

Geoscience needs for Geothermal Energy Development

Western Canada Workshop

Vancouver, BC

October 16-17 2008



Workshop topics

- Geoscience needs for high-temperature geothermal development (electric generation or thermal heat)
- Out of scope: Geoexchange systems (shallow geothermal production retrieving stored solar or shallow groundwater heat with heat pumps)



Key questions for the workshop

- What are the characteristics of key geothermal energy resources and tools?
- What are the geoscience needs (e.g. knowledge gaps) to support geothermal energy development?
- What could be the role of a governmental geological survey in addressing these geoscience needs?



Is there potential for geothermal energy production in Canada?



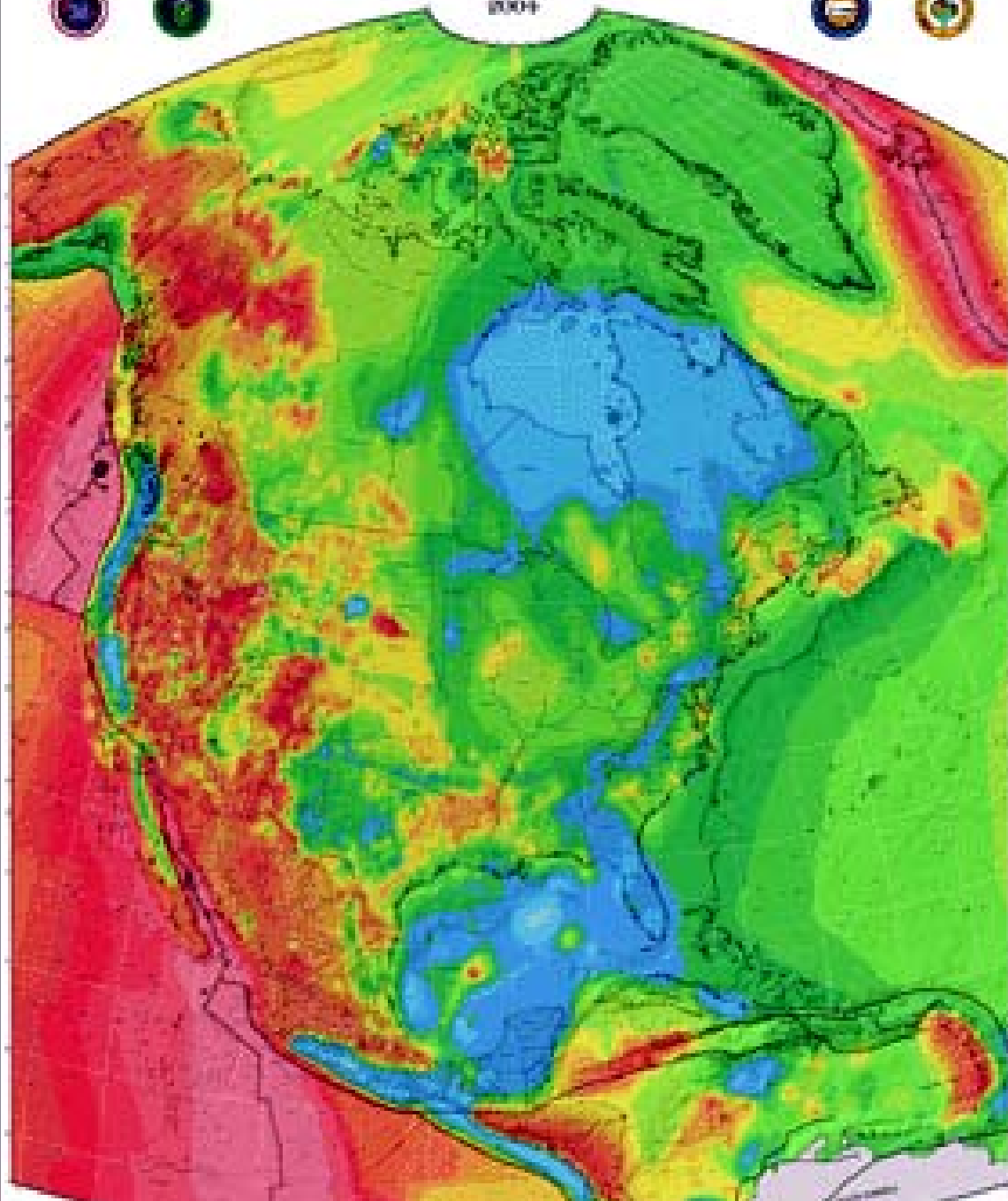
World Top 10 Installed Geothermal Electric

Country	1990 MWe	1995 MWe	2000 MWe	2007 MWe	% of top 10	Growth per year 2000- 2007
USA	2774.6	2816.7	2228	2,687	29%	2.94%
Philippines	891	1227	1909	1,970	21%	0.46%
Mexico	700	753	755	953	10%	3.75%
Indonesia	144.8	309.8	589.5	992	11%	9.75%
Italy	545	631.7	785	811	9%	0.47%
Japan	214.6	413.7	546.9	535	6%	-0.31%
New Zealand	283.2	286	437	472	5%	1.14%
Iceland	44.6	50	170	421	5%	21.09%
El Salvador	95	105	161	204	2%	3.82%
Costa Rica	0	55	142.5	163	2%	2.06%
Total top 10	5692.8	6647.9	7723.9	9208	100%	2.74%

Canada's total Electric generation capacity was 111000 MW in 2000, none from geothermal

GEOHERMAL MAP OF NORTH AMERICA

2004



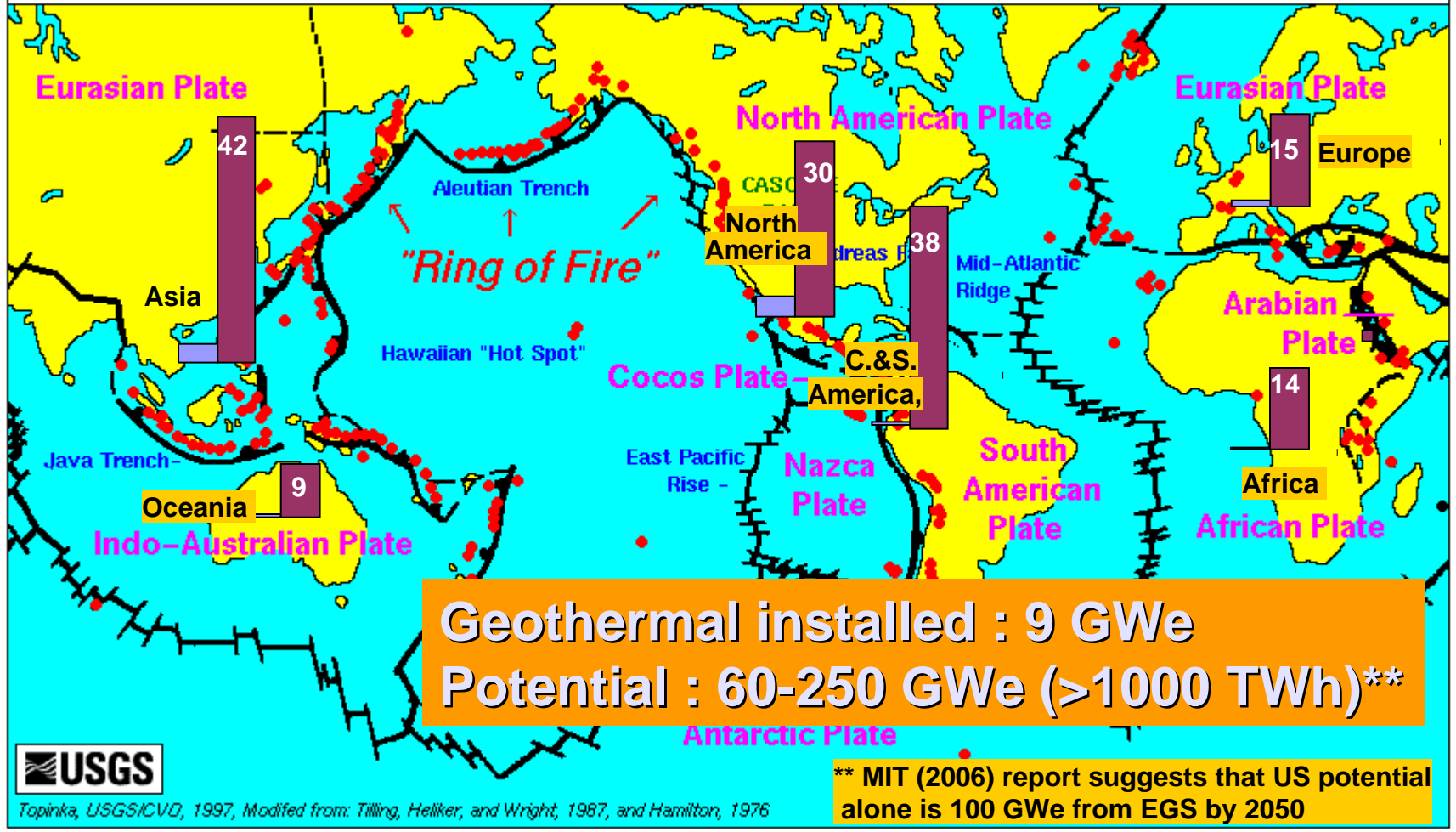
•Is there potential for geothermal energy production in Canada?

North America:
Very favorable context:
Geology
Scientific
Industry
Economy
Policy : Energy & CC

Geothermal for Electrical generation by continent

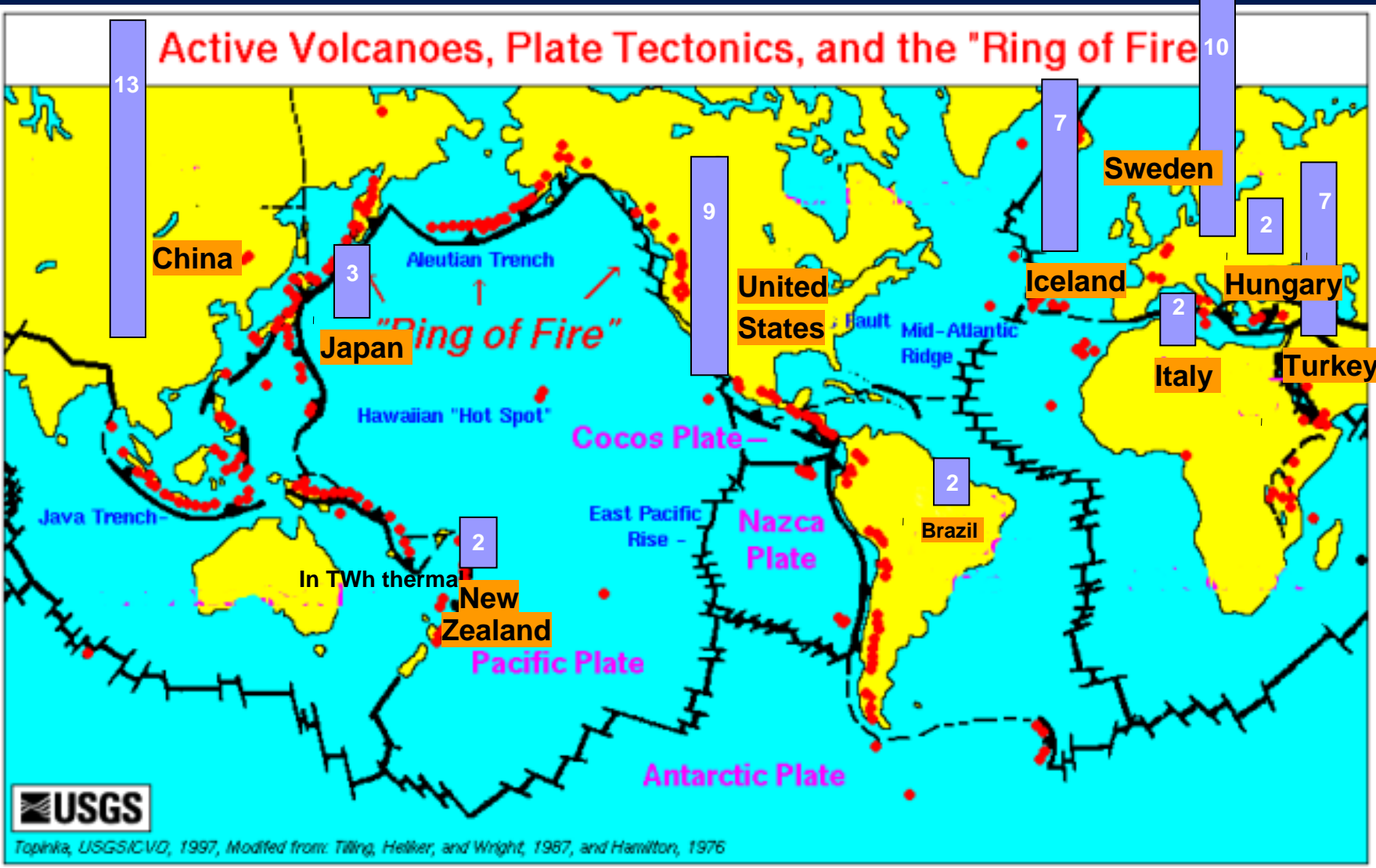
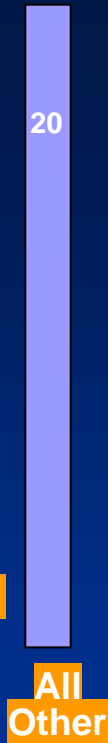
Total geothermal electric 57 TWh/yr (2005 numbers)
 Total Canada Electricity 609 TWh/yr
 Total World Electricity 17350 TWh/yr 1 GWe installed = approx 5 TWhe (50%)

Active Volcanoes, Plate Tectonics, and the "Ring of Fire"



Sources: <http://energy.senate.gov/public/ files/testimony.pdf> (Iceland president testimony to US Senate 2007)
<http://www.eia.doe.gov/emeu/international/electricitygeneration.html>

Thermal Geothermal produced 76 TWh/yr (2005)



What are the characteristics of key geothermal energy resources and tools? – Topics to discuss

Geothermal resources in Western Canada

- **High temperature volcanic belts**
- **Sedimentary basins**
- Deep Fluids systems (crustal circulation, thermal springs, etc.)
- Hot dry rocks

Technology, tools, databases, maps

- Enhanced Geothermal Systems
- **Geothermal prospecting tools**
- Geothermal: State of geoscience database and mapping in Canada and British Columbia and future needs



What are the geoscience needs (e.g. knowledge gaps) to support geothermal energy development?

- Geoscience supports governments (resource assessment, regulations, Clean energy and GHG policy)
- Geoscience supports exploration and development of mineral and energy resources by reducing economic risks
- Geoscience reduces environmental risks of resource development



What could be the role of a governmental geological survey in addressing these geoscience needs?

- Maps or atlas of geothermal potential?
- New databases?
- Supporting industry with geotechnology and method development?
- Supporting extra-mural research in universities?
- Developing an integrated national geothermal research program?
- Bringing lessons learned to home from leading geothermal countries?



Developed countries with potential invest in Geothermal Research

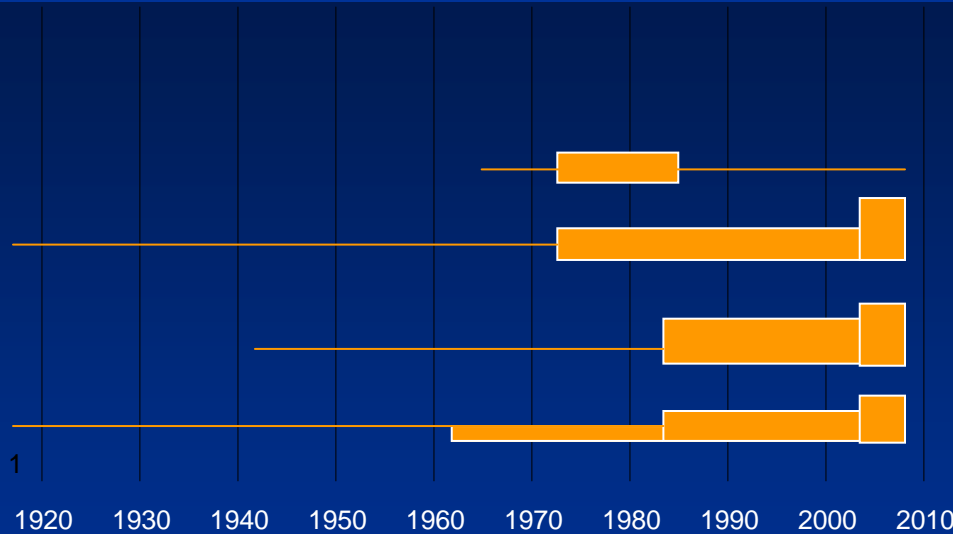
Some examples- Long- term research and Exploration

Canada

USA

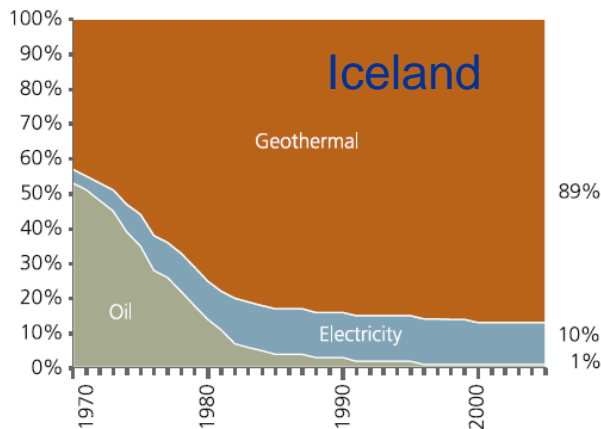
Iceland

France

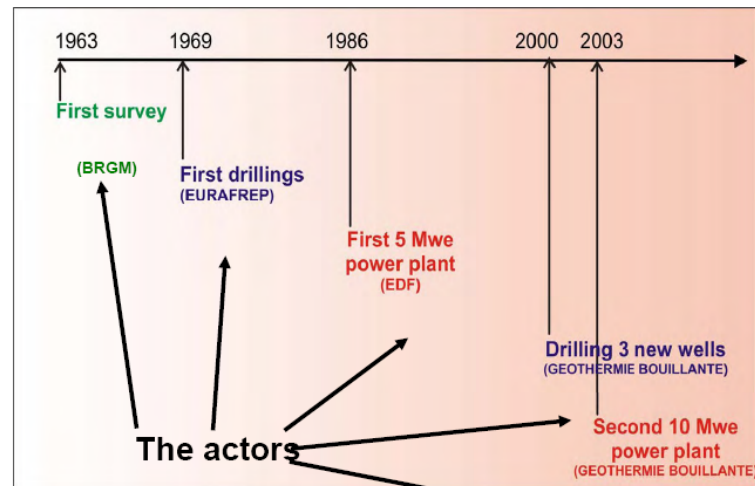


First geothermal power plant, 1904, Lardarello, Italy.

Fig. 4. Relative share of energy resources in the heating of houses in Iceland



The Bouillante geothermal exploitation



France

Workshop Agenda

Day 1

- Background: BC context, GSC past program
- Key resources
 - Break out groups and summary

CANGEA dinner

Day 2

- Key technology, tools and datasets
 - Break out groups and summary
- Wrap up



Geothermal potential

	Installed Capacity (MWe 2005)	Potential (MWe)	%	% Future
North America	3,517	30,000	39%	20%
Asia	3,290	42,000	37%	28%
Europe	1,124	15,800	13%	11%
Oceania	441	9,000	5%	6%
C. & S. America	424	38,000	5%	26%
Africa	136	14,000	2%	9%
World Total	8,933	148,800		