

**Prospectors and Developers Association Of  
Canada (PDAC) - March 9-12, 2003**

***THE PROSPECTOR MYTH - COMING TO TERMS  
WITH RISK MANAGEMENT IN MINERAL  
EXPLORATION***

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# **“The Prospector Myth is the exploratorist’s version of the Hero Journey”**

**Motivational bias in the pursuit of projects, funding, fame and fortune is the primary reason exploratorists persistently overestimate the potential of their projects.**

**“Have Faith - success will eventuate, given persistence and sufficient trials: one real success will carry a dozen failures”**

**Does this work For You?  
Is their another way?**

# **An Alternative Approach:** **Project Risking**

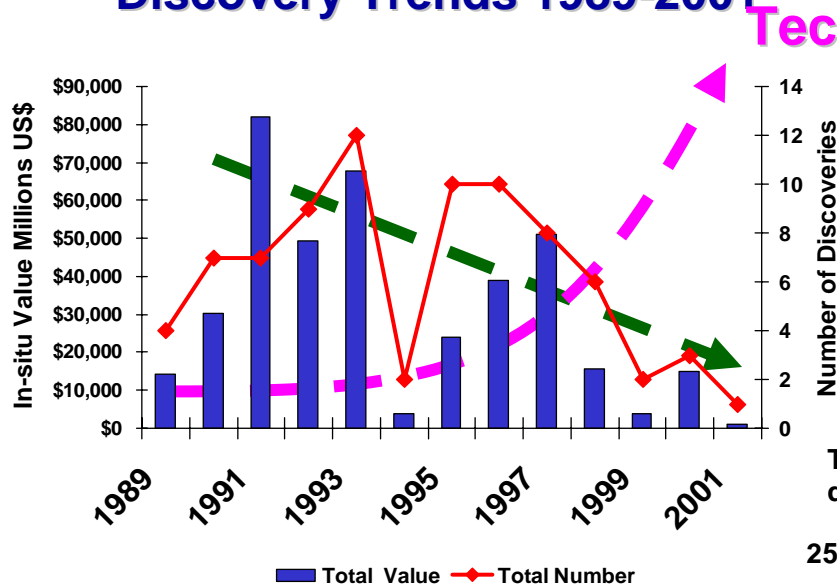
*lessons learned from the Petroleum Sector*

## *Today's Presentation:*

- ❖ **The Exploration record - “Destroying Shareholder Value”**
- ❖ **The Petroleum Industry Experience**
- ❖ **Insights to the Mineral Industry Analog**

# Exploration Not Cutting It! Alternatives Growth Strategies Essential

Discovery Trends 1989-2001



Technology

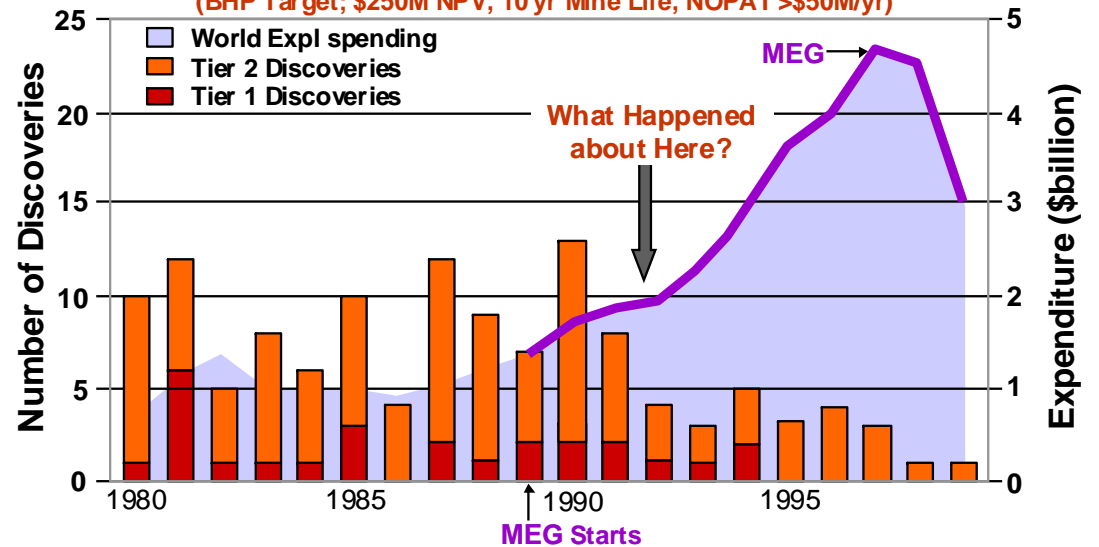
Decline in Number of discoveries



**THE GREATER PROBLEM:  
Decline is Discovery Quality**

There has been a distinct decline in discoveries of Tier 1 and 2 deposits per year since the early 1990s despite increased expenditure.

(BHP Target; \$250M NPV, 10 yr Mine Life, NOPAT >\$50M/yr)



Decline in Quality of Discoveries



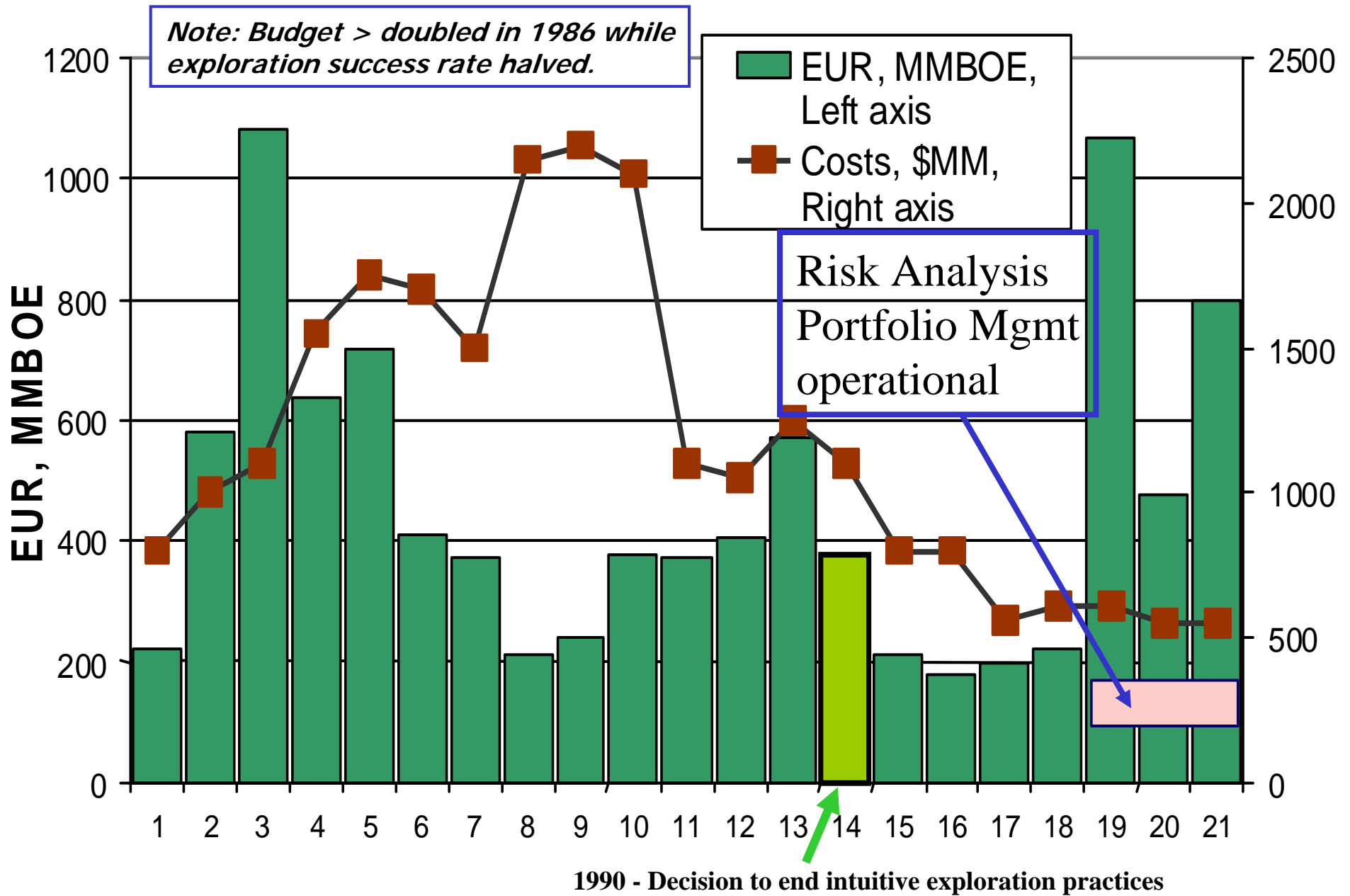
# There are some lessons to be learned from our Petroleum cousins

Rather than *creating value* during 1980-1995, Frontier Exploration aimed at high-risk, high-reserve new ventures clearly resulted in the net *destruction of value*".

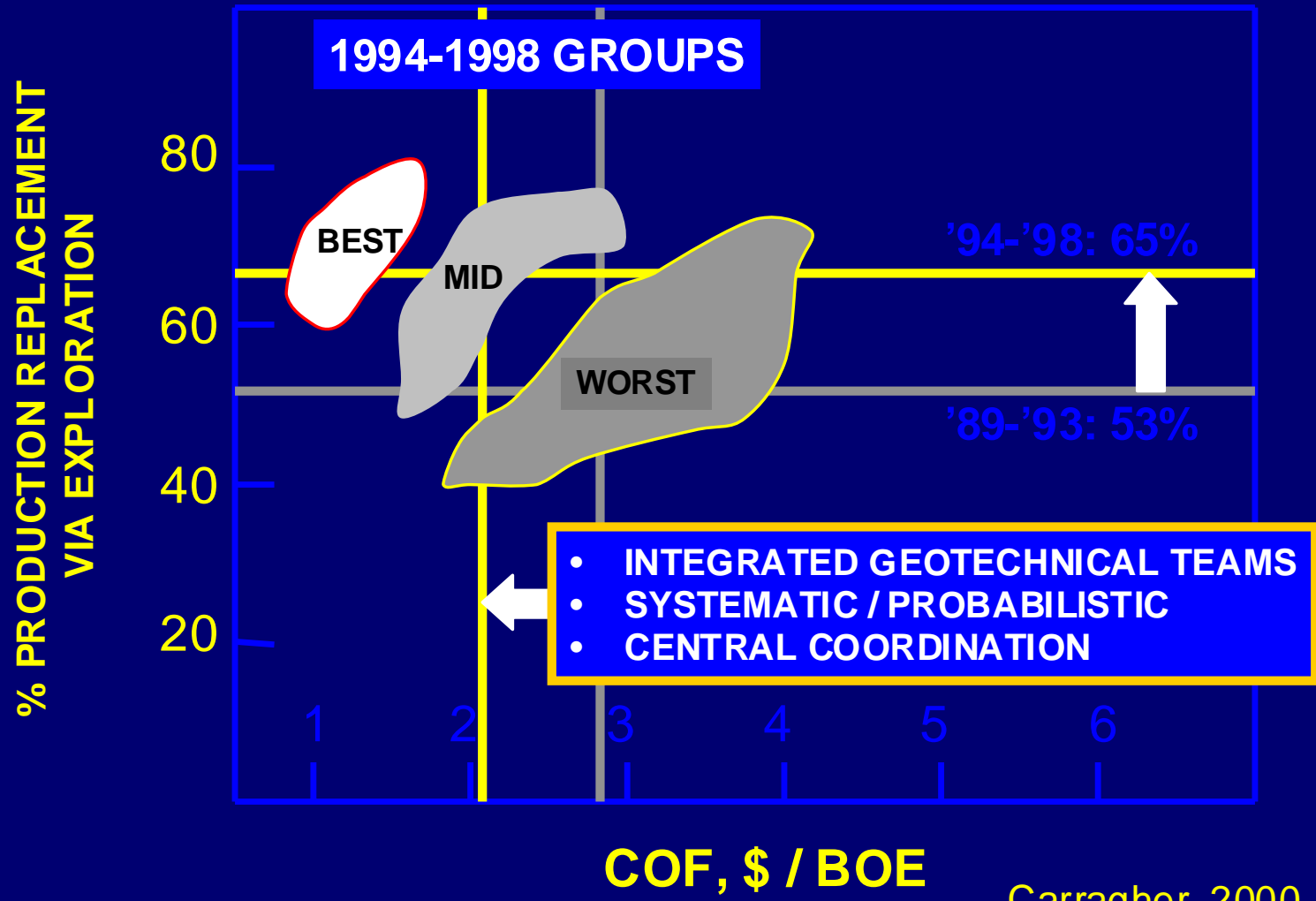
-- SHELL, MOBIL, AMOCO, & OTHERS

**These are referred to as the Insane Years**

# COSTS AND RESOURCES Year 1 = 1976



# KEYS TO IMPROVING E&P PERFORMANCE



# Conclusions of the E&P Sector:

1. **“Best Practices” Lead to Superior E&P Performance:**
  - Integrated Geotechnical Project Assessments;
  - Systematic Probabilistic Risk Analysis;
  - Centrally Coordinated Portfolio Management
  
2. **Cultural Patterns of E&P Underperformers Lead To:**
  - Biased Inputs;
  - Inconsistent Prospect Evaluation Procedures;
  - Repetitive E&P Errors;
  - Mediocre Portfolio Performance
  
3. **Adoption of Sophisticated Software and Economic Theories are NOT a Remedy for Biased Geotechnical Input**
  
4. **Requisite to Improvement in E&P Performance is CHANGE:**
  - Organizational Structure
  - Management Style
  - Professional Culture

# Comparing Symptoms

## Petroleum 1989-92

- ❖ declining discovery rate
- ❖ decline in top tier discoveries
- ❖ destroying shareholder value
- ❖ decline in reserve base
- ❖ unfulfilled price expectations = write-down of assets
- ❖ “dash for cash” (globalization greener pastures)
- ❖ ultimate collapse of investor/management confidence in exploration = massive decline in spending (staffing)
- ❖ pursuit of alternative (A/D) solutions

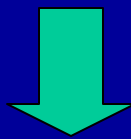
## Minerals 1999-2002

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- ❖ decline in top tier discoveries
- ❖ destroying shareholder value
- ❖ decline in reserve base
- ❖ unfulfilled price expectations = write-down of assets
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# Comparing Processes

## Petroleum 1989-92

- ❖ Technological advances (models, seismic, geochem) are integrated into business solutions
- ❖ Market alignment. Juniors move to niche (lower cap) plays - majors recognized as the primary explorer
- ❖ Move towards a statistical process of play/target evaluations
- ❖ Integrated “hypothesis testing”. Focus on disproving (all targets elements required)



- ❖ Foundation laid to Risk Analysis and Portfolio management

## Minerals 1999-2002

- ❖ Technology (black box) is either not trusted or unable to characterize target models ... % drilling an industry metric
- ❖ Market fragments. Juniors are used to replace Majors as primary explorers (Prospector myth/motivational bias taken to a new level)
- ❖ Target/play evaluations driven by an intuitive process (Championism)
- ❖ Anomaly/bump testing (integrated targets preferred but not necessary)... “mines are made, not found”. “you never know until you drill.”



- ❖ Remain Focused on funding solutions not performance ones

# What does risk management mean to the geologist?

## MAIN PROFESSIONAL RESPONSIBILITIES OF EXPLORATIONISTS

- IDENTIFY COMMERCIAL PROSPECTS
- MEASURE THEM (ESTIMATING):
  - CHANCE OF SUCCESS
  - RESERVES CONTAINED
  - PROFITABILITY
- UNBIASED ESTIMATES
  - post mortems, audits

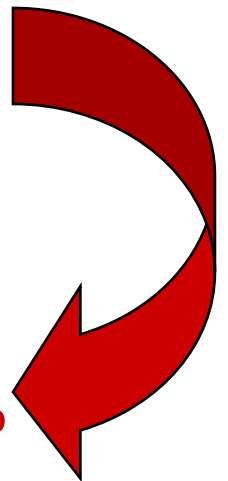
*Here is where the mineral industry is weak..  
We need to learn how to “estimate”*

## e.g. Porphyry Copper Exploration. Chance of a Successful “Prospect” in Chile

<u>Geologic Requirement</u>	<u>Chance of Success</u>	
❖ Geology (age)	= (0.7 - 0.95)	0.9
❖ Structural controls	= (0.6 - 0.95)	0.8
❖ Cu porphyry intrusive	= (0.05 - 0.15)	0.1
❖ Phyllic Overprint	= (0.1 - 0.5)	0.3
❖ (preserved) supergene enrichment	= (0.05 - 0.75)	0.6

**Chance of a discovery =  $0.9 \times 0.8 \times 0.1 \times 0.3 \times 0.6 = 1.3\%$**

Chance of it being economic is derived from separate geostatistical analysis



# Chance of Success: Understanding Risk

## Focusing on the Right Problem

### ❖ Cost of target opportunity in Chile

- Comparing costs from 1997-1998 using traditional methods to 1999-2001 period using hyperspectral, there was over a 15 fold decrease in the cost to identify a new porphyry and acquire a property.

<u>Geologic Requirement</u>	<u>Chance of Success</u>	
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The technology Factor

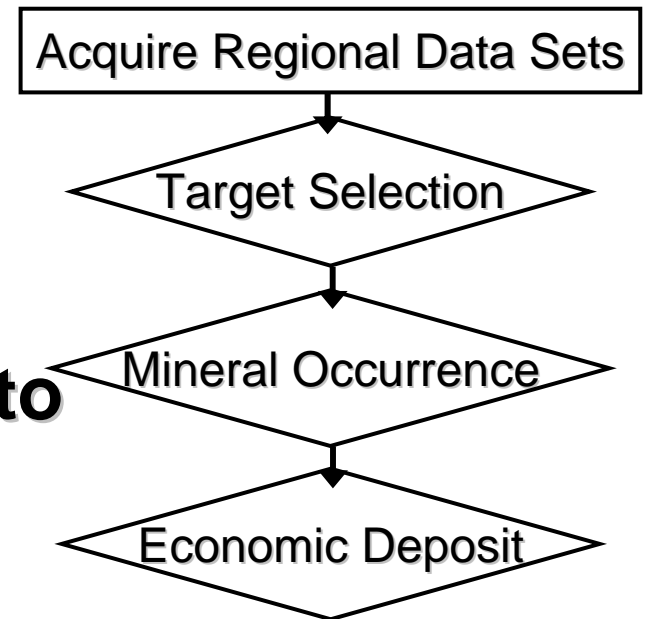
**Chance of a discovery =  $0.9 \times 0.8 \times 0.8 \times 0.8 \times 0.6 = 28\%$**   
**72% chance the project will fail.**

# Exploration Risk Concepts are Not New

## *“Exploration Success Model”*

(Andy Green, CSIRO)

- ❖ ~ 5% of targets are mineral occurrences
- ❖ Of those, 1-2% will evolve into economic deposits
- ❖ 1000-2000 targets need to be tested!



*We have long recognized there is a Probability factor in discovery.... But we have never tried to quantify it*

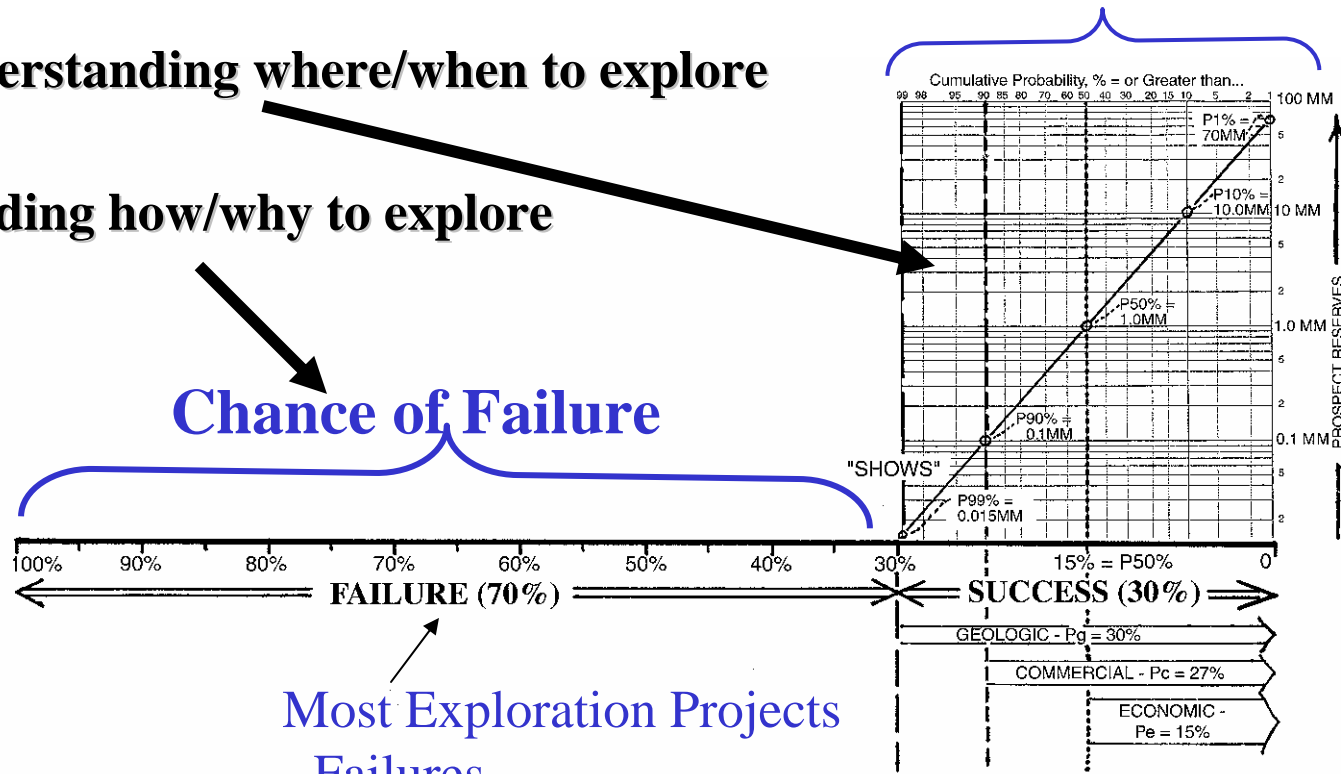
# Understanding the Difference: Chance of discovery, versus the chance the discovery is economic

The chance a discovery is  
commercial/economic

Understanding where/when to explore

Understanding how/why to explore

Chance of Failure



Most Exploration Projects  
- Failures

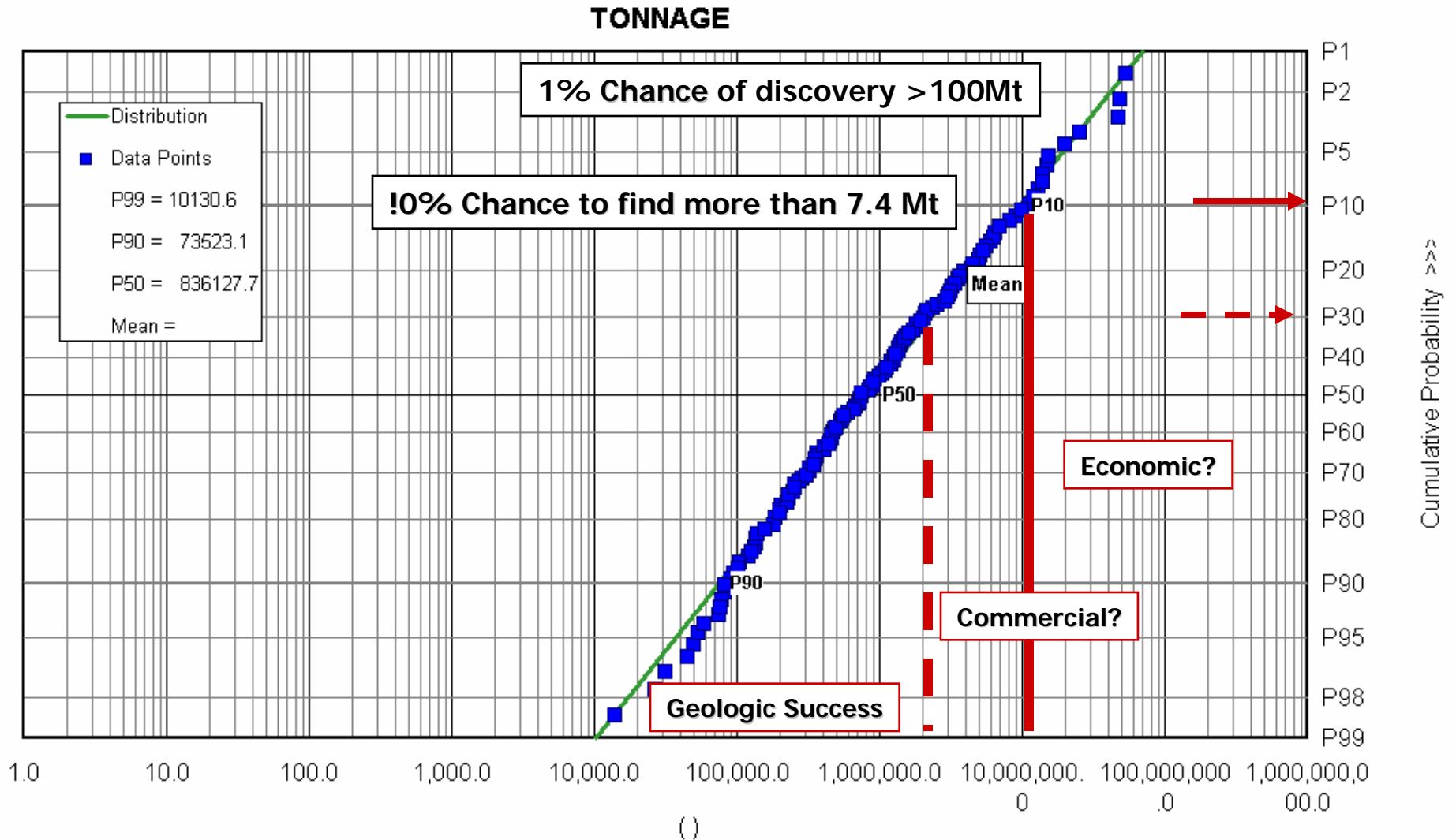
Exploration failure and exploration success (economic, commercial, and geologic).

# What is the chance for a discovery to be economic?

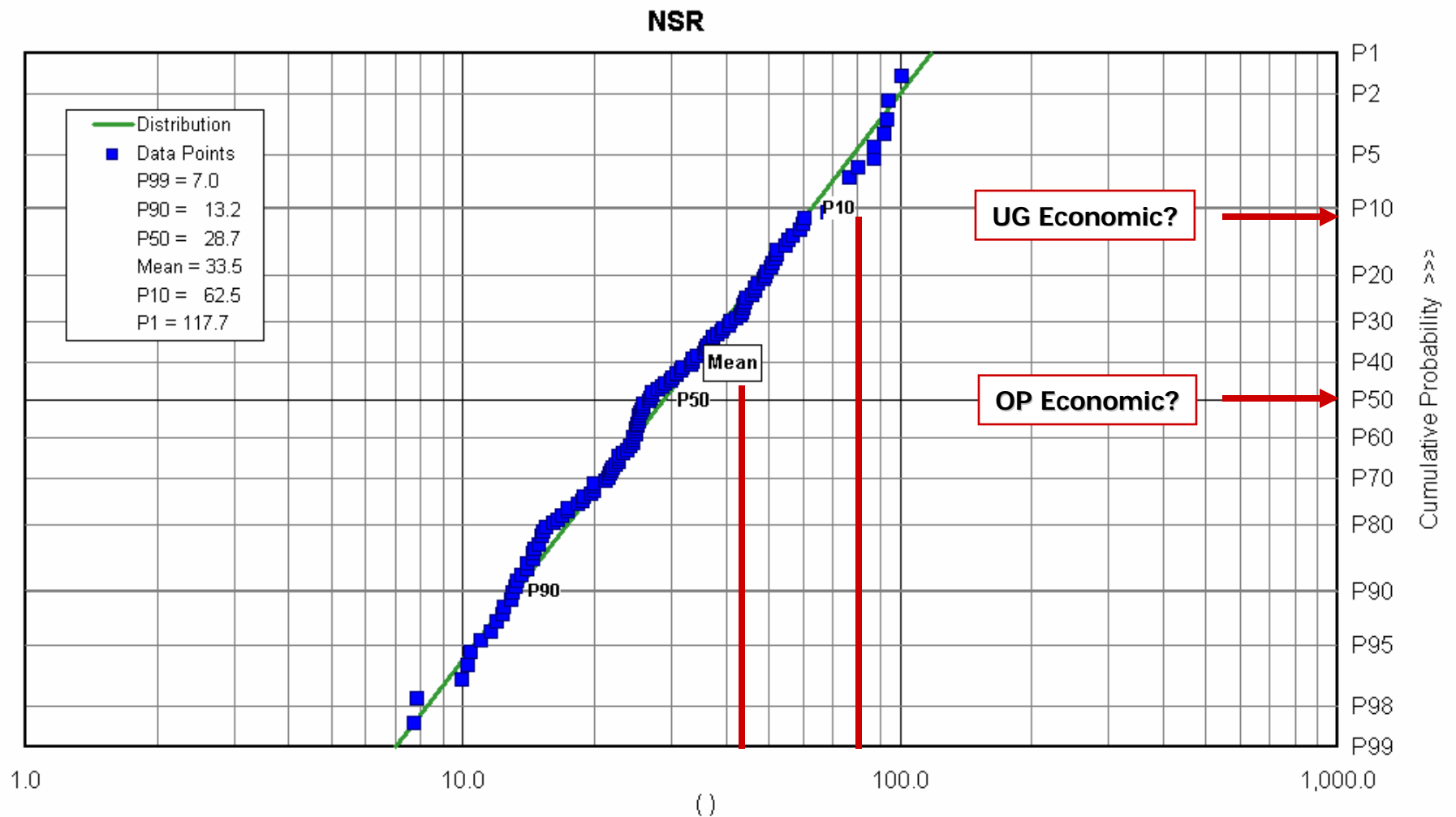
**What the petroleum sector recognized is that mother nature has no bias.... therefore:**

- There is a natural (log-normal) distribution of deposits (tonnes and grade)
- Analyzing camp, region, deposit type, etc., statistics will yield insight to the respective distributions
- Applying a business model will produce target thresholds that applied to the distribution curves gives you the probability of success
- Mapping your project performance against these estimates will reveal your exploration biases

# Distribution of VMS Deposit Size within The Abitibi Greenstone Belt



# Distribution of Average VMS NSR values in the Abitibi



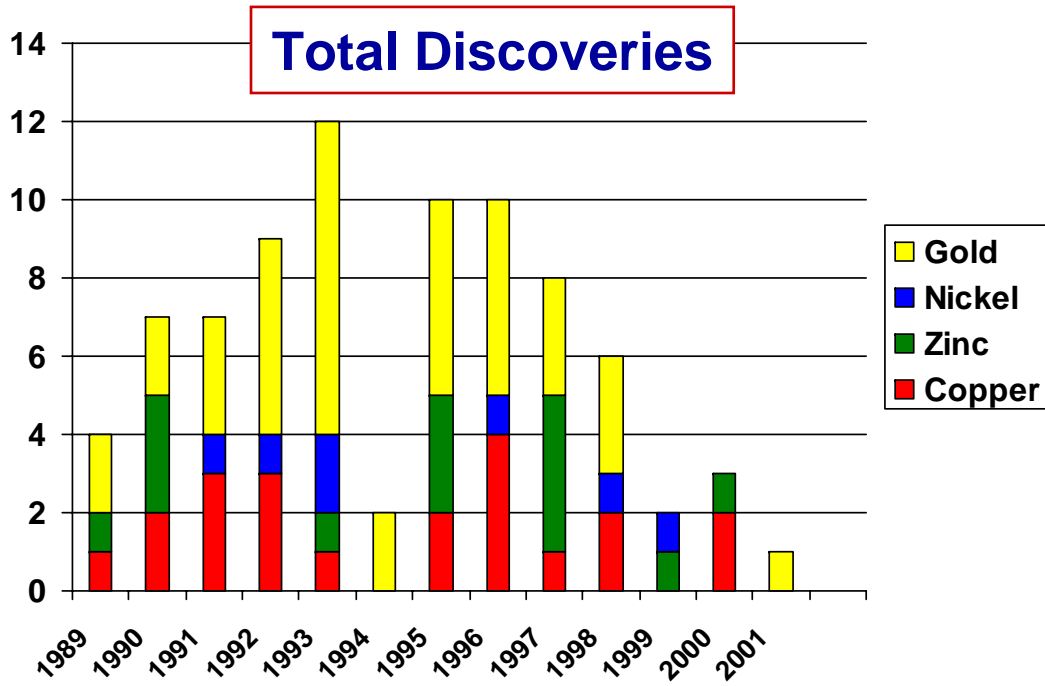
# Understanding Exploration Risk:

## It can affect Strategy

### Example: Explore or Partner?

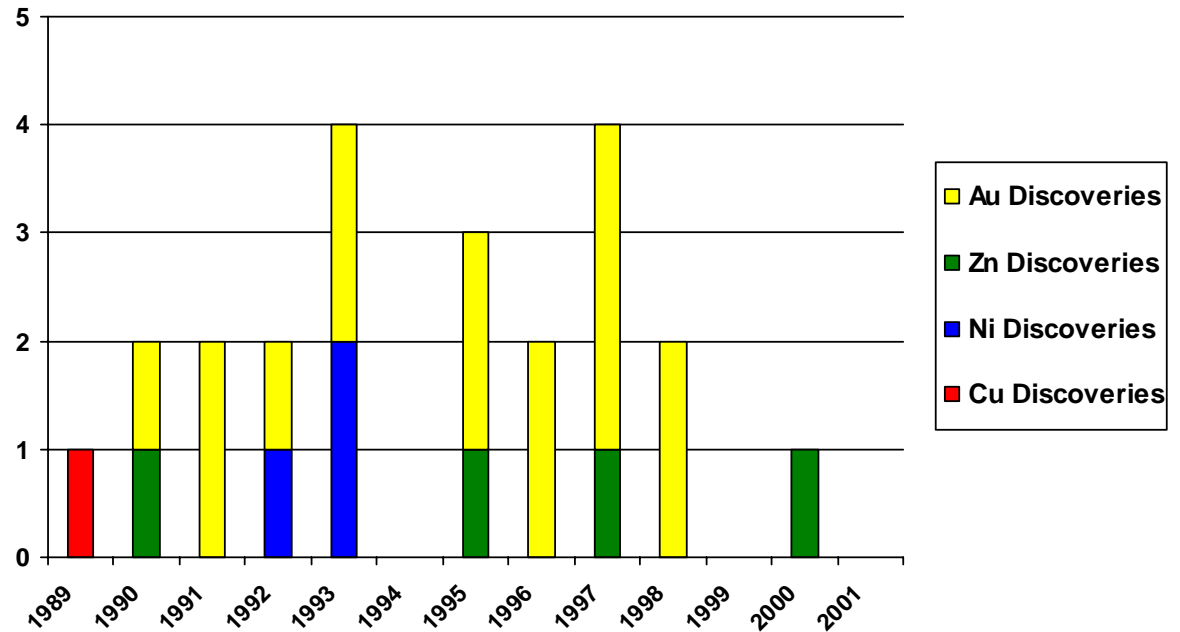
- 1) Assume that the chance of discovery in a given area is 1%
- 2) Assume that the “average” cost to generate a drill ready property through in-house exploration is \$150,000. Thus deterministic analysis would suggest that it would cost \$15MM per discovery.
- 3) Lets assume that by buying into drill ready projects allows us to halve our risk (i.e. 2% chance of discovery). Not including the financial impact the deal might have on the potential project economics, lets assume our average property acquisition cost is \$500,000. (eg. A couple large, better projects) Thus deterministic analysis would suggest the average cost of discovery will rise to \$25MM. In this case this strategy is destroying value!

**The above numbers are “guesstimates”. If we do not know the appropriate measures and risks.... How do we know our strategy is appropriate?**

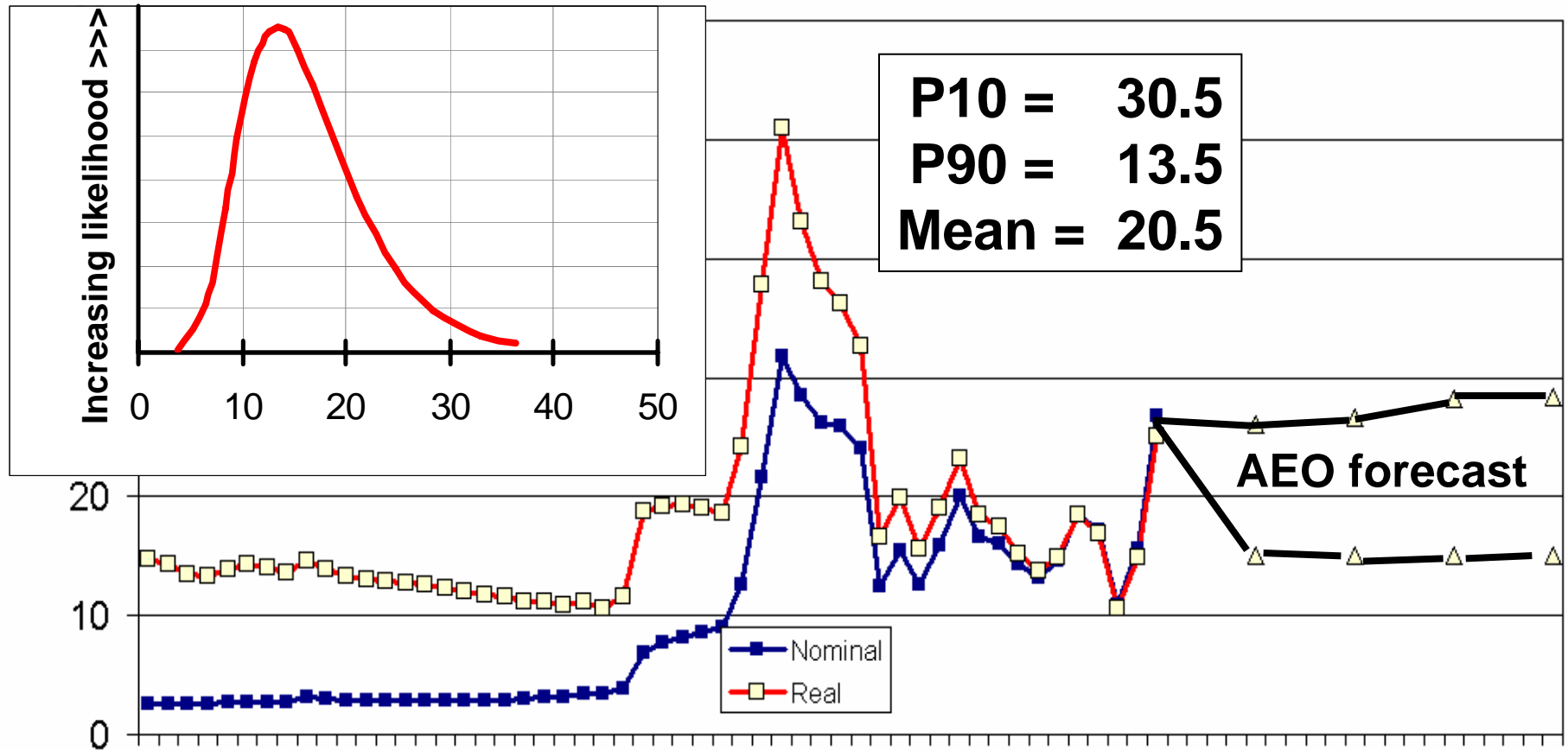


# Number of Discoveries by Year

**The Junior**   
**Discovery Rate**  
*Tough Competition for Majors with acquisition strategies*



# REAL OIL PRICE HISTORY, 1949 - 2000



**FORECAST OIL PRICES PROBABILISTICALLY**

# **Conclusions: Implications of Risk Analysis and Portfolio Management**

- ◆ **Geologic risk is measurable (estimating is possible).**
- ◆ **We can develop probabilistic models from measured geotechnical data**
- ◆ **It is possible to convert geologic concepts to business models using risk analysis tools**
- ◆ **You can reduce (eliminate) motivational bias. Projects (irrespective of deposit type/commodity) can then be objectively managed with respect to economic risk.**
- ◆ **We have tools by which to better understand/implement exploration strategies**
- ◆ **Portfolio management tools can then be used to align projects with corporate objectives**

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***Many thanks to Jim Gouveia and Peter Rose of Rose & Associates. This talk borrows heavily from their petroleum sector, exploration risk management knowledge and experience. I greatly appreciate their support in developing the mineral industry analogs presented in this talk..***