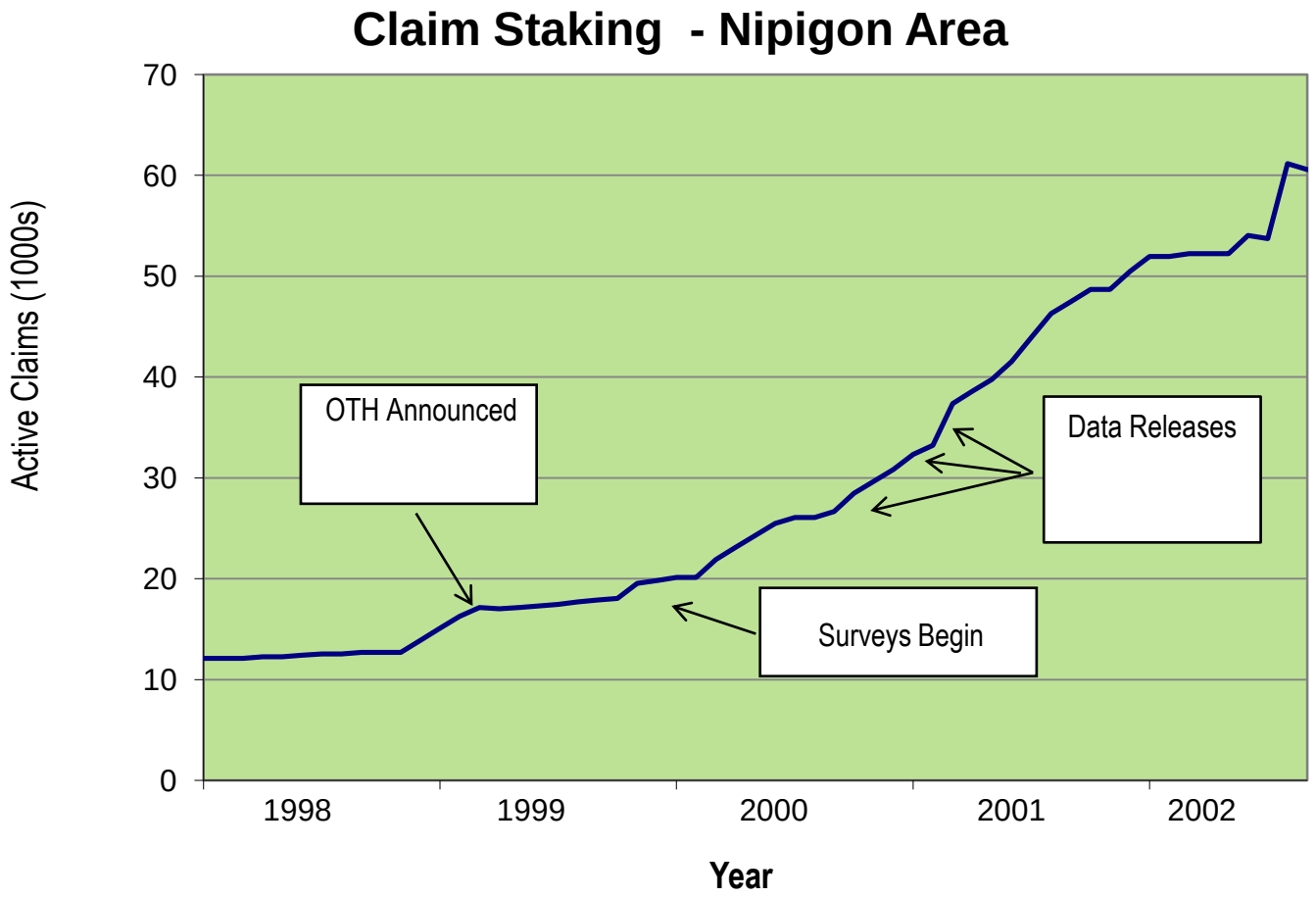


Government Geoscience → **Private Sector Exploration** → **Discovery Development Production** → **Social Benefits**

Outputs	**Outcomes:** Immediate	Intermediate	Final
Maps Reports Data Advice	•More Exploration •Lower cost •Less time •Reduced risk	•Discoveries •Lower development costs •Increased ROI	•Economic Growth •Employment •Prosperous Communities •Resource rents

100% **Attribution to government geoscience** **0 – 5%**

Immediate Outcome: Exploration Activity



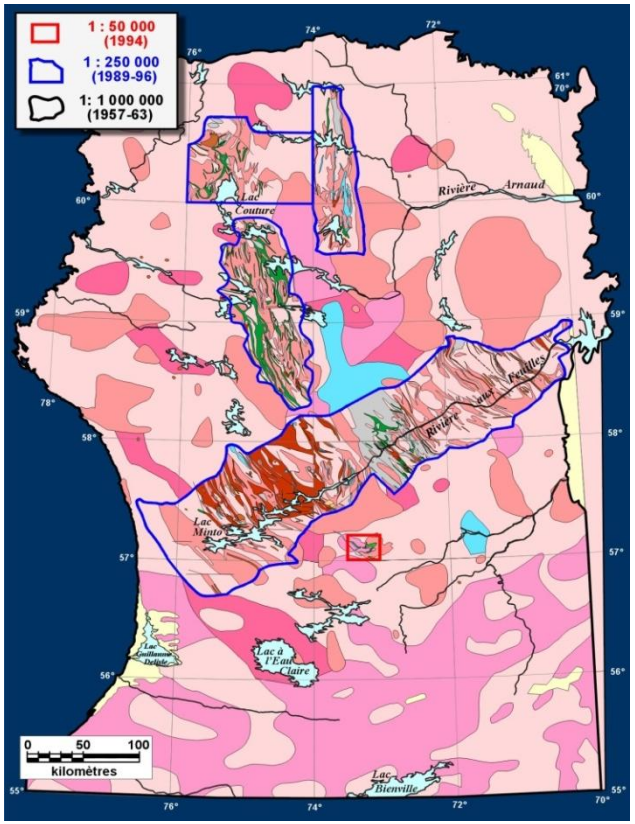
Operation Treasure Hunt , Fyon et al (2002)

Immediate Outcome: Exploration Spending

Every $1 million of government investment to enhance the geoscience knowledge base will likely stimulate $5 million of private sector exploration expenditures [over the medium term]……(Boulton, 1999).

- Based on 13 earlier studies in Canada and Australia
- Supported by 11 subsequent case studies
- Reasonable "rule-of-thumb", *but* depends upon:
  - Location (lower in remote areas)
  - Timing in business cycle (higher during peaks)
  - Scope of geoscience program (*local* increase not *necessarily* reflected in *total* exploration spending).

Geoscience Stimulates Exploration: Grand Nord Case History



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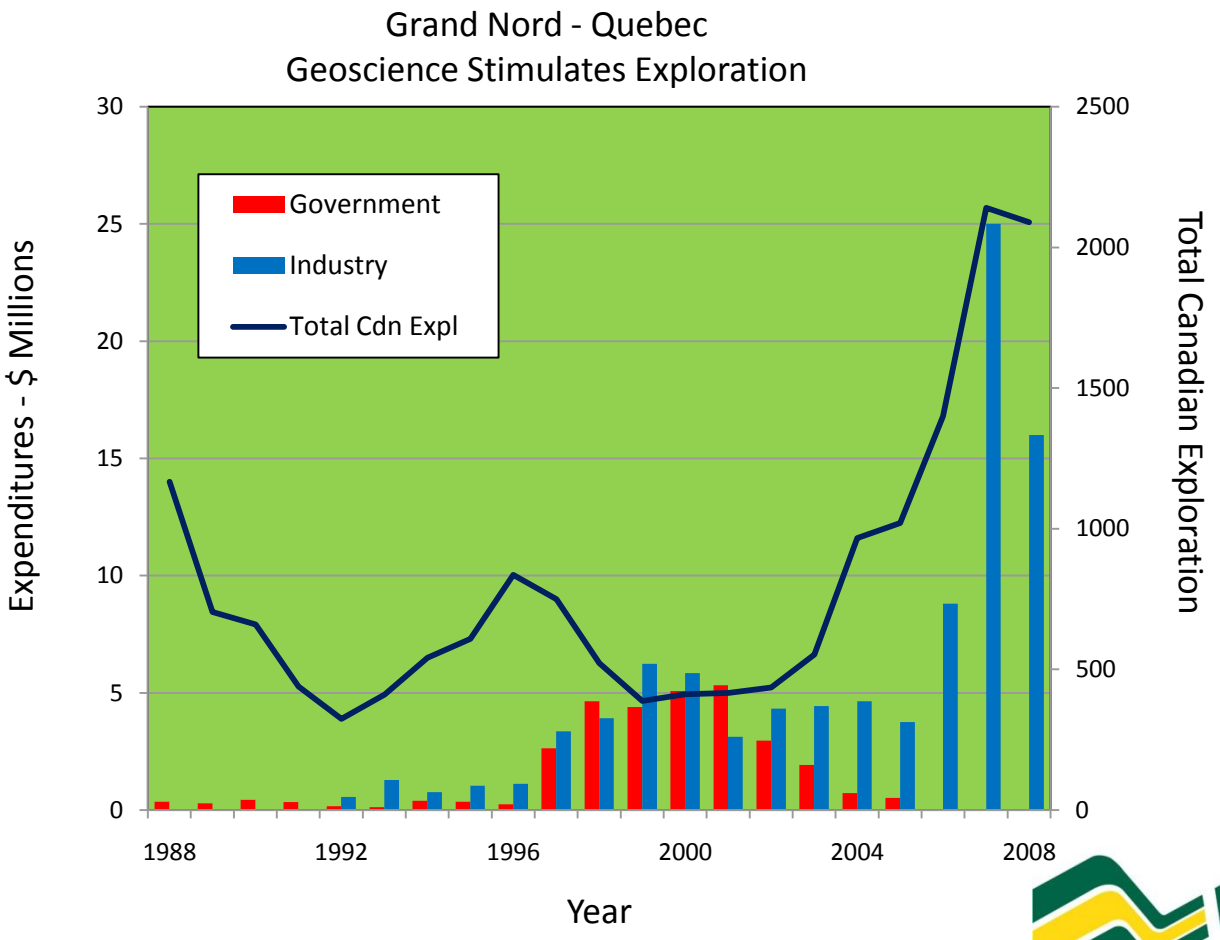
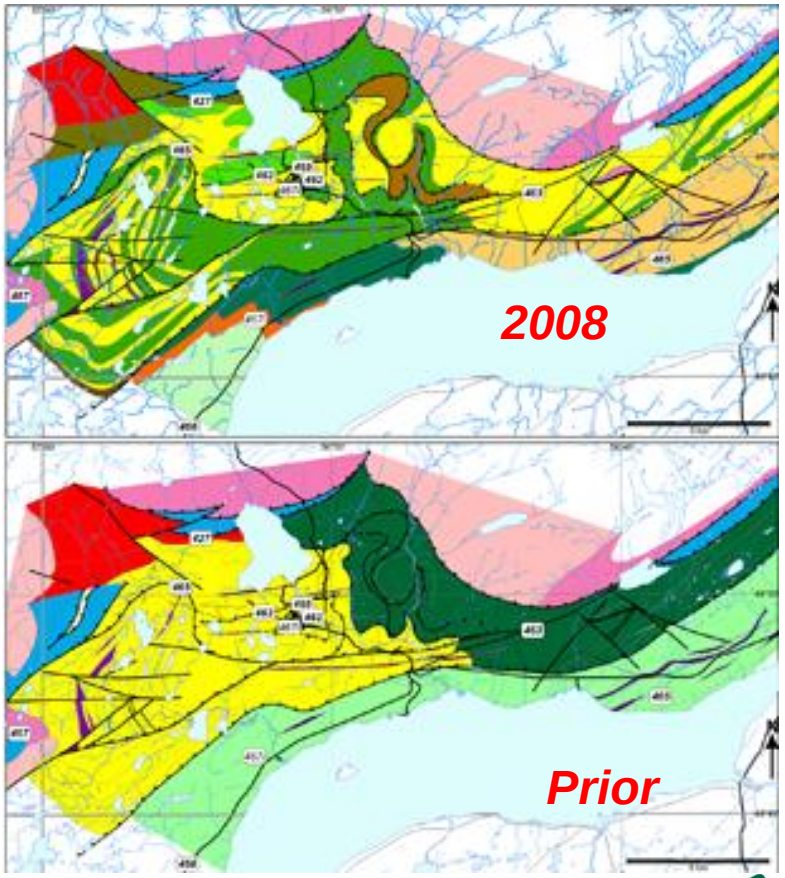


Maurice et al, 2009

Immediate Outcome: Lower Cost

- Industry users confirm geoscience increases exploration **efficiency**
  - No need to duplicate common information
  - Spend less eliminating low potential areas
- Amount of increase rarely quantified
  - 5%, 20%, more?



Immediate Outcome: Reduced Risk

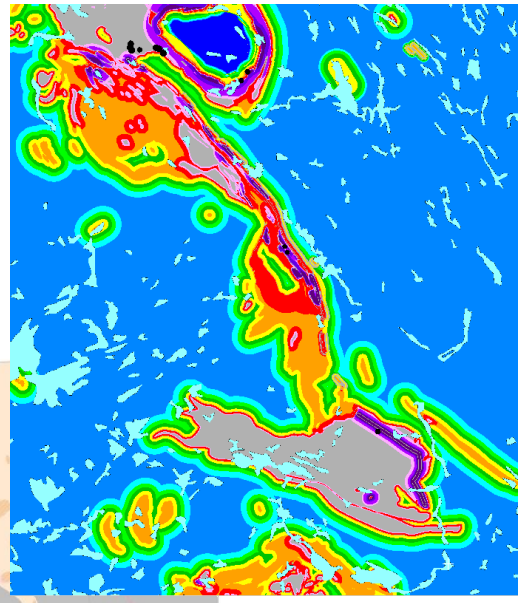
- Probability of Occurrence

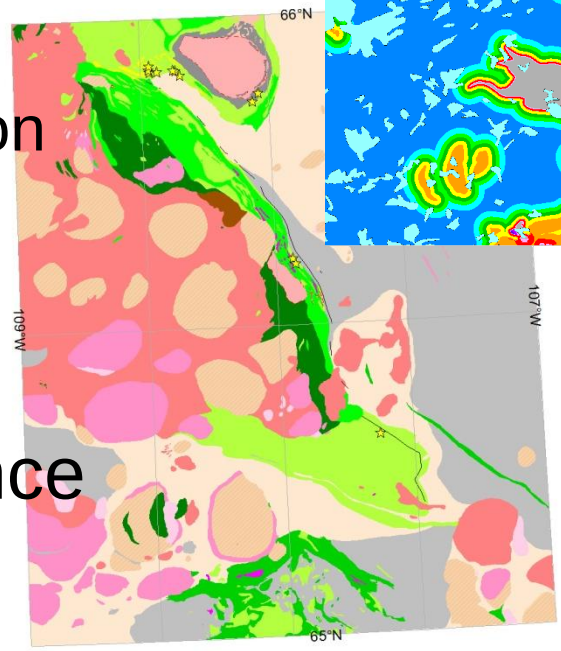
  $P_s = p_1 \times p_2 \times p_3 \ldots \times p_n$

  VMS Model, e.g.

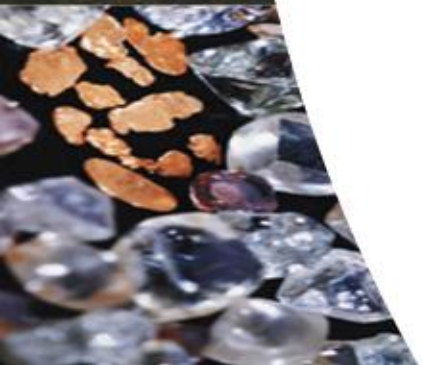
  1. Lithology
  2. Subvolcanic intrusion
  3. Semi-conformable alteration

- Some p_i's evaluated from public geoscience information



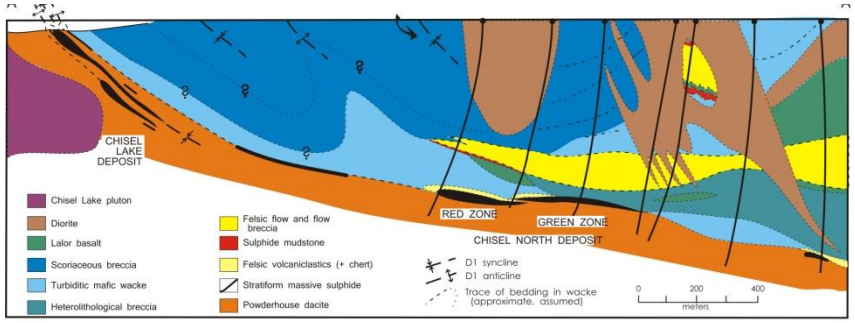


Hackett River, NT

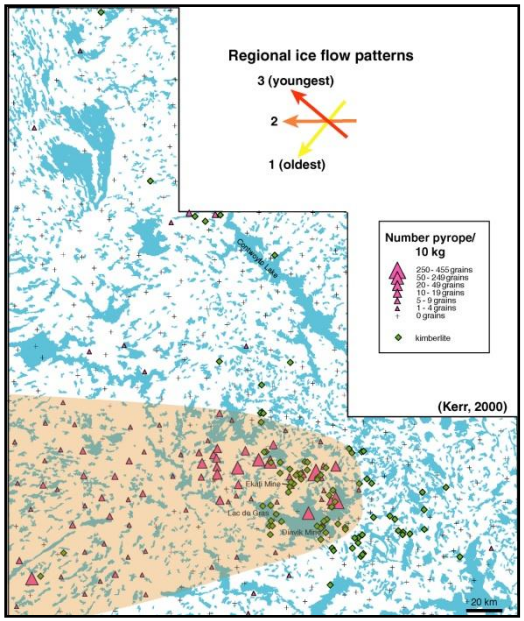


Intermediate Outcomes: Discoveries

- Mostly anecdotes – government survey directly reveals target
  - Voisey's Bay
- More typical role in supporting decision-making poorly documented
  - Ekati
  - Lalor Lake



Galley et al., 1993

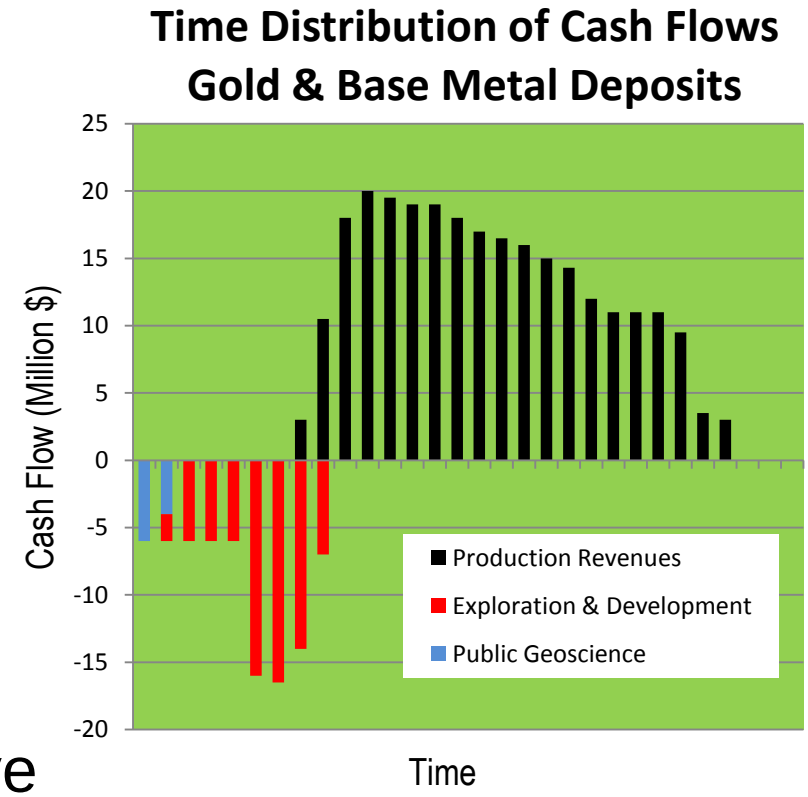




Intermediate Outcome: Return on Private Investment

Mackenzie et. al (1988)

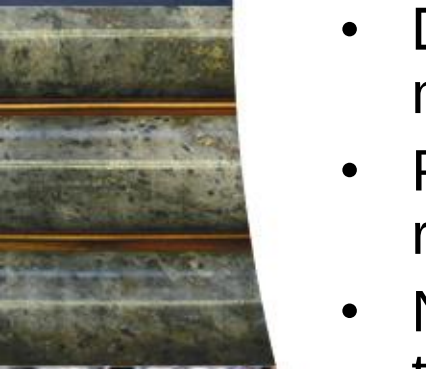
- Case study: 18 Newfoundland base metal and gold discoveries
- Assume government geoscience spending reduces average discovery cost by $10M
- Increases ROI by 25%, EV by 50%
- Public geoscience has the greatest impact of five policy alternatives
- And it's "reusable"!



Final Outcome: Social Benefits

- Mining creates wealth
  - But how much is attributable to geoscience?
  - Amounts up to 5% often suggested.
- Governments recover a share of economic rents through royalties and taxes. In Canada, from 2004 to 2008:
  - Government revenues from mining $5.5 billion/year
  - Governments spent $80 million/year on mineral-oriented geoscience, or about 1.5% of revenues.

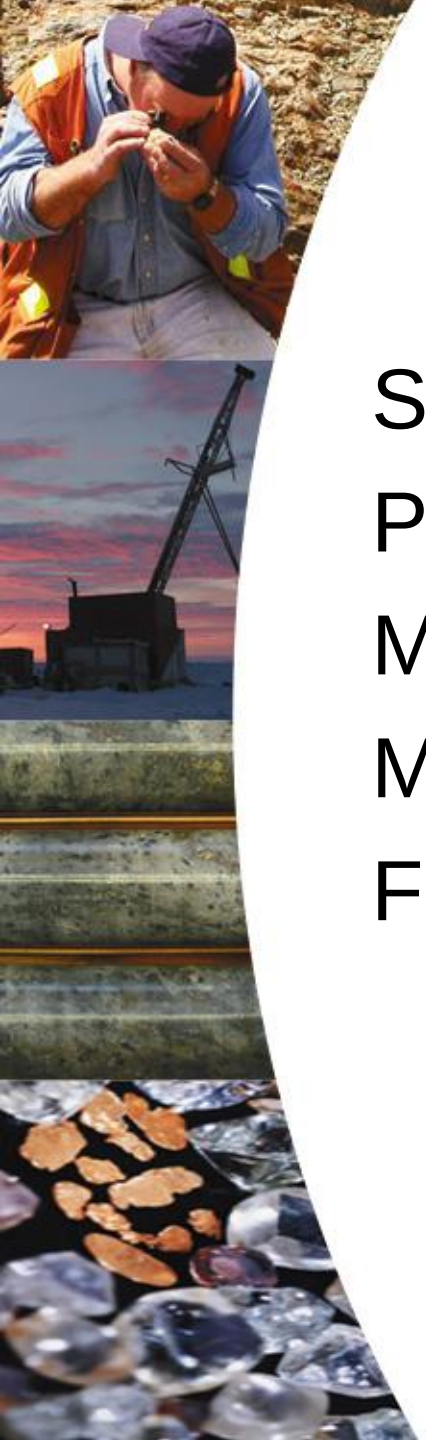





Conclusion:
A Work in Progress

"…it is important to understand that the geoscience mapping of the Canadian landmass will never be 'finished'. …. it will always be a work in progress." Ward et al. (1999).

- Despite a long "shelf-life", scientific advances gradually make geoscience information less useful
- Progressively more detailed maps and data are required as exploration areas mature
- New geoscience information spurs new exploration thinking
- **The combination of publically available high quality geoscience and assessment files at little or no cost to the end user enhances discovery probabilities.**



Acknowledgements

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