

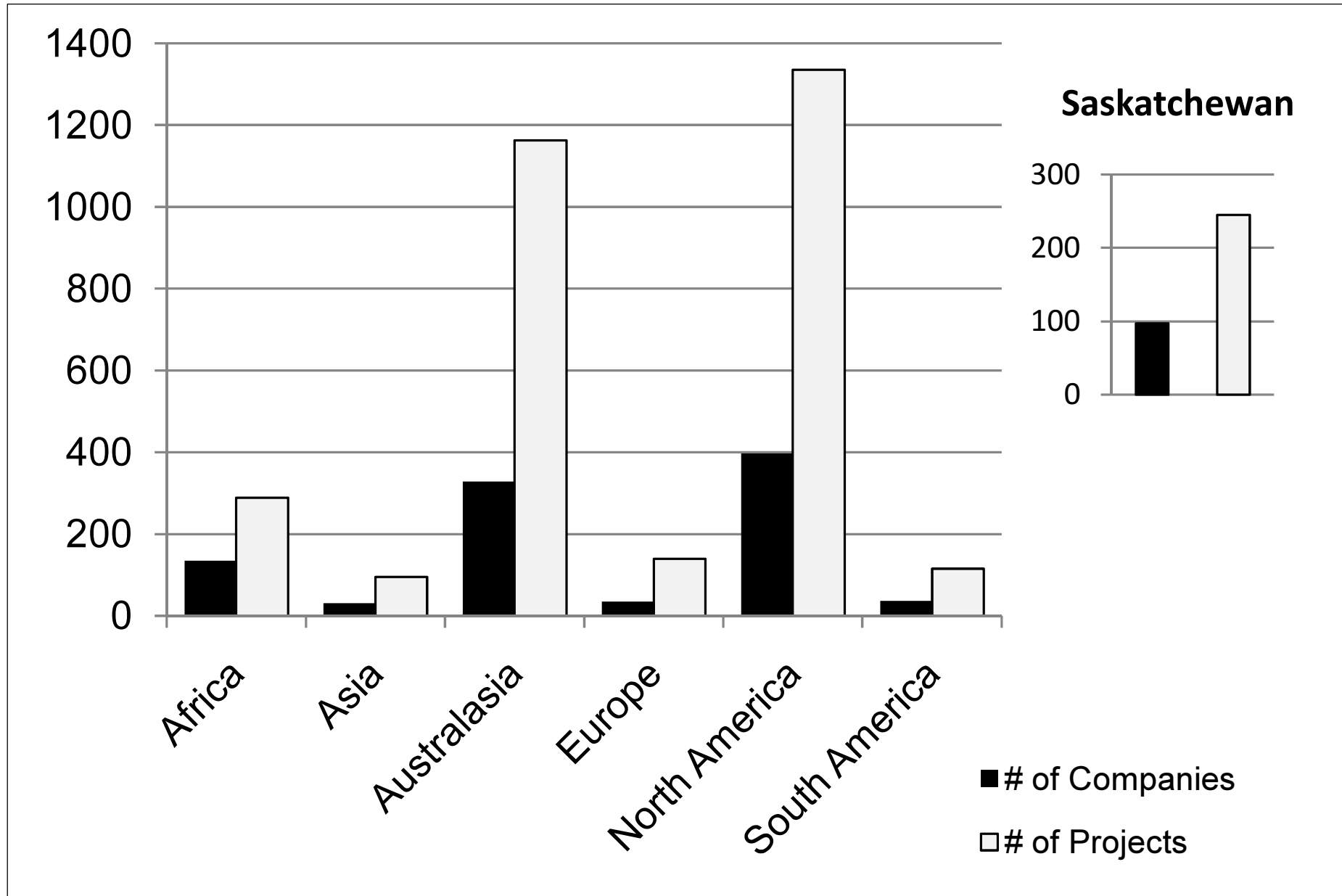
Paradigmatic Shifts in Exploration Process

- The Role of Industry-Academia Collaborative Research and Development in Discovering the Next Generation of Uranium Deposits

Jim Marlatt, Raven Minerals Corp.

Kurt Kyser, Queen's Facility for Isotope Research

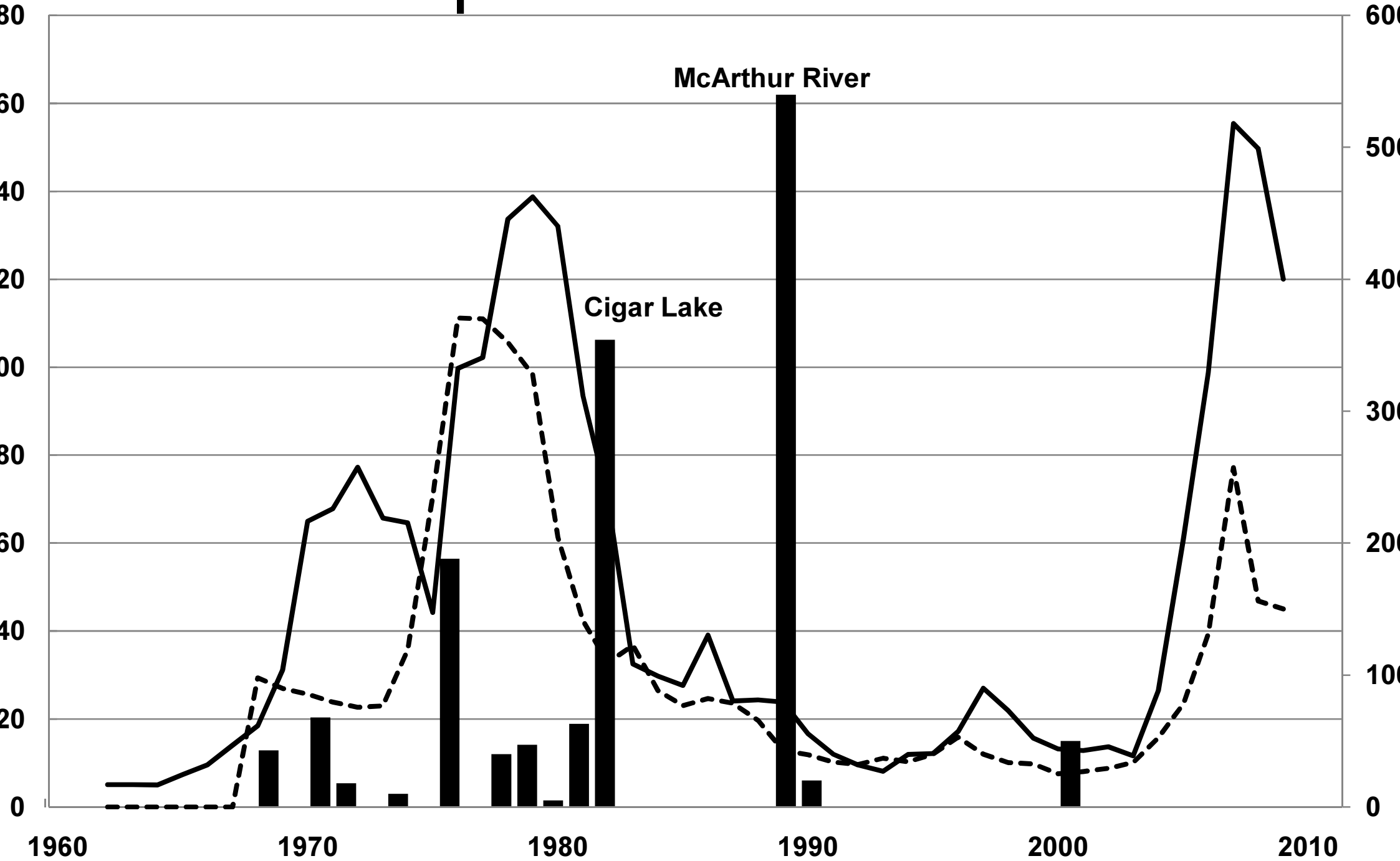
Global Distribution of Uranium Exploration Companies



Global Exploration

- In 2008 over 900 companies claimed an interest in over 3000 uranium projects worldwide
- From 2004-2008 an estimated \$3.2 billion was expended on uranium exploration
- Brand new, larger, higher grade economic deposits have not been discovered

Deposit Discoveries



Saskatchewan

- Over 100 companies claimed some sort of interest in over 200 uranium exploration projects
- From 2000-2009 about \$650 million has been expended on uranium exploration
- Brand new, larger, higher grade economic deposits have not been discovered

?

Where are the new
economic
uranium deposits?

An Industry in Crisis

- two decades of exploration has not lead to the discovery of large, new, higher grade economic uranium deposits
- this is interpreted as a severe and prolonged anomaly
- we call this is an emerging crisis
- we call on the need for a paradigm shift in exploration process for new discoveries

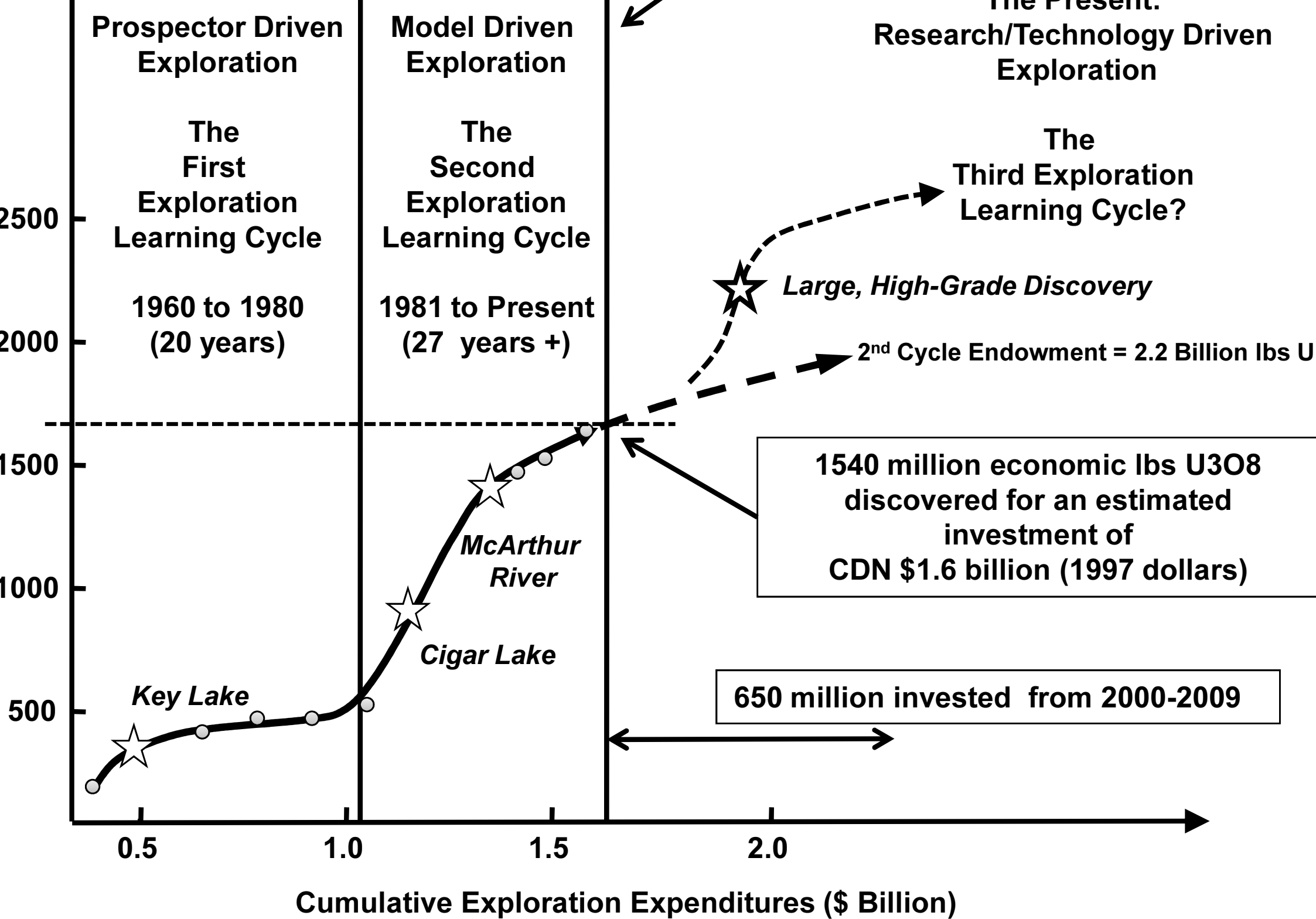
Athabasca Exemplar: Evidence of Crisis from the Athabasca Learning Curve

(Adapted from the framework developed in:

Harris, D.P., Zaluski, G., Marlatt, J.

A method for the selection of exploration areas for
unconformity uranium deposits.

Natural Resources Research 2009; 18:109-136.)



Athabasca Analysis

- 1.54 billion economic lbs U₃O₈ (830,000 tonnes U) discovered at a cost of CDN\$ 1.6 billion (1997 \$)
- Total basin endowment is estimated at about 2.2 billion lbs U₃O₈ (1.2 m tonnes U)
- About 650 million lbs U₃O₈ (350,000 tonnes U) available for discovery on the second learning curve

Uranium Deposits Discoveries on the 2nd Learning Curve

Best Single Point Estimate

80 million lbs expected for \$150 investment

16



80% Confidence Range



20

40

60

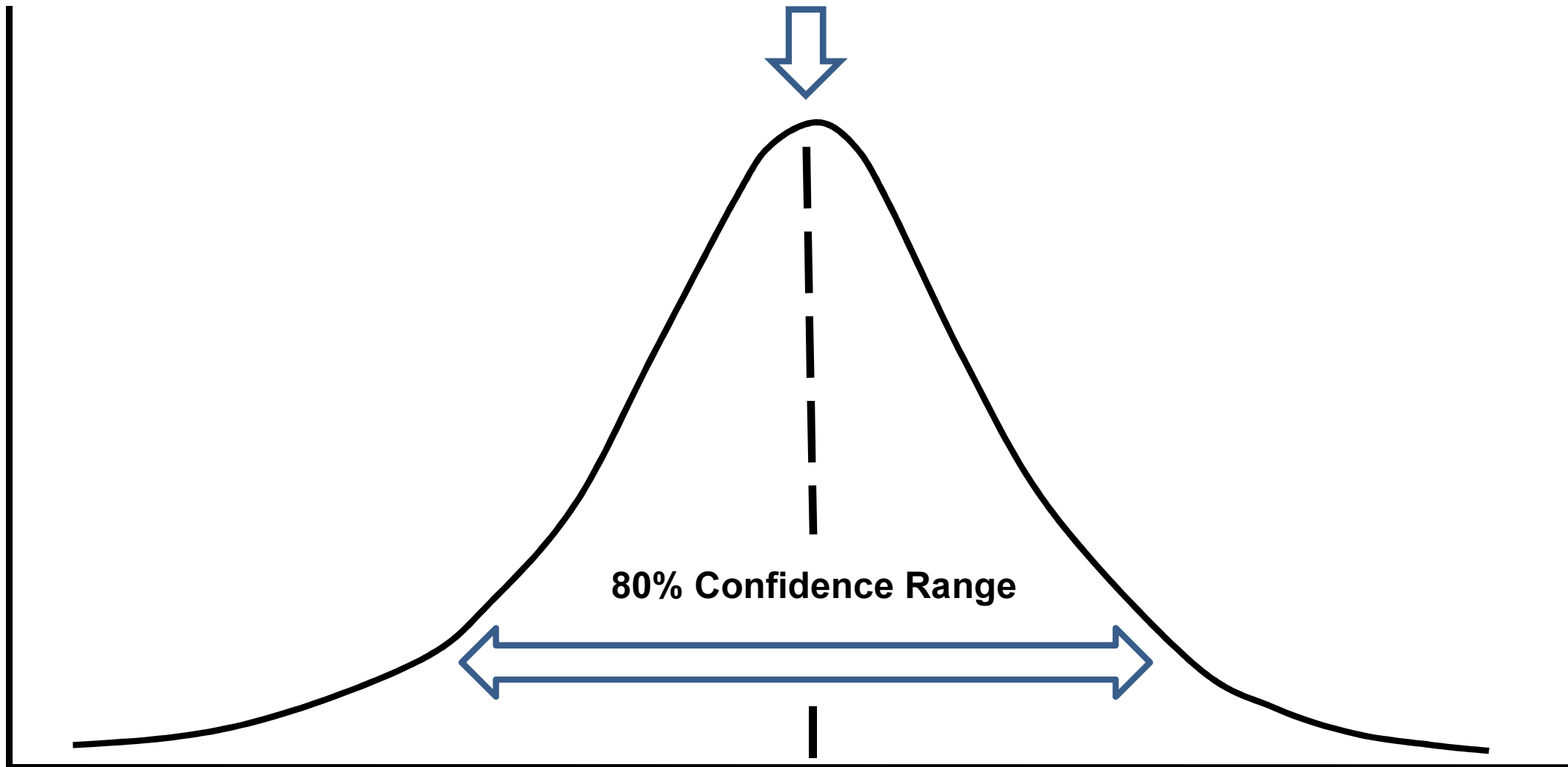
80

100

120

140

Probability Density



Athabasca Analysis

- future incremental investment of \$150 million should lead to a deposit with an average size of 80 million economic lbs U3O8 (43,000 tonnes U)
- An expenditure of \$650 million or 4 times this amount over ten years has yielded no new economic discoveries
- This is a severe and prolonged anomaly

Athabasca Summary

- The absence of economic discovery represents a severe and prolonged anomaly
- The play is mature, heavily explored, depleting & is not responding to conventional exploration approaches in a timely & cost effective fashion
- The recognition of ineffective exploration signals the need to shift to a new learning curve for discovery: A paradigm shift

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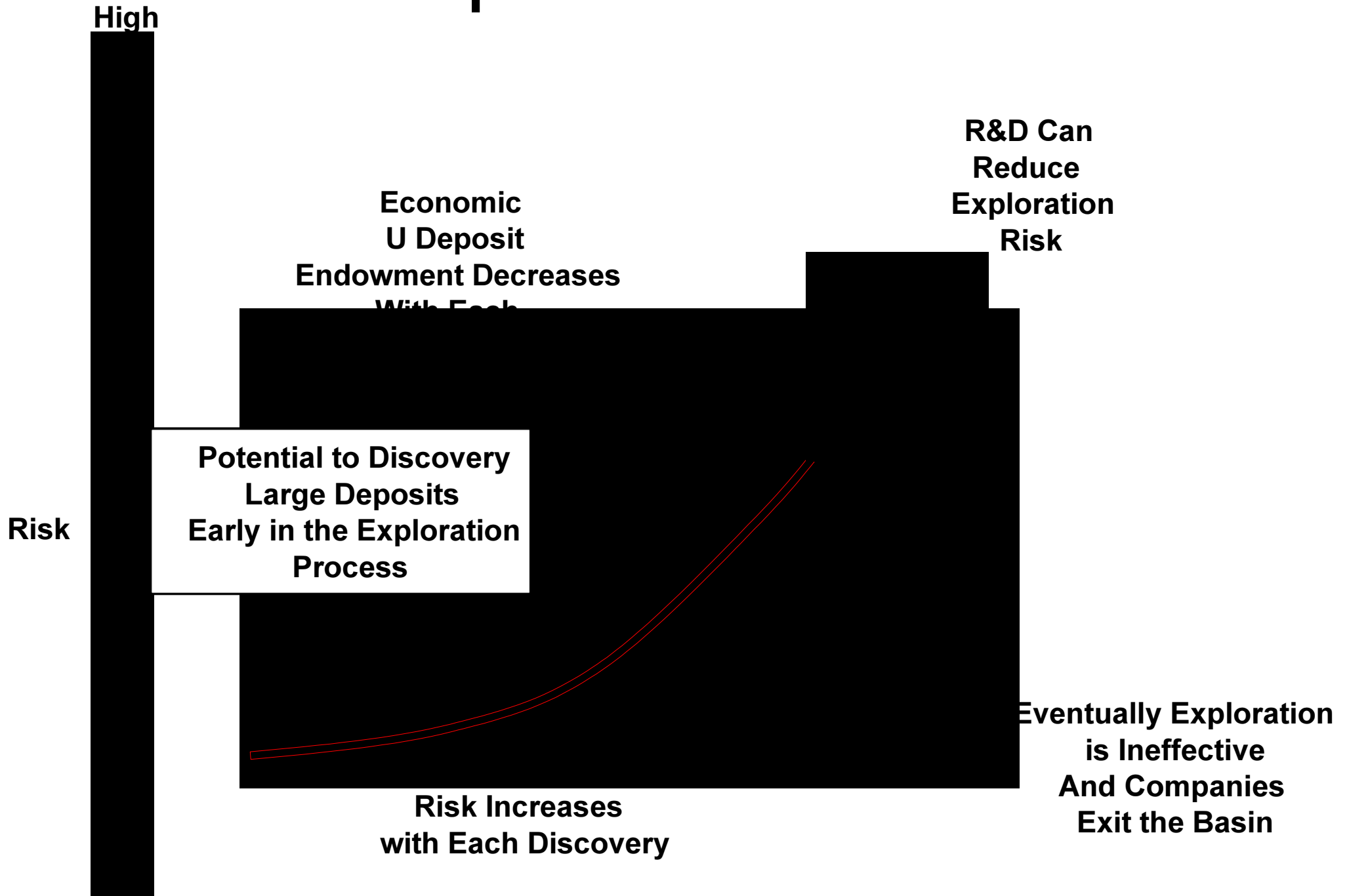
Industry-Academia Collaborative Research and Paradigm Shifts in Exploration Process

- The Past: Prospector Driven Exploration
- The Present: Model Driven Exploration
- The Future: Research / Technology Driven Exploration

Probability of Economic Discovery

Exploration Sequence	Exploration Targets
conceptual drill targets	10,000
reconnaissance drill tests	1,000
showings	100
advanced projects	10
pre-feasibility	3
feasibility	1.5
economic deposit	1

Exploration Risk





Permissivity

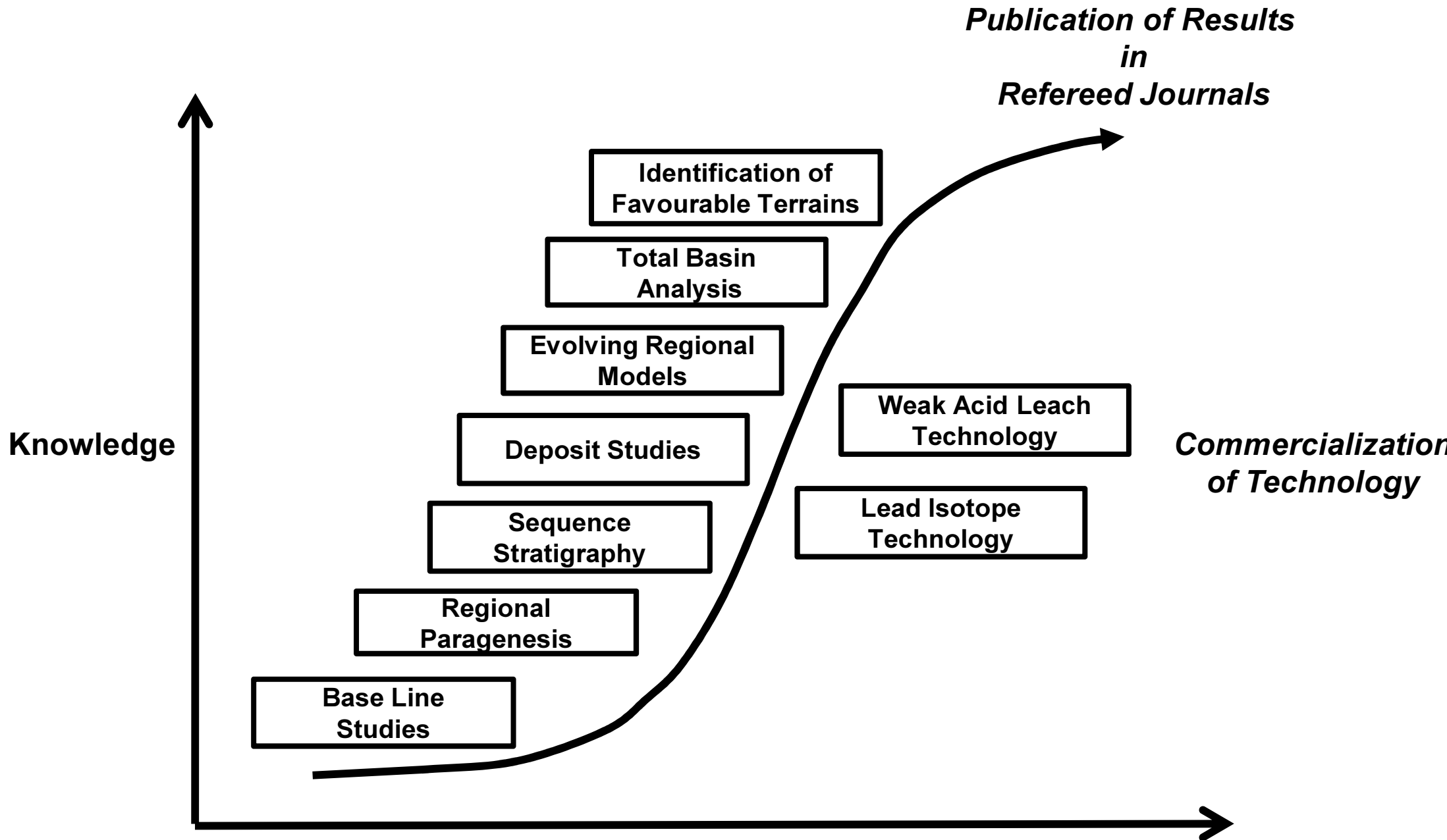
Do deposits exist in the geological terrain?

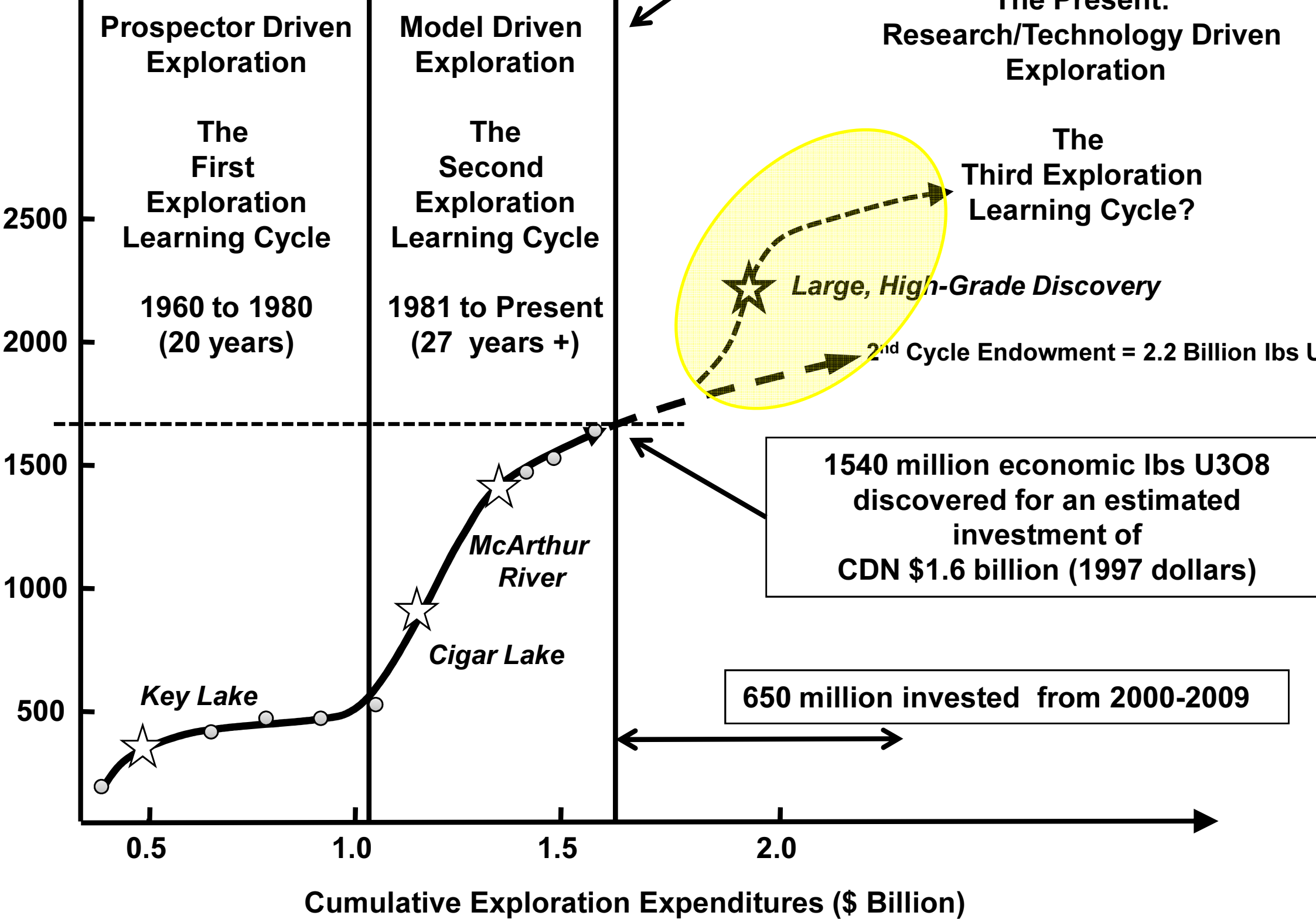
Prospectivity

Does the enterprise have the technology to search for and discovery these deposits?

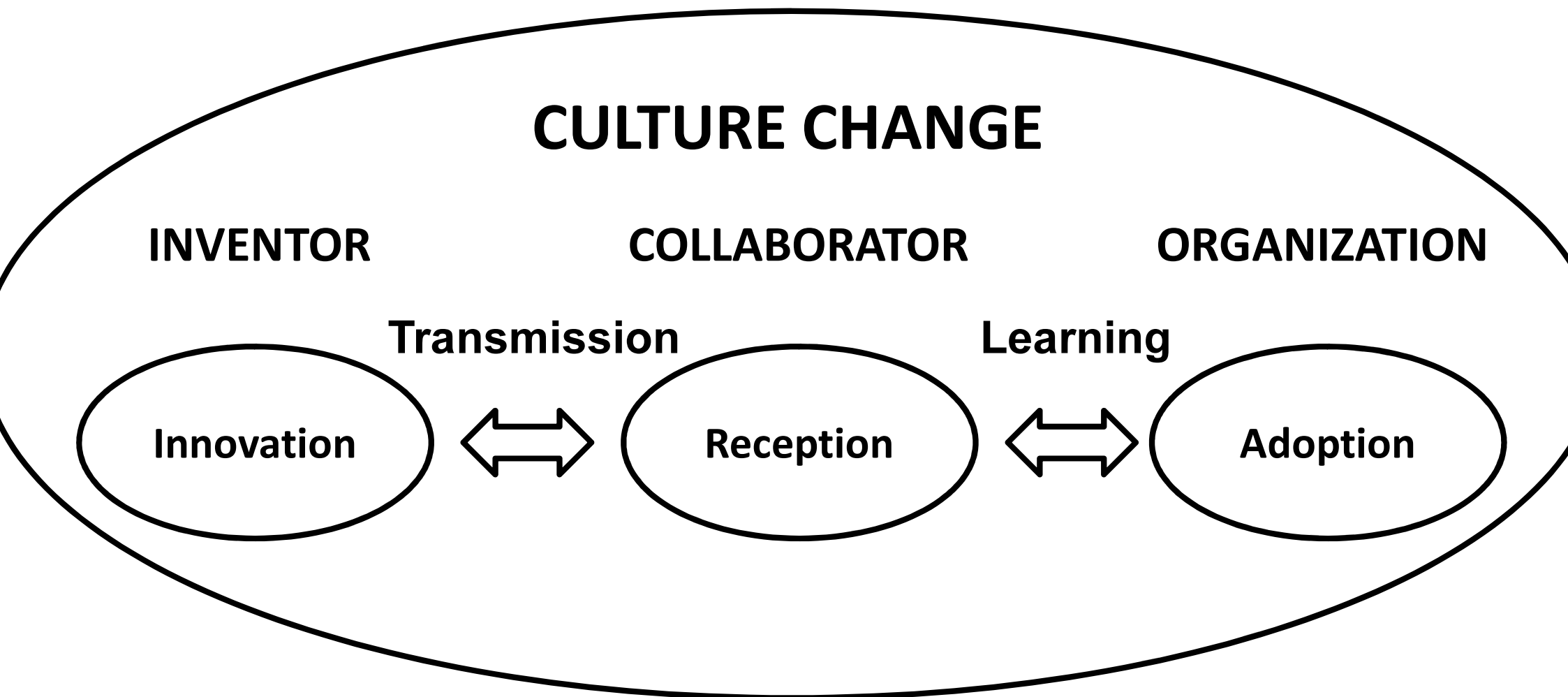
Can the enterprise develop new technologies?

Example of Collaborative Research





Model System of Collaborative Research

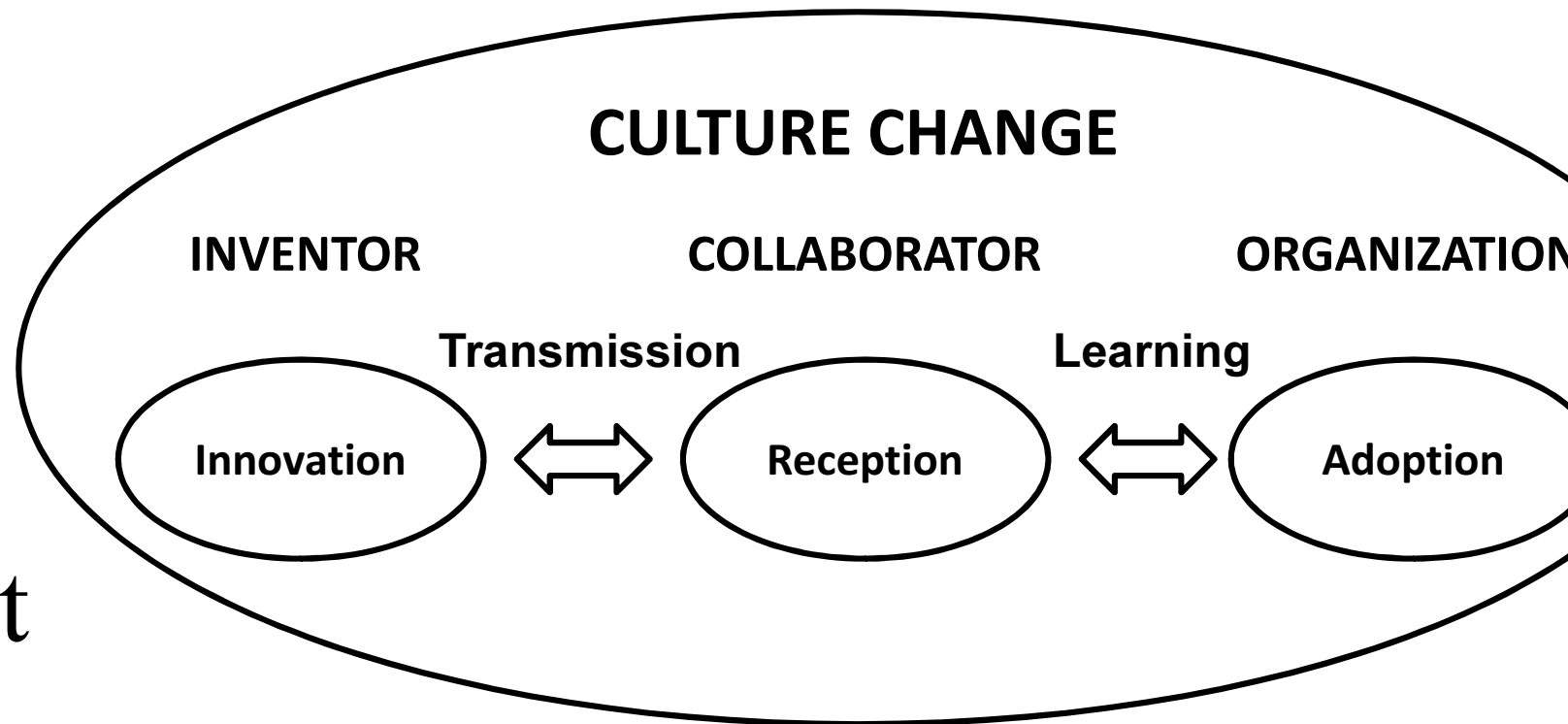


Weak Links in the Collaborative Research Value Chain

Creativity

Leadership

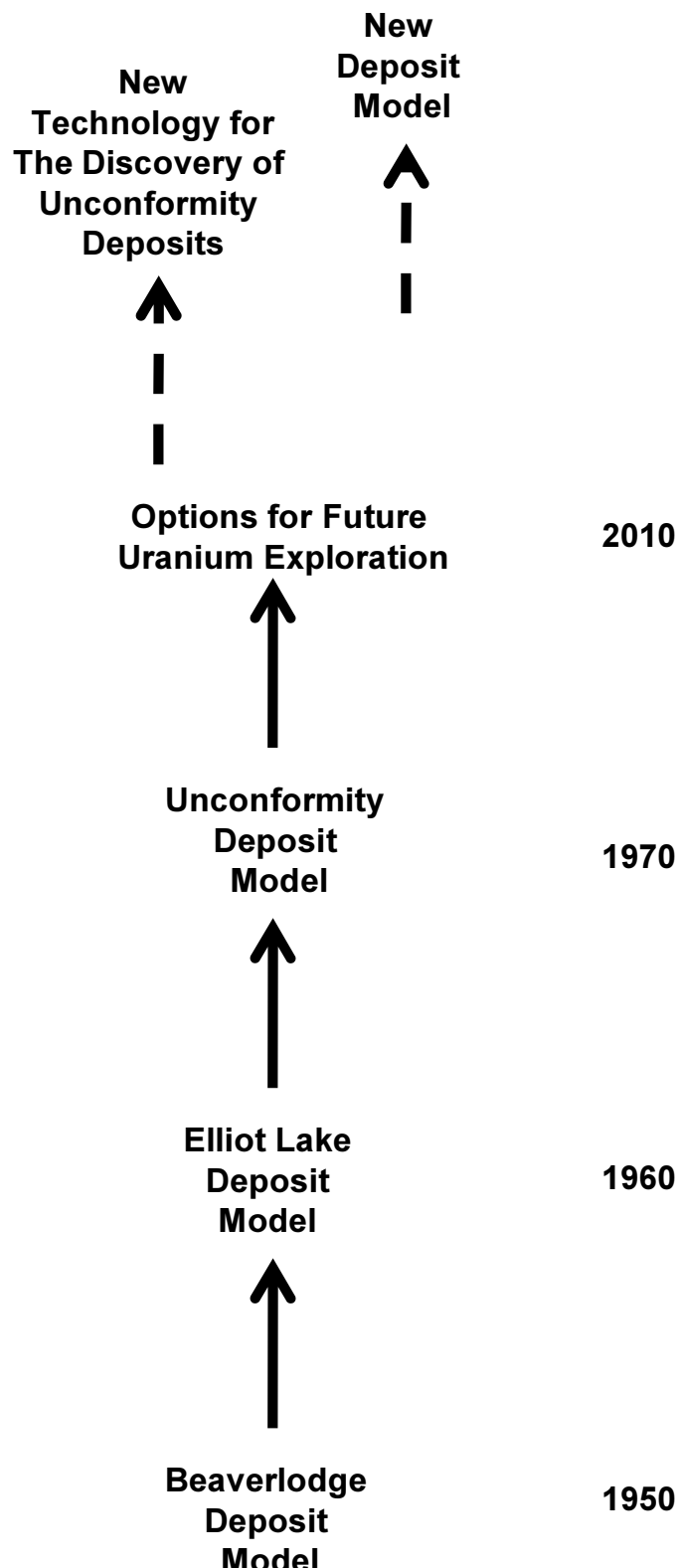
Management



Management Imperative in Supporting R&D

- **Management** needs to turn the current business model upside down: Adopt R&D as a top priority in the exploration enterprise
- **Management** needs to identify and support rare **Creative Leaders**
- **Leaders** need to develop the sustainable industry-academia collaborative system
- **Leaders** need to be adept at nurturing cultural acceptance of R&D outcomes as a change management process

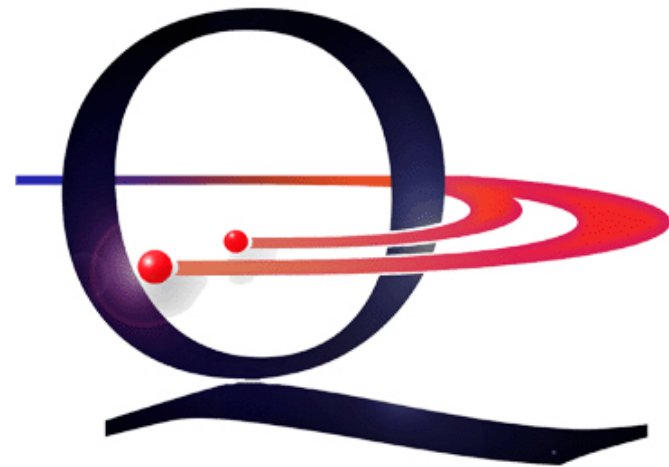
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