



# **New Canadian Initiative on Innovation and Mineral Exploration: Case Histories**

Presentation at SIMEXMIN, Ouro Preto

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Past President, PDAC

VP – Exploration, Avalon Rare Metals Inc.

24 May 2010, 08:30



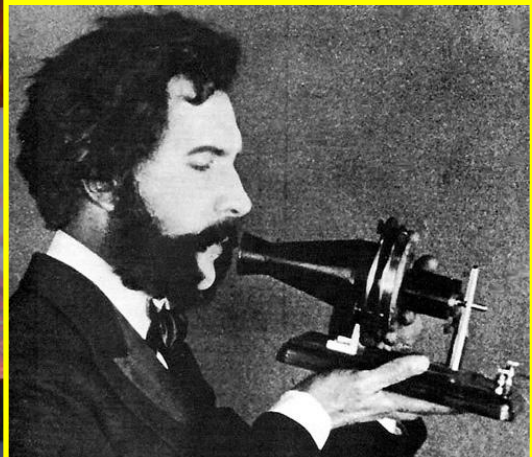


"He that will not apply new remedies must expect new evils; for time is the greatest innovator."

— *English philosopher and statesman Sir Francis Bacon (1561-1626)*



# WHAT IS INNOVATION?



- **Invention:** creating something new, but not necessarily distributing or using it.
- **Innovation:** successful application of ideas in practice
- **In business**
  - Invention is the conversion of cash into ideas.
  - Innovation is the conversion of ideas into cash.

• Alexander Graham Bell and Mike Lazaridis

• Bell Telephones and Research in Motion



# INVENTION VERSUS INNOVATION

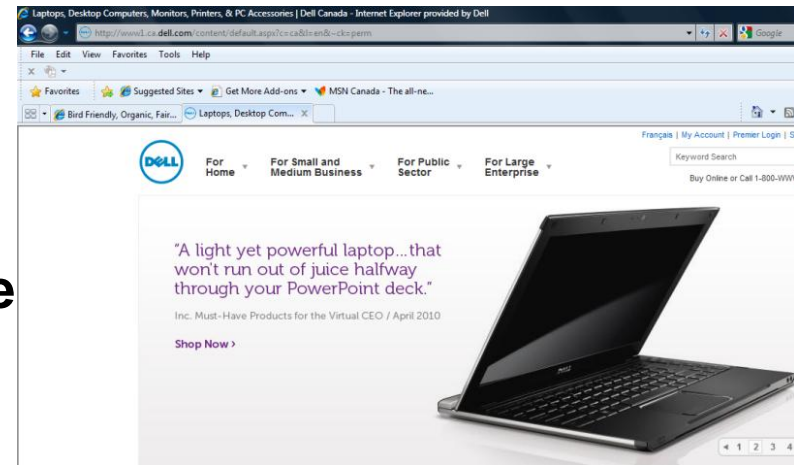
- **Xerox invented:**

- Personal computer
- Graphics monitor
- Word processing software
- Laser printer
- LAN
- Computer mouse

- **But they did NOT become market leaders in any of these**

- **Other innovators became the leaders:**

- IBM – Apple – Microsoft - Dell, etc

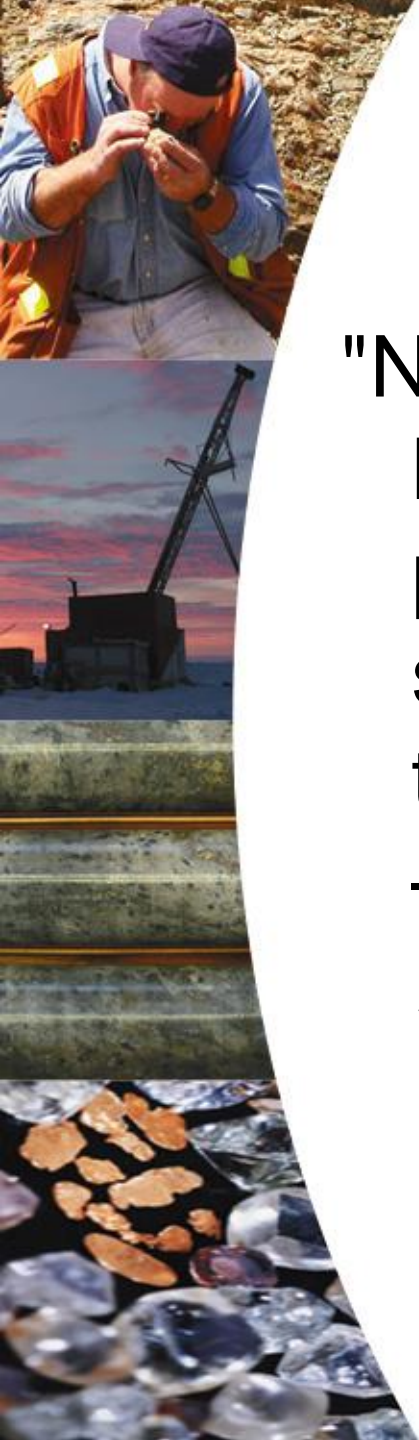


# THE “FIRST MOVER” PROBLEM

## Example: Oyu Tolgoi, Mongolia

*The “first mover” and the inventor are similar.*

- Oyu Tolgoi potential recognised by a Magma Copper (first mover) geologist
- **Magma purchased by BHP Billiton**
- BHP Billiton (second mover) did not see the potential and sold the project to Ivanhoe (third mover)
- **Rio Tinto (fourth mover) purchased interest in Oyu Tolgoi**
- Oyu Tolgoi now one of largest copper deposits in world



"Never before in history has innovation offered promise of so much to so many in so short a time."

— *Microsoft co-founder Bill Gates*



# CANADIAN MINING INNOVATION COUNCIL

- Network of industry, government and academic leaders seeking excellence in research, innovation, commercialization and education
- **In exploration: R&D initiative to develop breakthrough advances in exploration technology**
- 15 (exploration) companies have signed up
- **Initiative is just getting going**

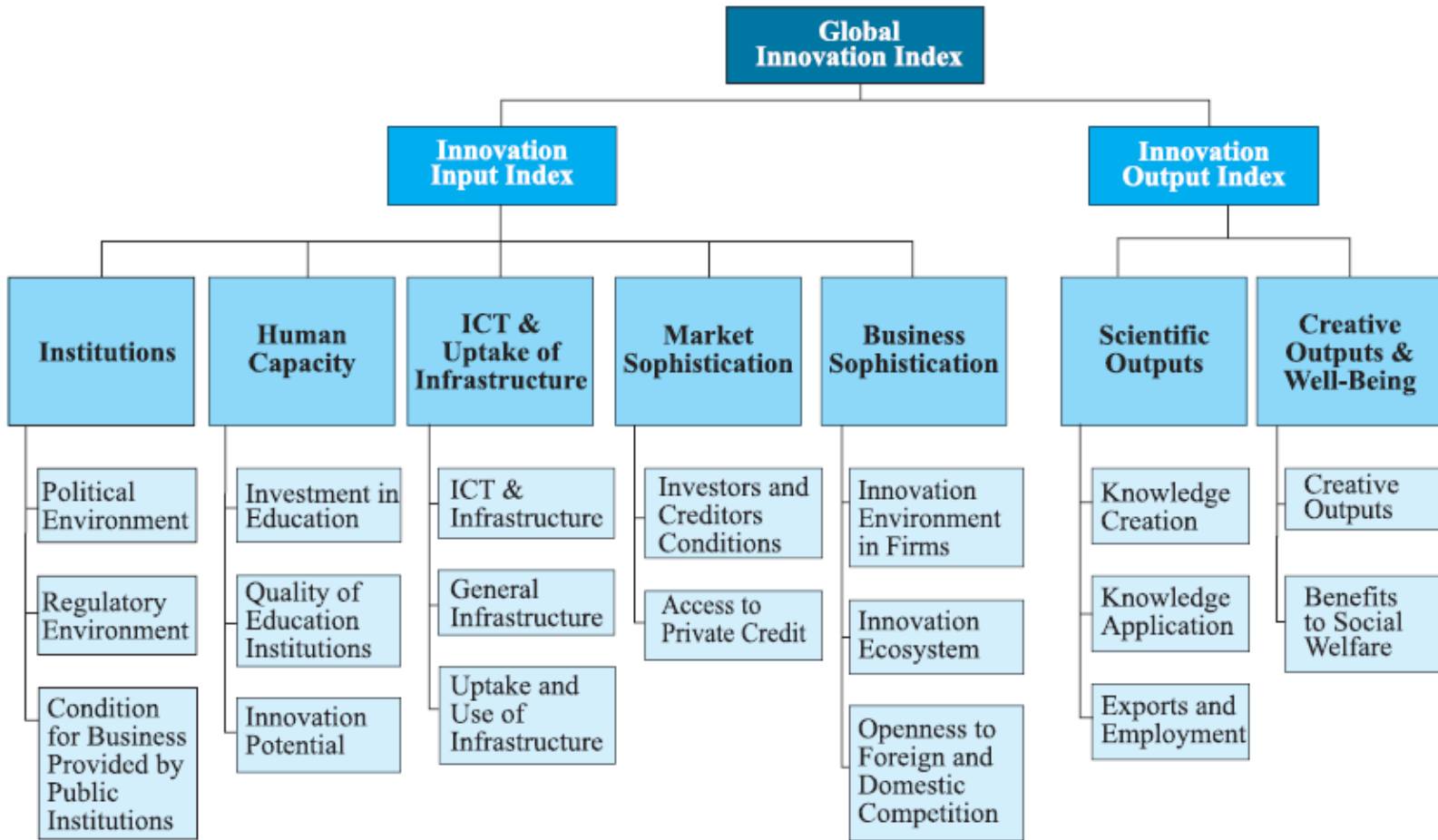




# HOW TO MEASURE INNOVATION POTENTIAL?

- Global Innovation Index  
[www.globalinnovationindex.org](http://www.globalinnovationindex.org)
- Measures
  - Inputs to innovation
  - Outputs from innovation
- And ranks countries on innovation

# GLOBAL INNOVATION INDEX STRUCTURE



- Note: A country can score differently on the Inputs and Outputs!
- If it has a good system (inputs), is the system actually working (outputs)?

# RELATIONSHIP OF INNOVATION INPUTS AND OUTPUTS

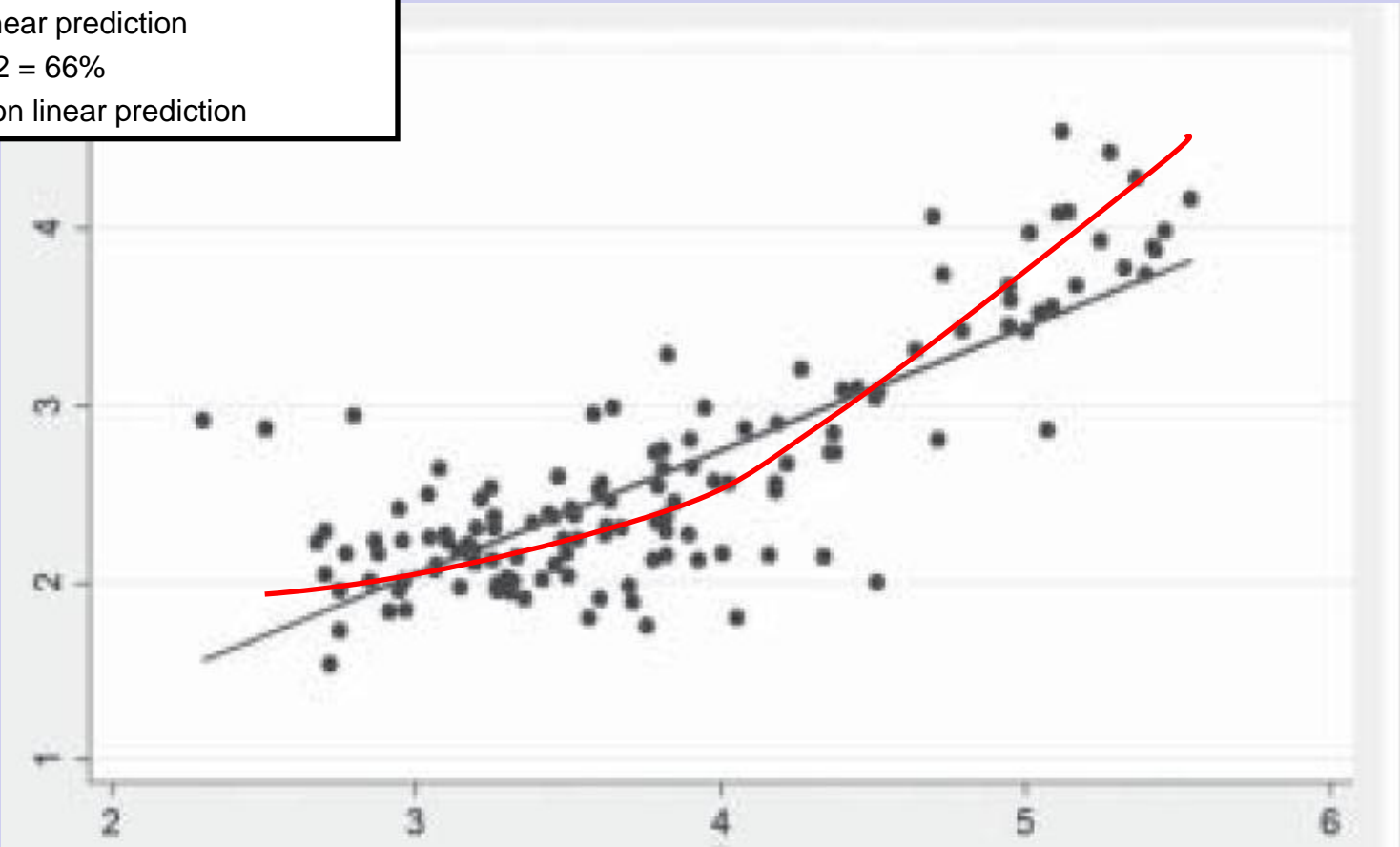
132 countries

— linear prediction

$r^2 = 66\%$

— non linear prediction

Output



Input

Source: Global Innovation Index

# RELATIONSHIP OF INNOVATION INPUTS AND OUTPUTS

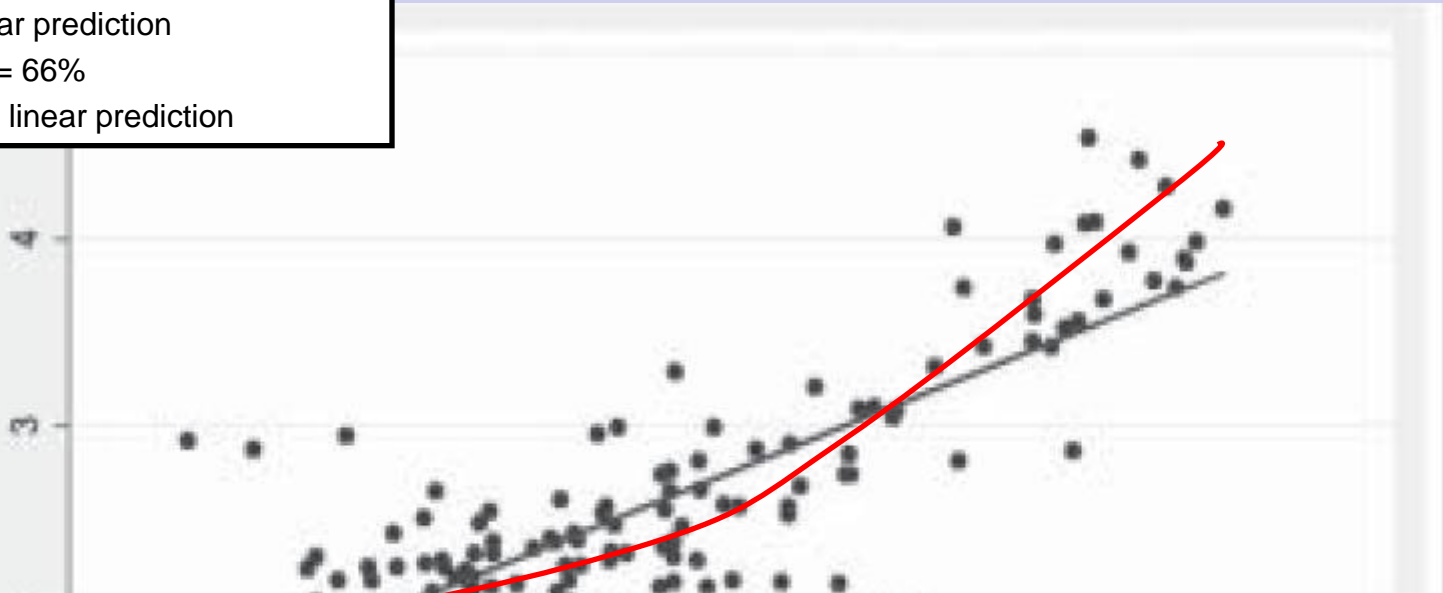
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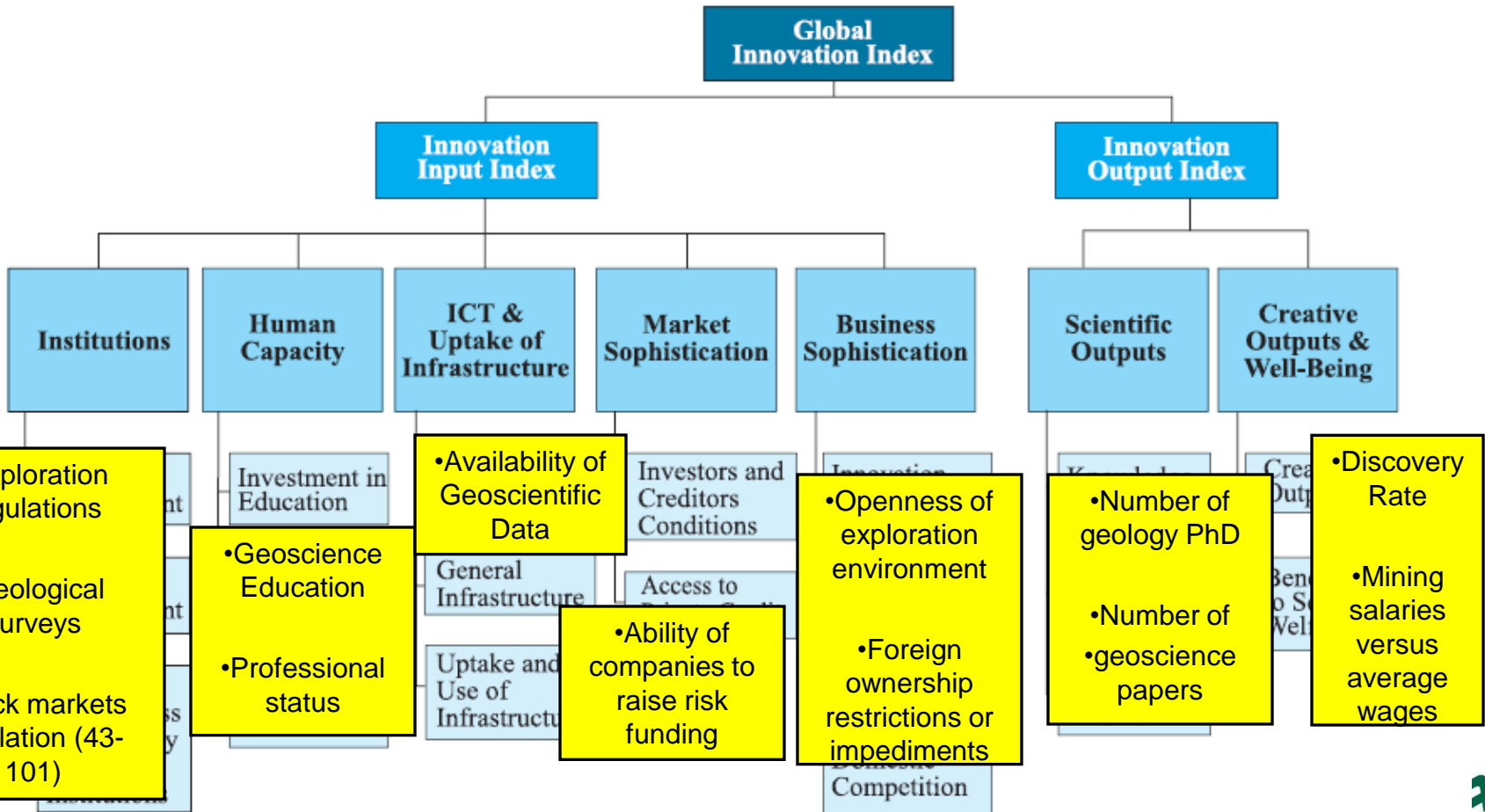
— non linear prediction

Output



- Asia, Europe, OECD, Americas: Inputs and Outputs show statistical correlation
- Africa and Arab countries: no correlation between innovation inputs and outputs

# CAN THE INNOVATION INDEX BE ADAPTED TO MINERAL EXPLORATION?



•A challenge for someone: gather this information!

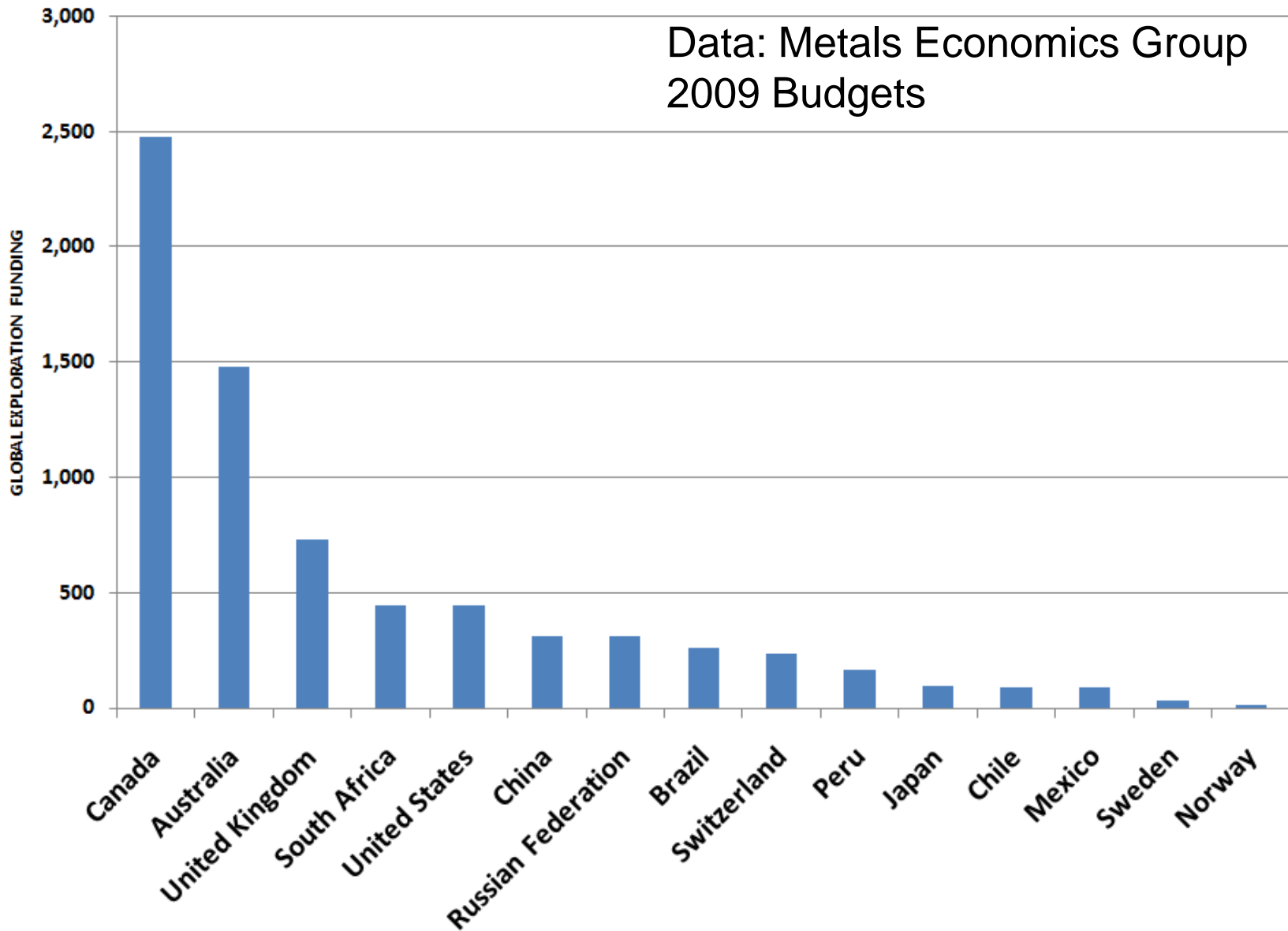


# Global Innovation Index ranks countries

- The GII ranks countries.
- For mining, there are three “types” of countries:
- Sources of funding for exploration and mining (e.g. UK)
- Countries where mining occurs but where little funding is generated for exploration & mining (e.g. Mongolia)
- Countries that both have a strong mining industry and generate funding for global exploration (e.g. Canada, Australia, Brazil)

# Source of Global Exploration Funds

Data: Metals Economics Group  
2009 Budgets



# INNOVATION INPUTS AND OUTPUTS

## Brazil, Canada, Australia

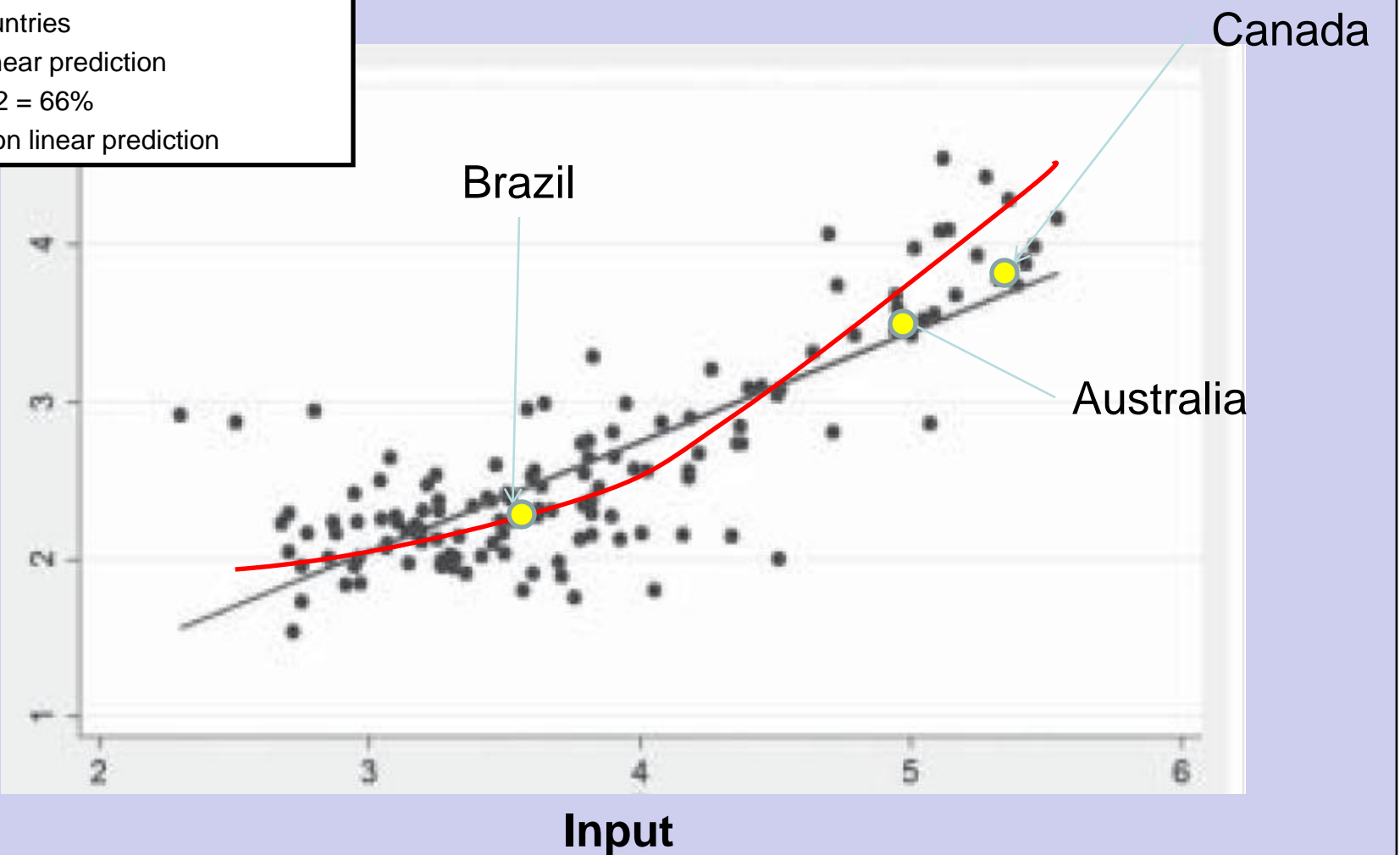
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Input

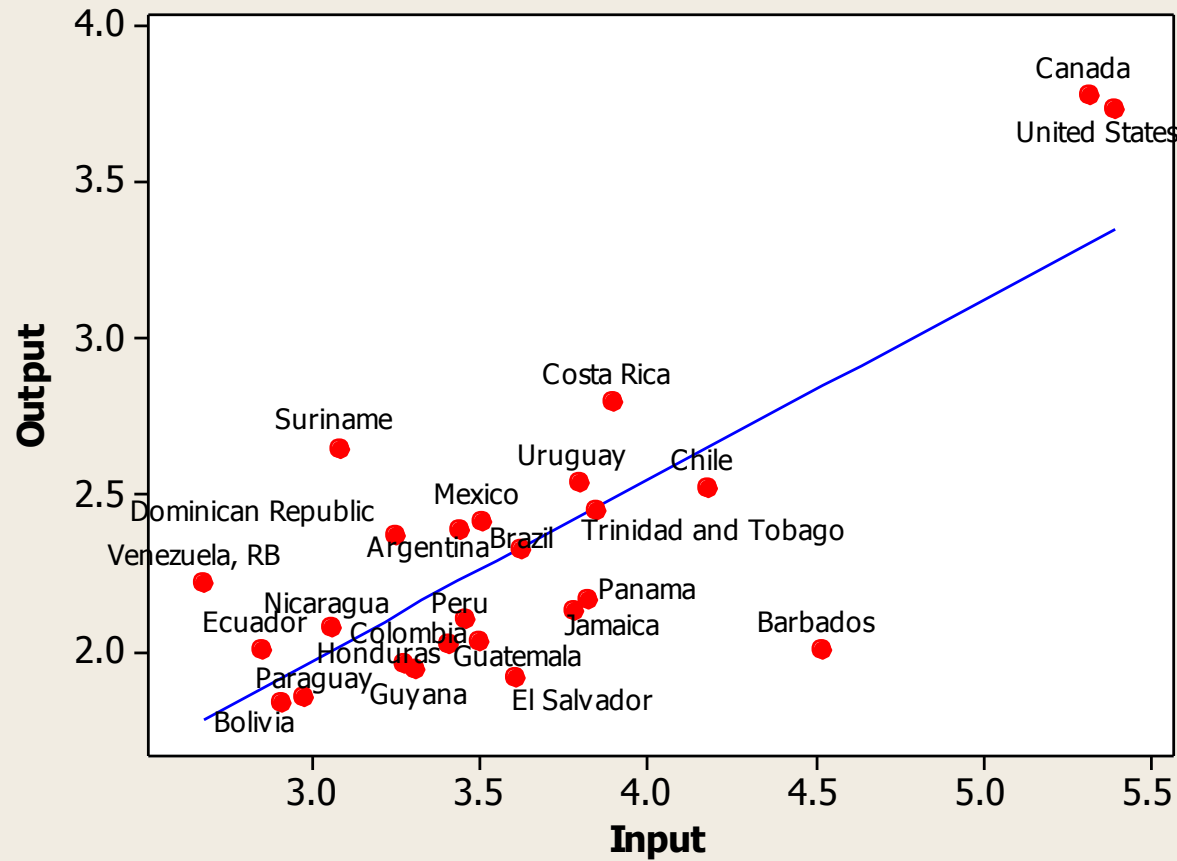
Source: Global Innovation Index

# Inputs versus Outputs

## The Americas



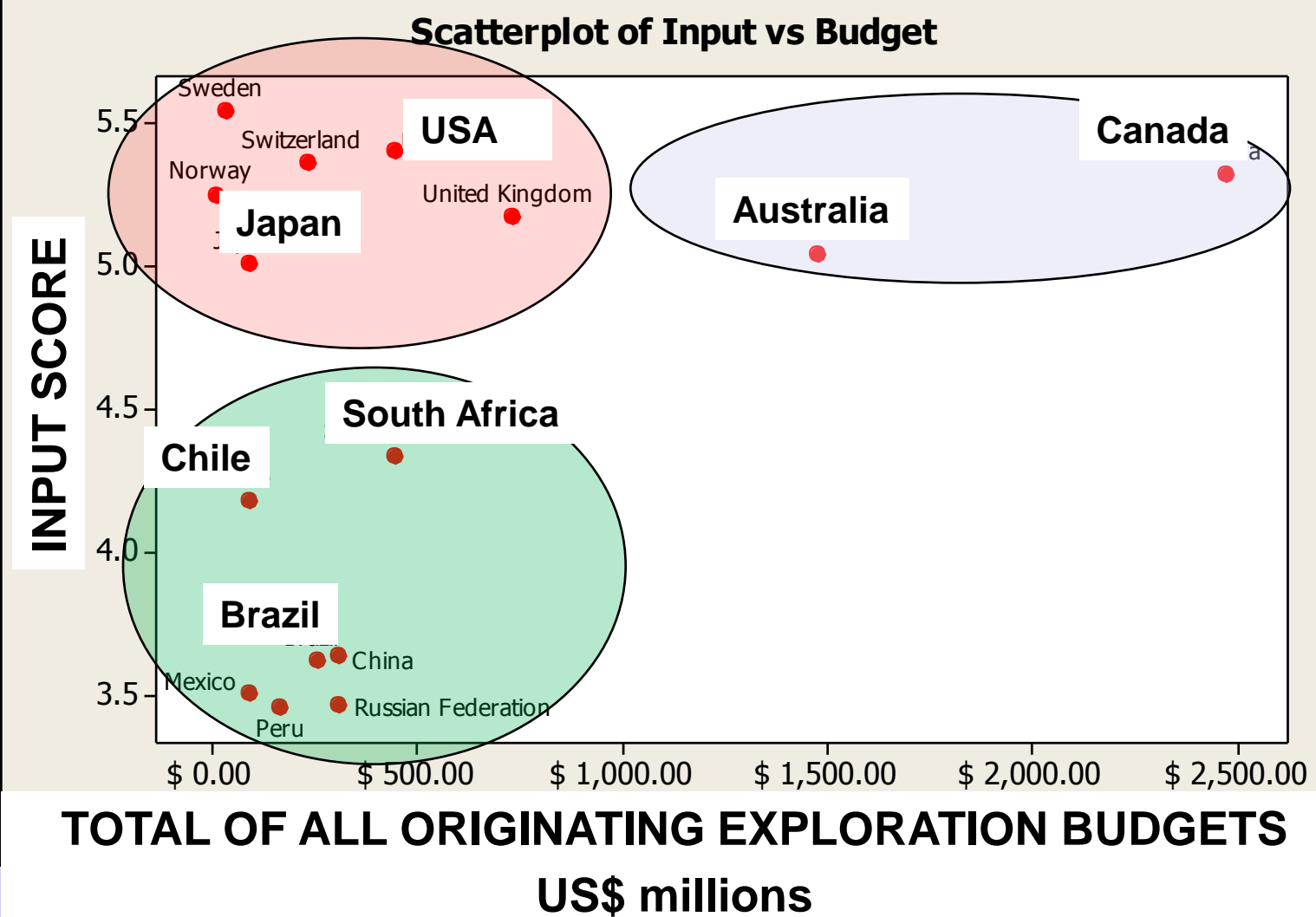
**Fitted Line Plot**  
Output = 0.2493 + 0.5742 Input



|           |          |
|-----------|----------|
| S         | 0.327715 |
| R-Sq      | 59.3%    |
| R-Sq(adj) | 57.5%    |



# INNOVATION INPUTS FOR MINERAL EXPLORATION COUNTRIES



# HOW CAN INNOVATION OCCUR IN EXPLORATION?

- A new “widget” (e.g. Portable XRF)
- Recognition of area
  - Political (e.g. Mongolia-Oyu Tolgoi)
  - Geological (e.g. Underworld Resources discovery in Yukon)
- A new market (e.g. rare earths and the “Green Economy”)
- A new form of business (e.g. royalty company: EuroNevada)



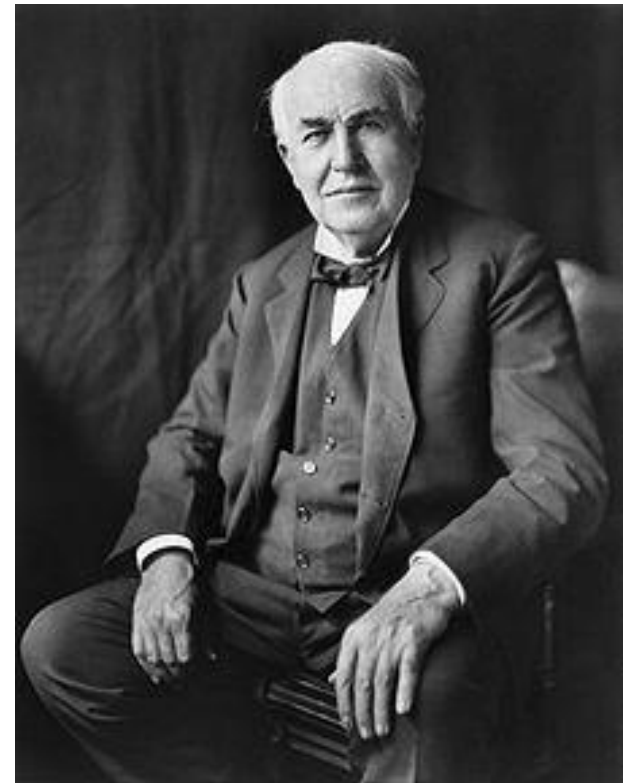
# WHAT ROLE FOR INNOVATION IN EXPLORATION CASE HISTORIES?

- Source of information: PDAC Awards and New Discoveries Sessions
- Convention presentations and contact with individuals
- 30 case histories, 2002-2010
- 17 countries and 28 companies
- Categorize discovery contributors
  - Geology, Geochemistry, Geophysics, Business
  - Score: 1=essential, 4=not relevant



**"Genius is one percent  
inspiration, and  
ninety-nine percent  
perspiration."**

**— *American inventor  
Thomas Edison (1847-  
1931)***

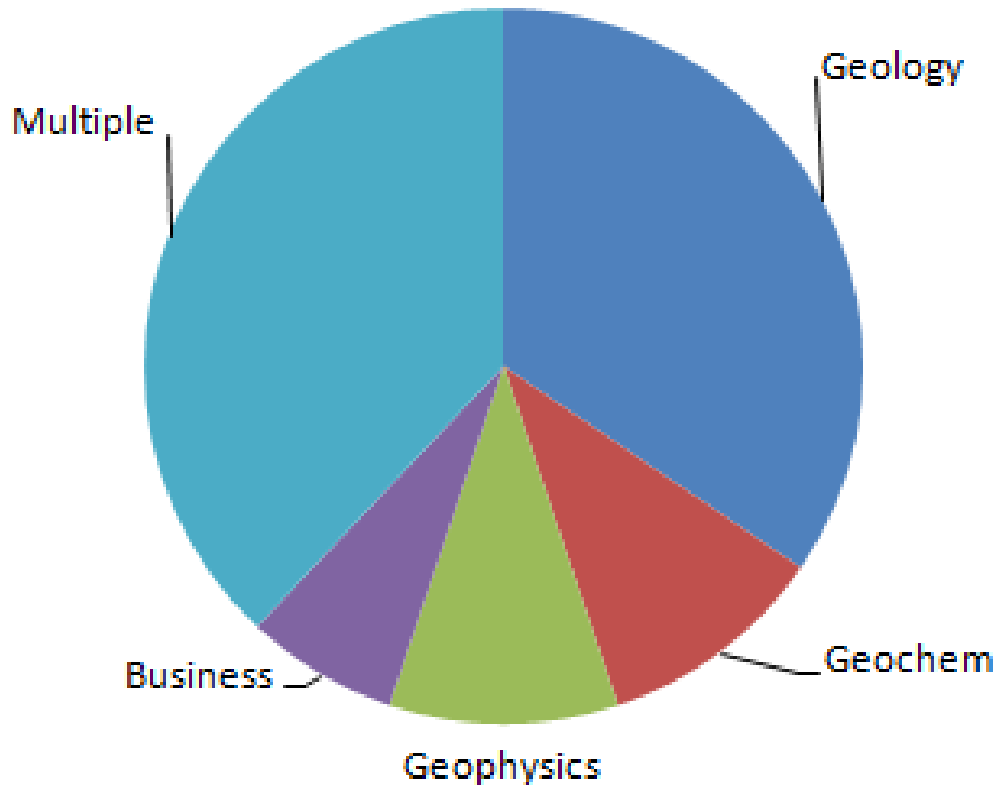


Edison started the first  
Industrial Park and  
founded General Electric



# MAIN CONTRIBUTORS TO SUCCESS

## Role of Innovation



Essential first method for success in case histories:

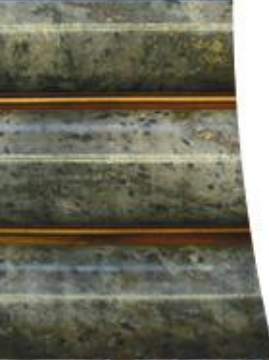
- About 1/3 geology
- About 1/3 multiple methods
- About 1/3 either geochem, geophysics or business
  
- Multiple methods:
  - 60% involved geology
  - 40% involved geochemistry
  - 20% involved geophysics



# WHAT DO THE EXPLORATIONISTS SAY?

## Papers at the New Discoveries Sessions:

- Geological concepts stressed
- Geochemistry (commonly soil and stream sediments) reinforced general geological targets
- Geophysics sometimes helped outline drill target, but also sometimes misled
- New breakthrough technology almost never mentioned



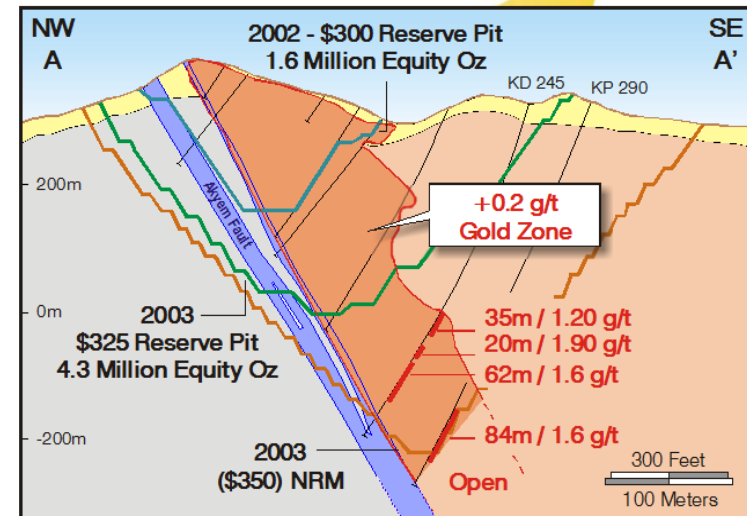
**"The more original a discovery, the more obvious it seems afterwards."**  
**— *Hungarian-born British novelist and journalist Arthur Koestler (1905-1983)***



# PURE GEOLOGY

- Newmont's gold projects in Ghana
- 1996 initial exploration
- 2001: considered selling projects due to perceived poor potential
- 2003: 3.3 M ozs
- completely relogged core and clarified exploration model
- 2004: 12 M ozs
- 2009: 17 M ozs

Akyem Reserve Growth  
Cross Section



# AHAFO AND AKYEM, GHANA NEWMONT

## Factors in Ghana Growth



- Relogging and reinterpretation
  - Recognition of brittle deformation textures
  - Understanding of late left-lateral shearing
  - Identification of plunging ore shoots
  - Wide open exploration potential
  
- Increased reserves
  - 130% at Ahafo
  - 175% at Akyem
  
- Decision to construct Ahafo

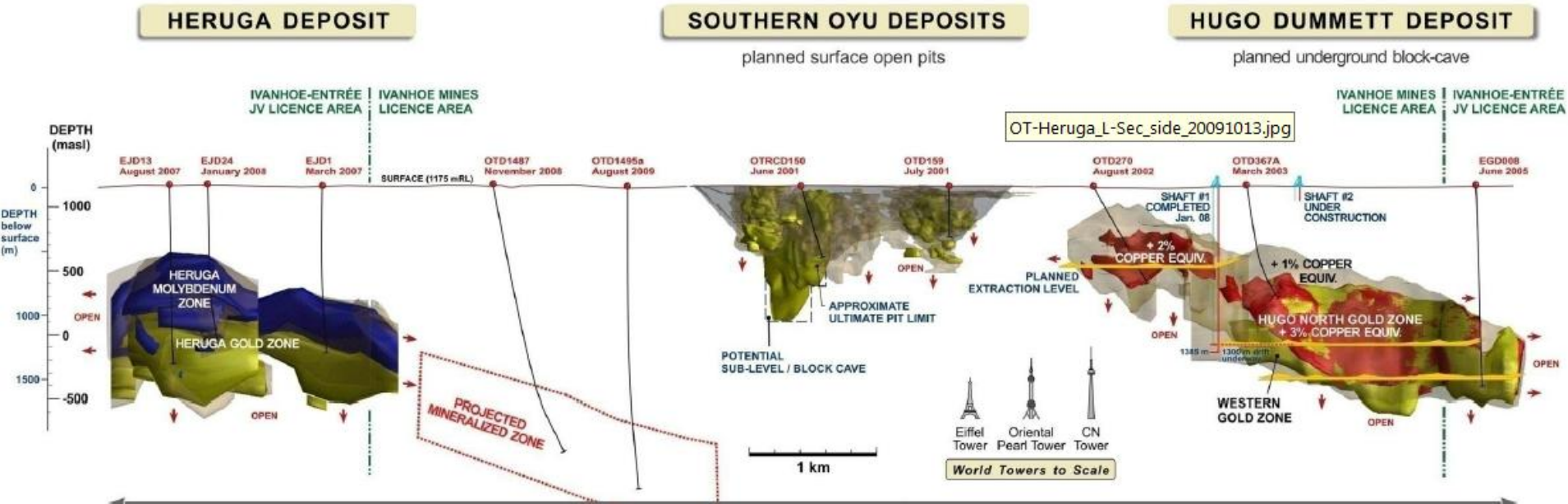
<http://www.newmont.com/about/history>



# OYU TOLGOI, MONGOLIA GEOLOGY AND GEOPHYSICS



- Visited by Magma geologist in 1996
- Passed through BHPB to Ivanhoe Mine Ltd
- Critical element was the recognition by the Magma geologist of the showings and alteration as indicative of major porphyry potential
- Geophysics was subsequently important, but geology was first.



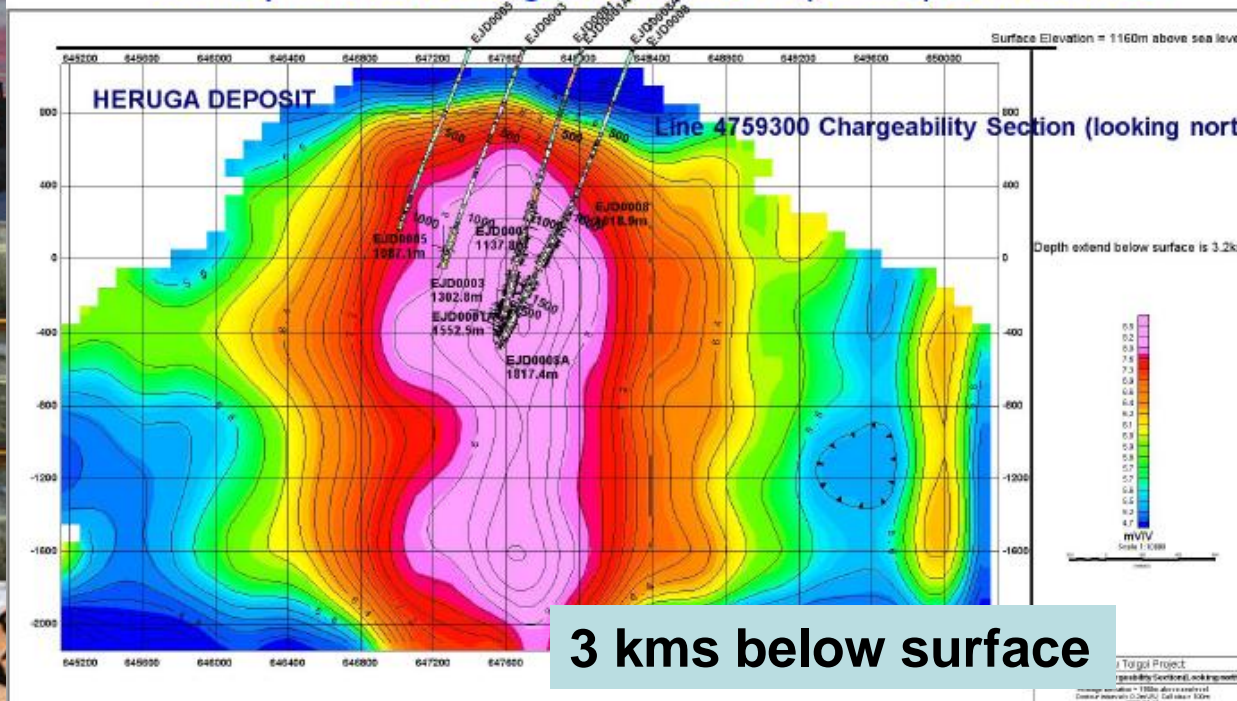


# OYU TOLGOI HIGH POWER GEOPHYSICS

## Heruga Deposit

Showing limits of Ivanhoe drilling to date

Total depth extent of image: 3.2 kilometres (2 miles) below surface



- Zeus deep geophysics
- Claims to be looking down ~3 kms below surface

- The Innovation: ability to bring together the risk of a new geography (Mongolia) with geology ability



# GOLDEN SADDLE, YUKON GEOLOGY AND GEOCHEMISTRY

- 1898: Gold Discovered in Klondike
- 1898: Yukon mining recorder reports high-grade gold-quartz vein at White Gold
- 1898-2008: >20 million ounces gold mined in Dawson Mining District
- 2003: Prospector Shawn Ryan stakes White Gold Property
- 2004 – 2006: Ryan collected 7,000 soil samples
- **2008- Underworld makes new gold discovery at Golden Saddle**

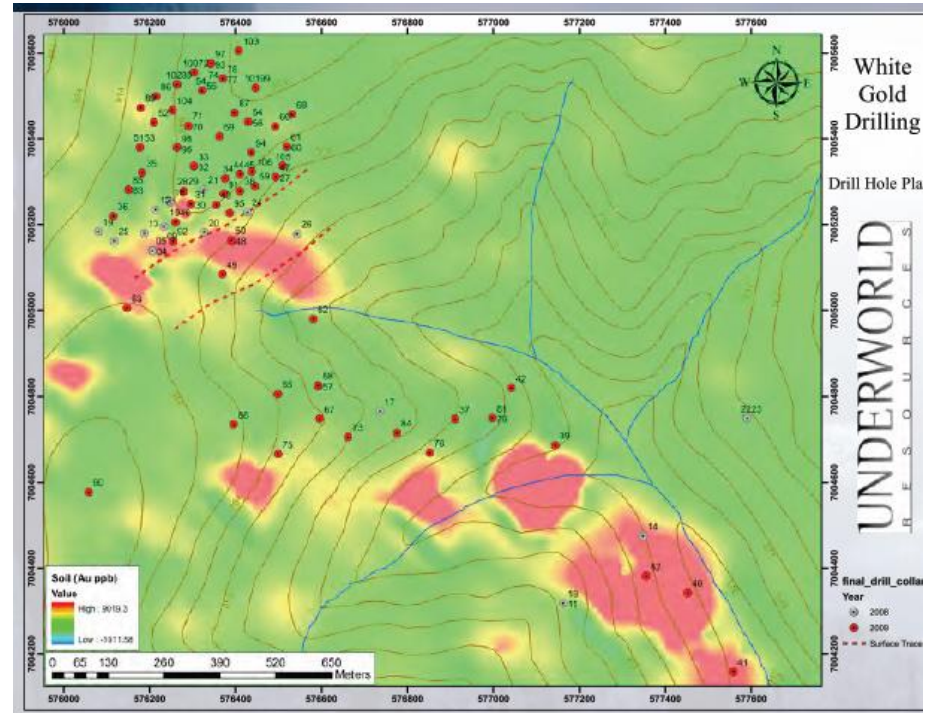


Thistle Creek Dredge



# GOLDEN SADDLE, YUKON UNDERWORLD RESOURCES

- Simple soil map – 7000 samples collected by prospector Shawn Ryan
- 2007: Underworld options property
- 2008: discovery
- 2010: 1.7 M ozs gold
- 2010: Kinross \$140 million takeover



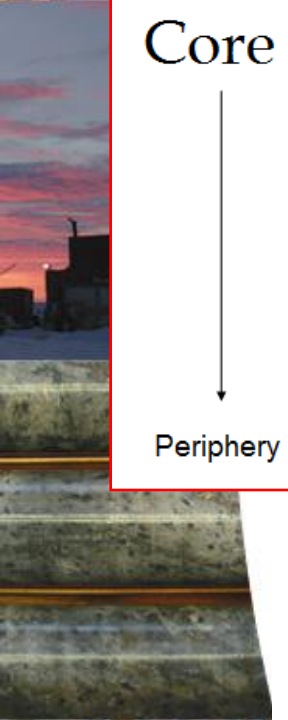
**The Innovation: going into a geological environment dismissed by conventional wisdom**



# PIMA MAPPING

## QUIMSACOCHA, ECUADOR

### IAMGOLD

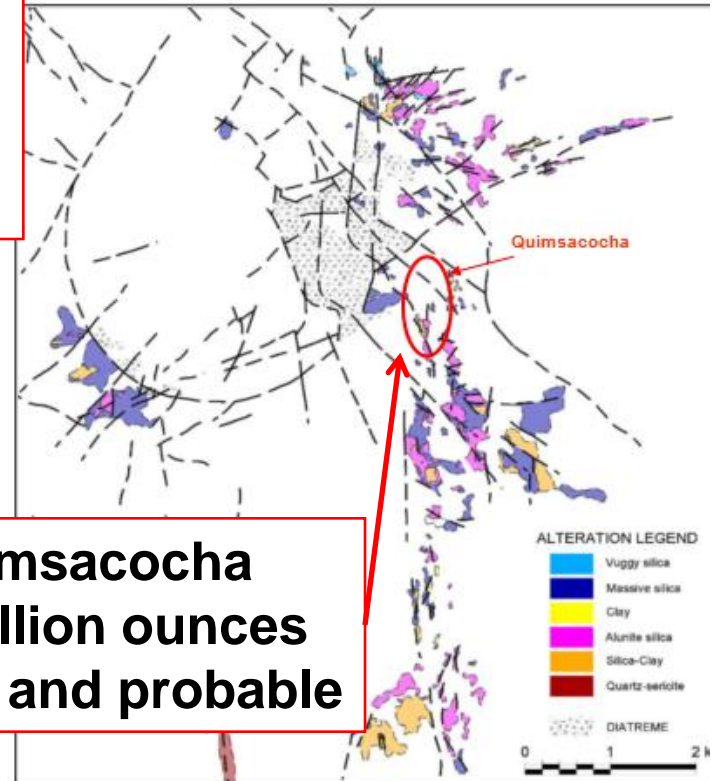


Core

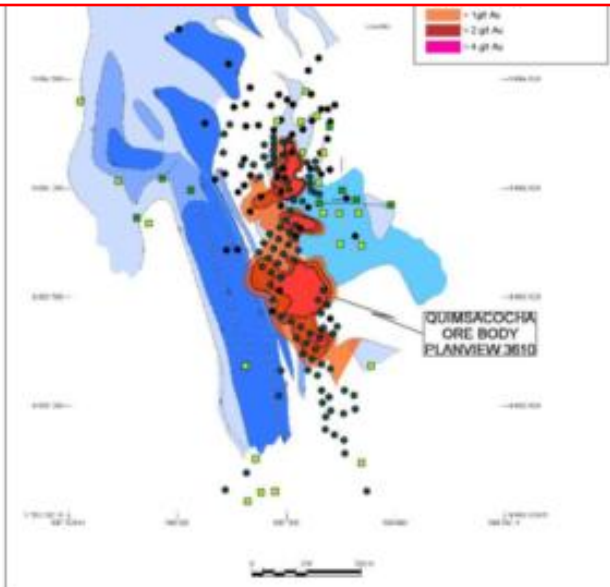
- Silicification - vuggy, massive or chalcedonic - multi-phases of brecciation
- Advanced Argillic - pyrophyllite, dickite, silica-alunite and kaolinite
- Illite - smectite
- Chlorite - pyrite

Periphery

### Alteration Footprint (Hedenquist et al)



**Quimsacocha**  
**1.7 million ounces**  
**Proven and probable**



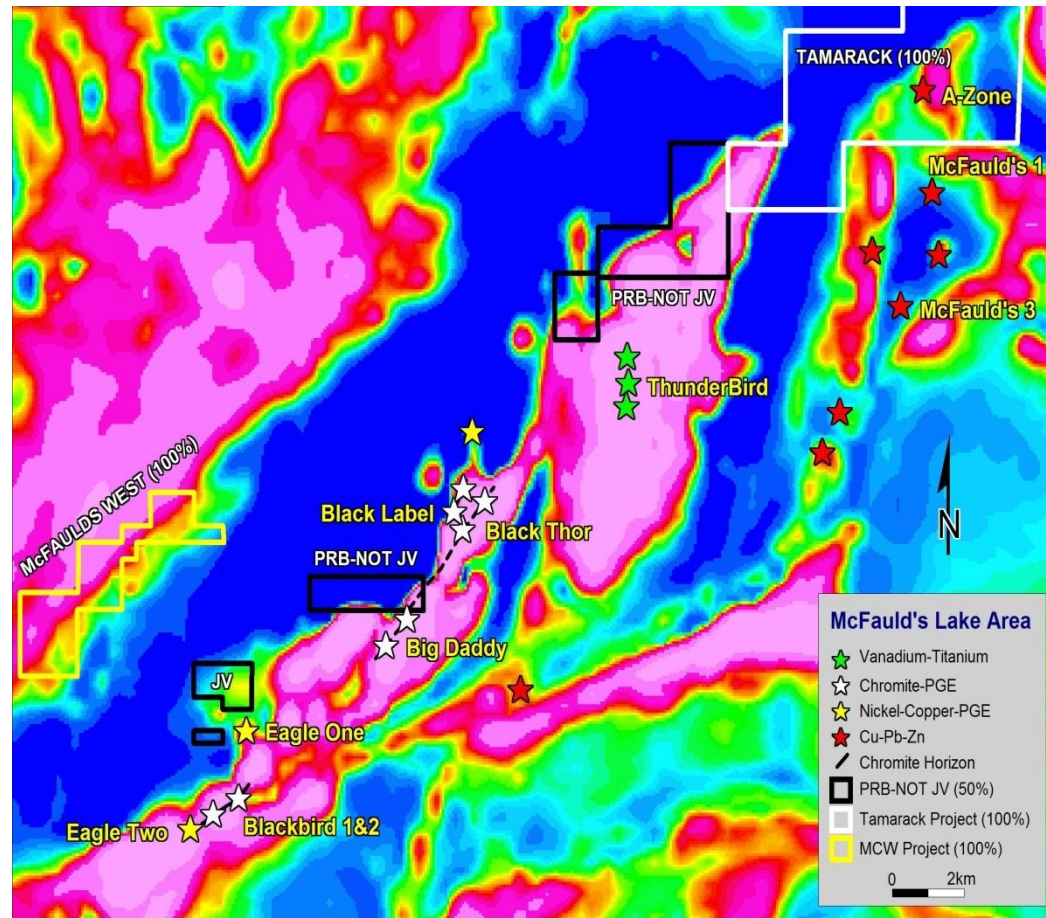


# McFaulds Lake, Canada Chromite Geophysics or Serendipity?



## Rim of Fire

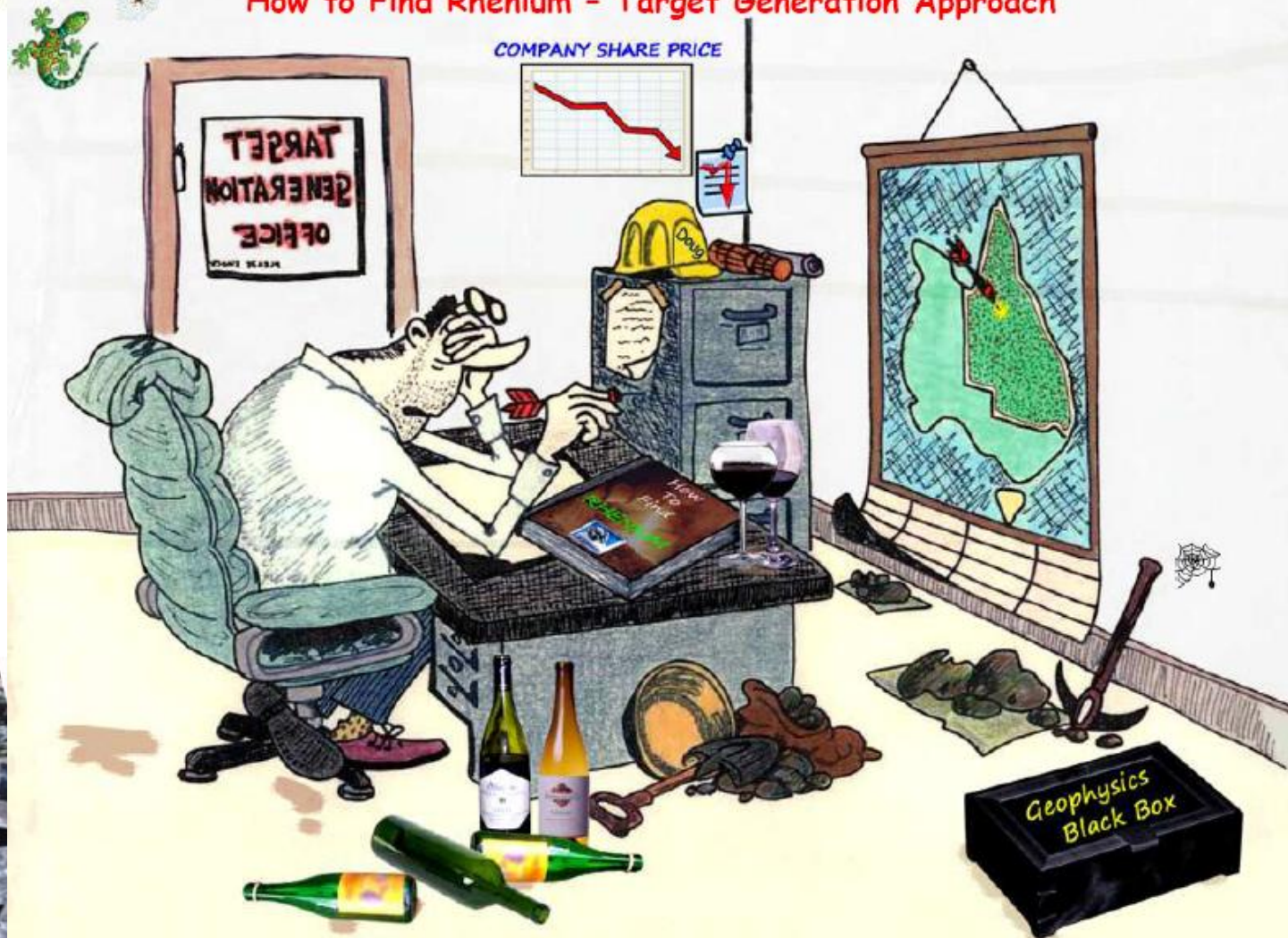
- Diamonds
- VMS
- Ni sulphides
- Chromite





# Source: Doug Kirwin

## How to Find Rhenium - Target Generation Approach



PDAC

Source: Doug Kirwin



PDAC

# INNOVATION

- **Be willing to fail**
- **Be willing to share your ideas**
- **Don't worry about not being the first mover**
- **It takes hard work for a long time (99% sweat)**
- **Don't be surprised if the idea does not seem to catch on**
- **Be an entrepreneur**





# INNOVATION IN EXPLORATION

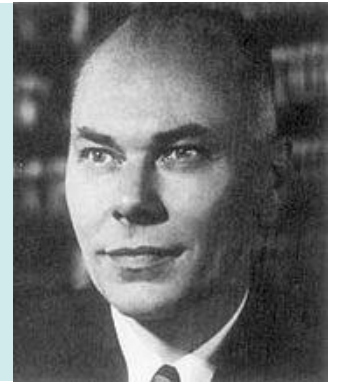
## A message to suppliers

**If you want to innovate, not invent:**

- **Come out with the cheapest functional equipment or software and you will take over the market:**
  - **Handheld XRF**
  - **Multispectral scanner**
  - **GPS that links into GIS systems with open maps**
  - **GIS software**
- **(example: computer assisted tomography (CAT) scanners: EMI invented and GE innovated)**



**As Howard Aiken used to say: “don’t worry about people stealing an idea. If it’s original, you will have to ram it down their throats”.**



**Thank you  
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