CanGEA
Canadian Geothermal Energy Association

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Outreach & Membership Director

Understanding Geothermal

- Crucial variables to successful development
  - Heat (resource)
  - Water (medium)
  - Flow/Permeability
- Need to understand all variables; lots of research for Canadian resource
- Recent developments: Enhanced Geothermal Systems or EGS

Geothermal Energy!

- Renewable, reliable source of electricity and heat
- Geothermal power sources produce long term revenues with no fuel costs and near zero emissions.
- Small environmental footprint compared to other power sources
- Geothermal power plants can continuously deliver power with >95% capacity
- Preferred choice of renewable energy for many utilities

- **HIGH RISK** to develop Resource!

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From Earth's Heat Energy to Electricity Production

CURRENT STATE OF GEOTHERMAL INDUSTRY IN CANADA?

Canadians Everywhere

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- Major resource trading partner; key supplier of energy to North America
- Canadian geothermal influence
  - Companies (TSX-V: SGP, Western Geopower, Polaris, NGP…)
  - Scientists and researchers
  - Investment Community (Jacob & Company, Dundee)
- Working for geothermal worldwide, need to bring the knowledge resource home

Canadian Energy Potential?

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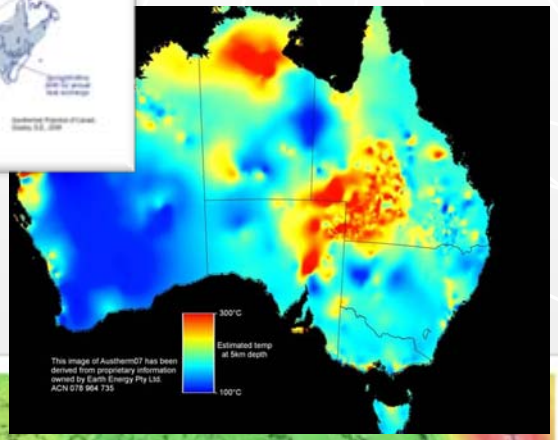
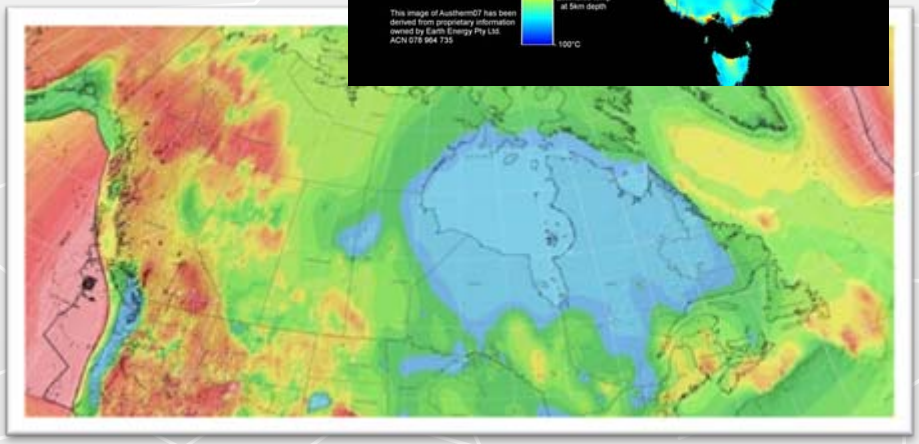
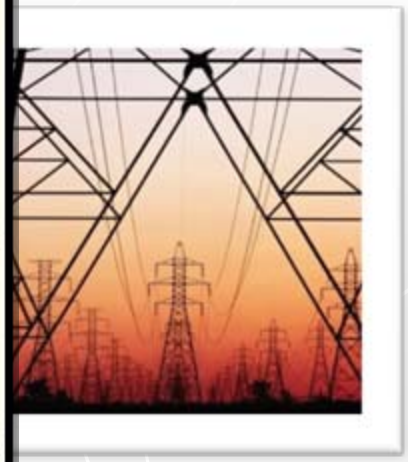
- 0 MW: Industry needs jumpstart
- Numerous estimates of MW potential
- Need unbiased heat resource number from respected third party (GSC, BC EMPR...)
- 1 MW would supply 800 Canadian homes





Electricity/Project Potential



- Meager Creek-300MW?
- Pebble Creek-Mt. Cayley
- Canoe HotSprings
- Harrison Hot springs
- Mining Opportunities
- Oil & Gas Applications
- General estimates not helpful for individual project financing

Electrical energy from geothermal resources is officially classified by Natural Resources Canada as a 'renewable' energy, meaning that they operate without destroying finite natural resources.

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BRINGING GEOTHERMAL TO CANADA

Building Critical Mass

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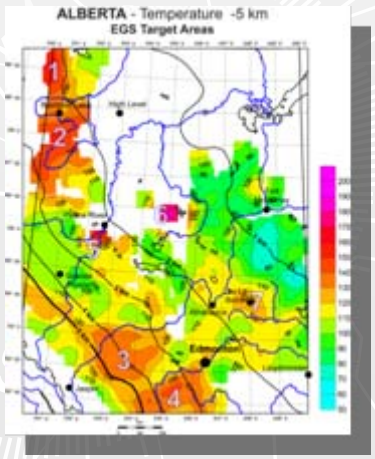
- Re-vitalization of CanGEA: Major corporate industry involvement including geothermal, oil & gas companies and renewed interest in renewable energy
- A coming together of industry, academia, government and grassroots program: Individuals and volunteers
- **Need SIGNIFICANT assistance to move industry forward in Canadian market**

SGP
nexen
Christopher James Gold Corp
ALTAROCK Energy Inc
Western GeoPower Corp.
YUKON ENERGY
ICELAND AMERICA ENERGY
WellDunn
Profit Today for a Green Tomorrow
GLITNIR
JACOB & COMPANY Securities Inc.

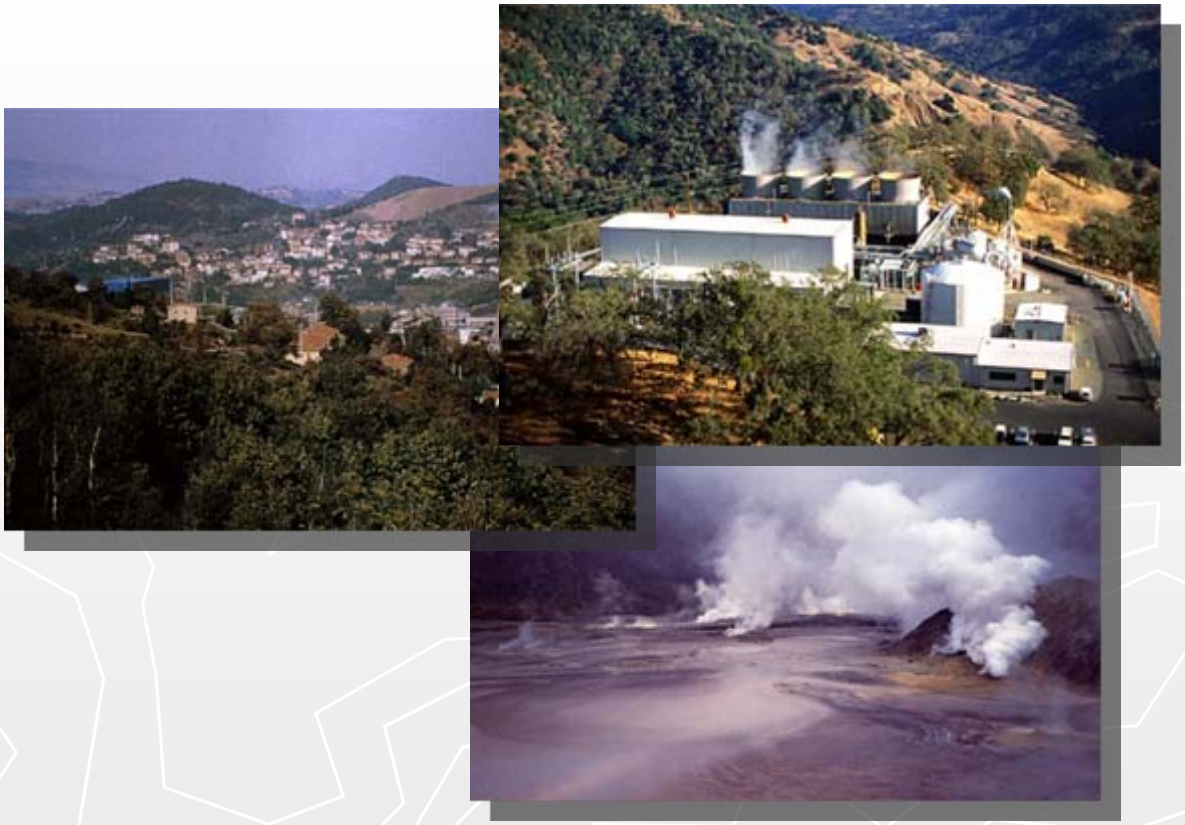
Starts with Research



- University of British Columbia:
  - Yellowknife & Sudbury (abandoned mines)
  - 4 MWt greenhouse project
  - BC EMPR Waste water potential
  - EGS Research
- Queen's co-production research (oil & gas field thermal waters)
- Database accumulation (BC Hydro, BC EMPR, CanGEA, GSC)
- GSC data review: Dr. Jessop
- EGS Study for Alberta: Dr.Moore, Dr. Majorwicz with Alberta Energy Research Institute
- Company exploration programs in BC, Alberta and Yukon
- International Policy Review – CanGEA/WellDunn

Follow Worldwide Lead

- >3,000 MW in US Market
- Iceland, Italy
- Leaders- Australia, Germany, New Zealand
- Proven Technology



Opportunity to learn from other countries and their successful geothermal policies

Industry development: Example -Australia

39 companies have applied for 347 licences covering >257,000 km^2 in Australia

10 ASX-listed Hot Rock Companies

Work programs (2002-13) worth A$996 million

Australian Governments have committed > $100 million for research and demonstration since 2000

Geothermal Industry Development Framework and Technology Roadmap in progress

Cost Benefit Analysis – 1:15 Every dollar that government puts in earns royalties and taxes of $15 over 10 years

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WHAT DOES INDUSTRY NEED?

Program for Success

- *Reduce RISK: Financial/Drilling/Project*
- Central database of existing data
  - Mining & Oil and Gas
  - BC EMPR, BC Hydro, GSC....
  - Private information
  - University research
- GIS based mapping programs
- Field research (mapping, sampling)
- Geophysics
- Continue developing drilling/subsurface dataset
- Training/education for next generation

Facilitate Exploration Research

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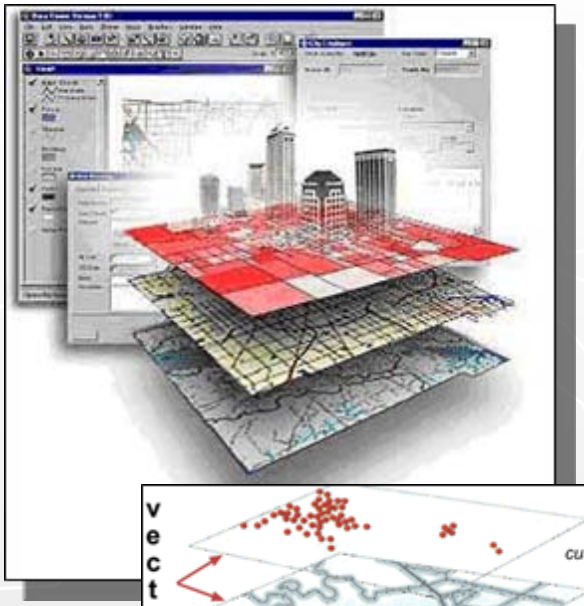
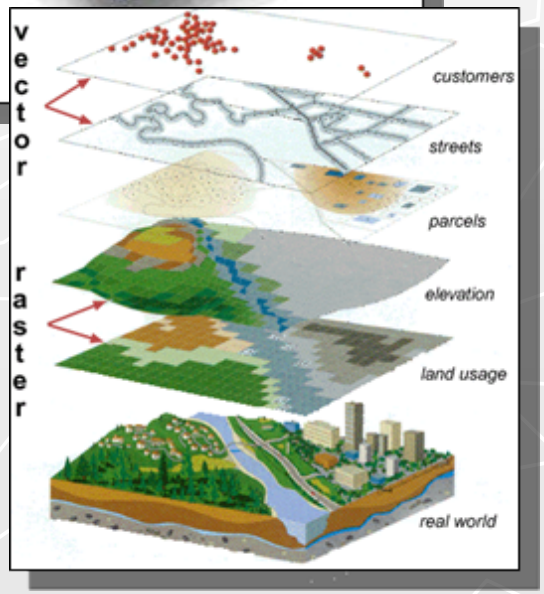
- Starts at a desk (with a phone & computer)
- Need to locate as much data as possible prior to any serious consideration
- BC Hydro reports, satellite imagery, GSC mining information, field mapping etc.
- Start to put a picture together
- Canadian dataset not centralized
- Digital database would facilitate research and lower costs: REDUCING RISK

GIS Mapping

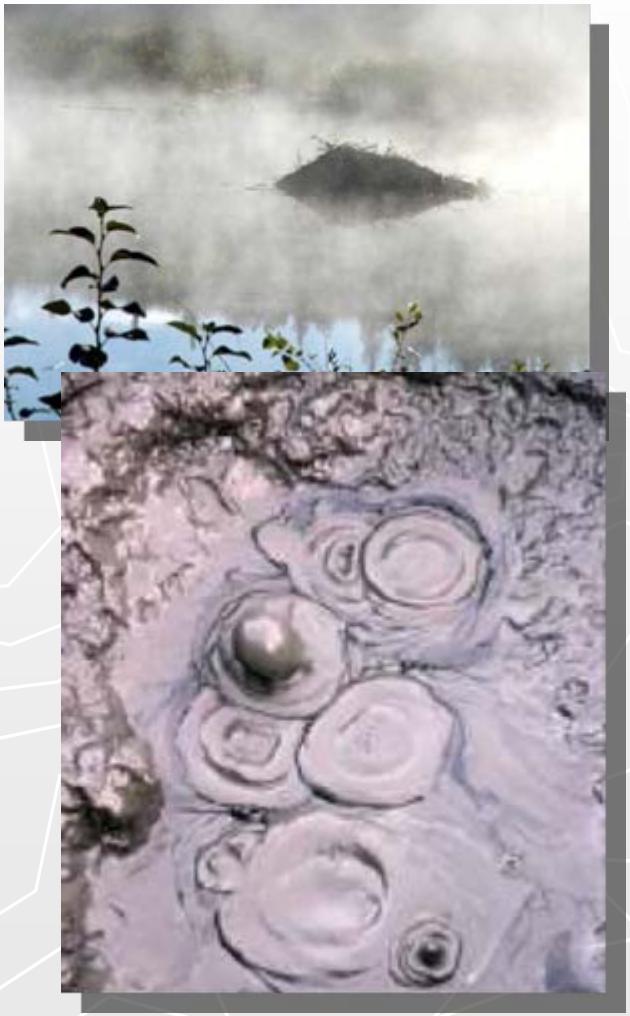
- New age in mapping technology
- Geographic Information System (GIS)
- Layer system (BC EMPR: mining, oil & gas)
- Import datasets (ARC or shp files)
  - Well data (temp grad, locations)
  - Geology (faults, lithology)
  - Infrastructure (transmission, roads, towns…)
- Allows exploration geologists to see the patterns





Necessary Field Research

- Temperature gradient data
- Exploration for hot water/hot springs
- Water chemistry & geothermometry
- Surface geochemistry
- Geological mapping (lithology, alteration & structural)
- Fundamental in bringing necessary information to industry
- 1980's GSC geothermal funding terminated: BRING IT BACK



Geophysics Program

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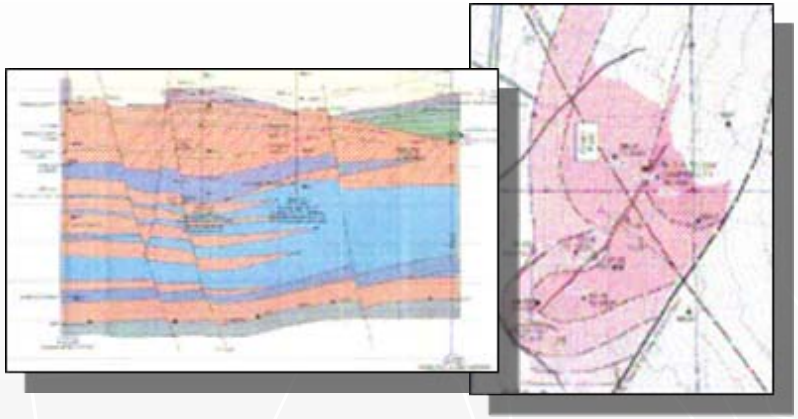
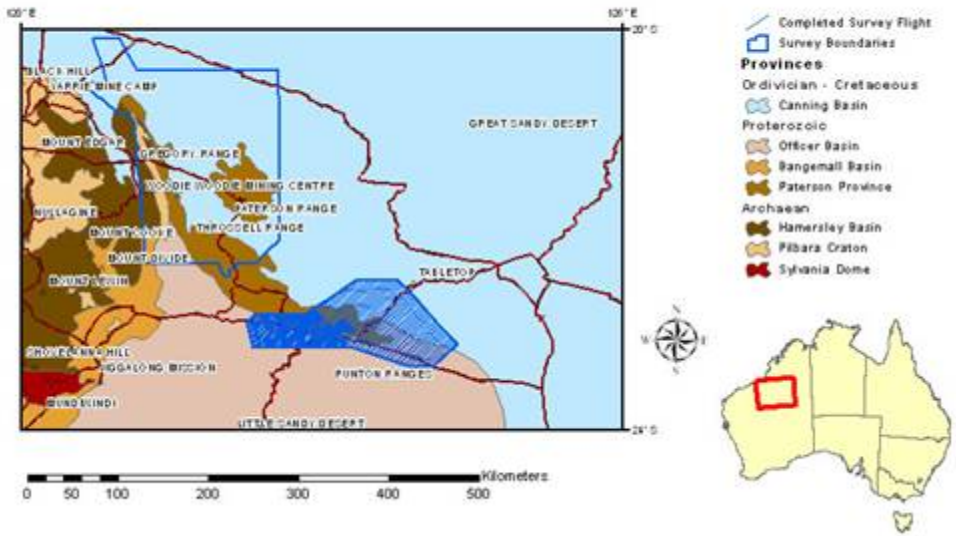
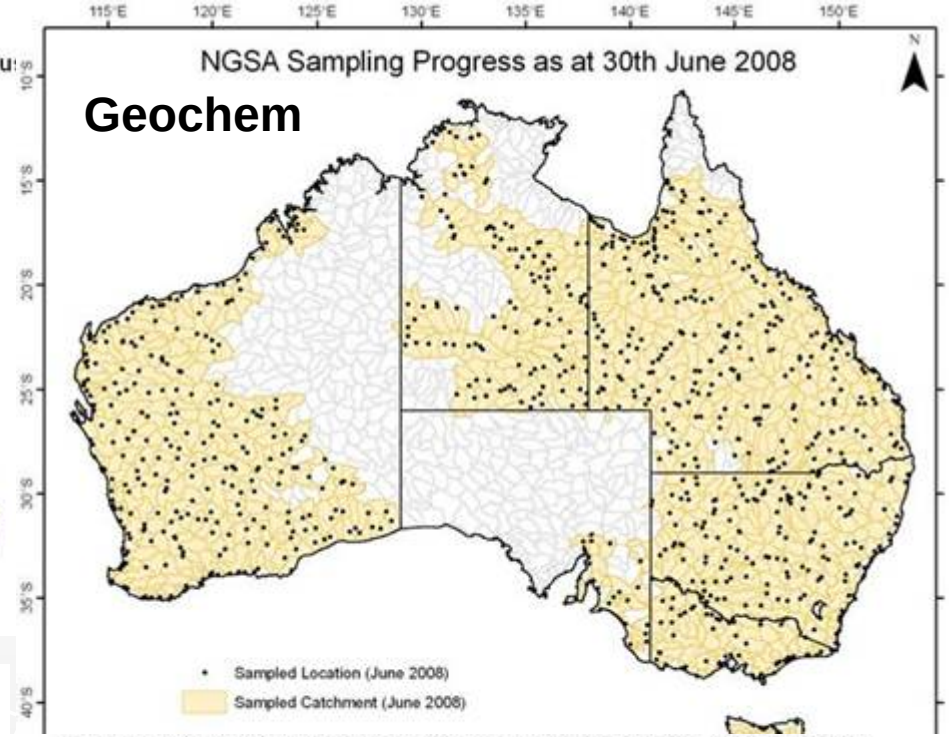


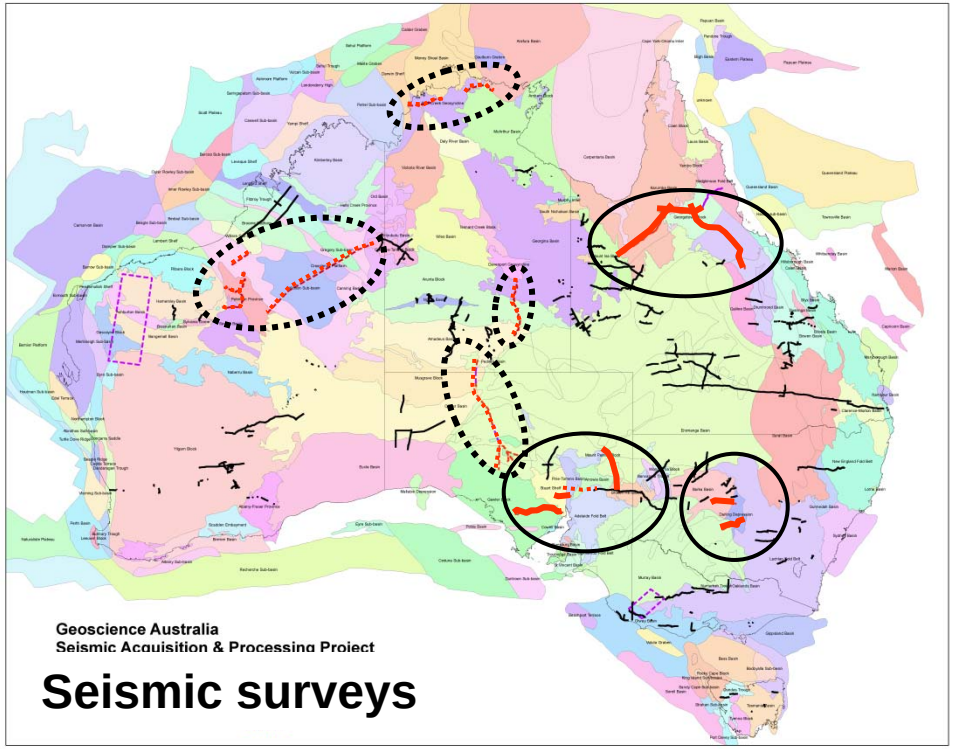
- Techniques can help us determine
  - Reservoir structure
  - Change in lithology @ depth
  - Heat flow potential & anomalies
  - Valuable tool to look into the subsurface without the drilling

- Active & Passive Seismic
- Infrared
- Gravity
- Aero & Surface Magnetics
- Resistivity
- Used in Oil & Gas and Mining exploration

Airborne Electromagnetics







Seismic surveys

Australia-Wide Airborne Geophysical Survey 2

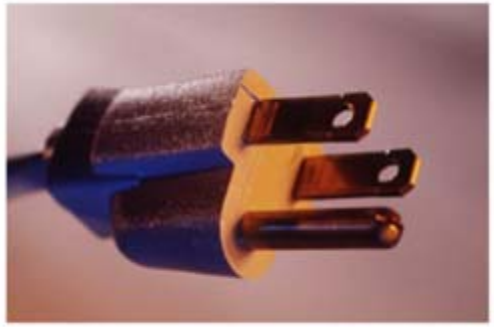
Drilling Support

- Drilling is reality: “Ground Truth” (proves or disproves all the theories)
- Shallow temperature probes
- Temperature gradient holes for reservoir delineation
- Tells us about lithology, fault system/structural environment, heat resource, and drilling issues
- Need to improve % of successful production wells
- $5million/well or drilling insurance

- Very expensive, high risk portion of geothermal development: NEED TO REDUCE THIS RISK
- Costs & success rate can make or break geothermal exploration companies: MAKES INVESTORS WEARY

Reduce Project Risk!

- Not just drilling!
- Electricity is “perishable good” : transmission can dictate economics
- Environmental Concerns
- Cultural Issues
- Political Atmosphere
- Power Pricing
- Need quality geoscience to improve odds for geothermal industry



Support: New Geoscientists

- “Help wanted” : Next generation of GeoScientists
- Need for qualified scientists & engineers in field of geothermal
- Few courses offered worldwide (Iceland, Stanford, New Zealand)
- High % of experienced researchers near retirement age
- Opportunity to pass on the knowledge to next generation
- Fresh perspective & new ideas

Just the start...

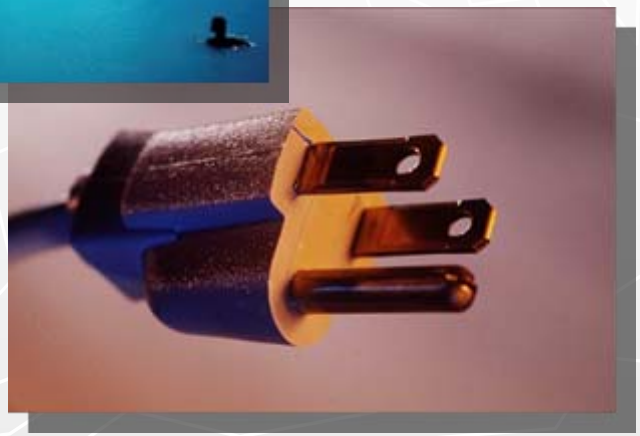
- Advanced exploration techniques of hydrothermal systems (isotope analysis)
- EGS fracturing research
- Microgeneration & <10MW drilling programs
- Pore space policy & co-production opportunities
- Granitic drill bit technology
- CO_2 heat medium
- Reservoir analysis in Canadian Cordilleran
- Increased technology transfer from other industries

General Education

- What's geothermal? Electricity?
- Amazing renewable energy resource, yet not widely recognized (including investment community)
- Resource potential only primary assessment
- Difficult to move forward with exploration and development
- Outreach & education for communities with geothermal energy opportunities
- Workshops & information available for decision makers

Helping Development

- Initial data collection and database
- Field research
- Geophysics
- GIS mapping
- Drilling program
- Researchers for tomorrow
- Education for public
- Continue to advance research



TAKEAWAY: Need to REDUCE RISK of project development to entice investment

High-Temperature Geothermal

- Base-load (>95% capacity factor)
- Domestic resource
- Mature and cost-competitive
- Produces near zero GHG emissions
- Small environmental footprint
- Sustainable resource, renewable energy
- Lowest long-term cost of all alternatives

QUESTIONS?

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