The CCOP Guidelines for Risk Assessment of Petroleum Prospects

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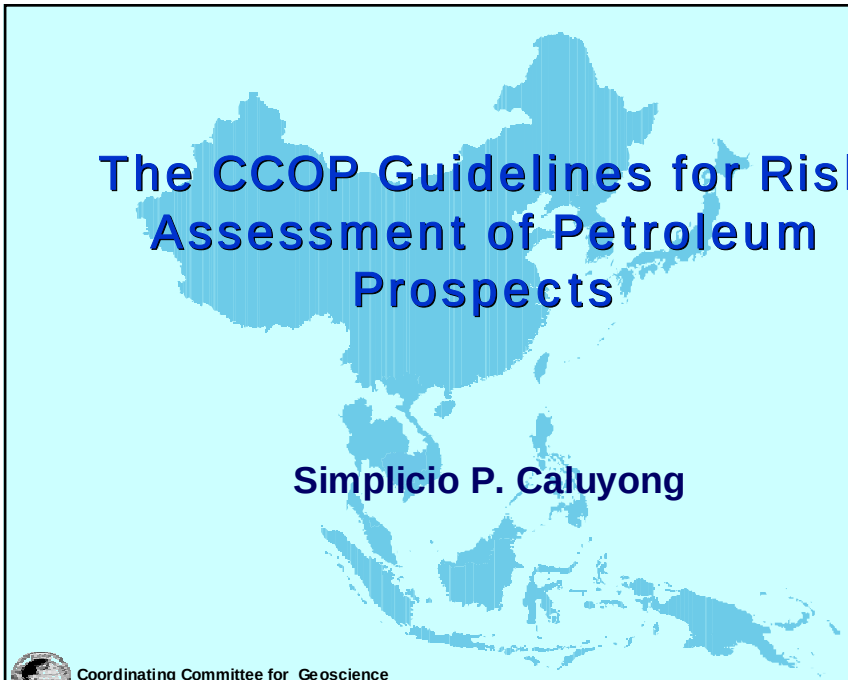

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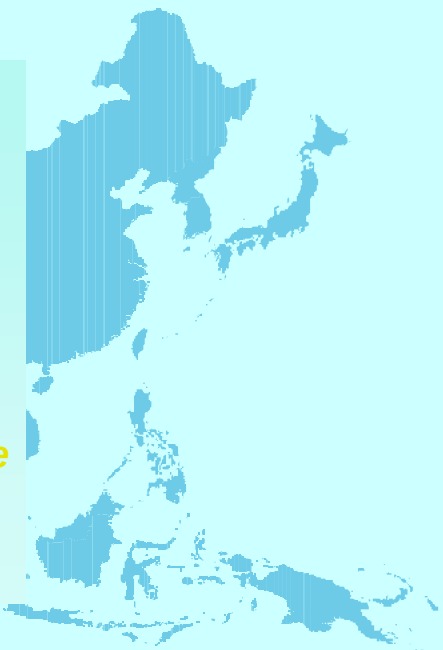

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REP Project, 1996-2002
- *background*

"A step from resource base understanding to evaluating economics and risks"

Outputs:

- Conducted a series of workshops and seminars dealing with resource management and using GeoX as the main software
- Formed a technical working group composed mostly of national coordinators for the REP projects

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REP Project, 1996-2002
- *background*

- Formation of 2 working groups with one group given the tasked of compiling the Guidelines for Risk Assessment
- The compilation were based on data and information passed on during previous NORAD-funded activities in the CCOP such as
  - OGRM (1989-1991)
  - WGRA (1992-1994)
  - REP 1 (1996)

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– Published the following:

- The CCOP Petroleum Resource Classification System, March 1999

- The CCOP Guidelines for Risk Assessment of Petroleum Prospects, July 2000

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- As a reference guideline for Member Countries that do not practice resource risk assessment
- As a reference material for Member Countries who wants to update their existing risk assessment guidelines
- Reduces the subjectivity of risking

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- Estimate the probability of discovery prior to drilling of a mapped prospect
  - Keep in mind that risk is associated with the volumetric calculations! The Probability of discovery is the chance of finding at least the minimum volume
- Calculate the undiscovered resources in an area during play assessment

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Basic requirements

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- REP Project
- Why Risking Guidelines?
- Probability concept
- Risking procedure
- Play & Prospect definition

- Resource classification system
- Clear definitions of play and prospects
- Understanding of the petroleum system

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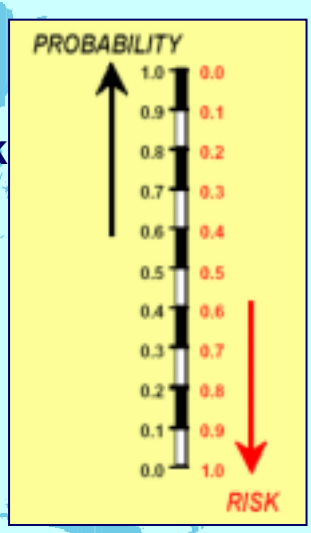
Probability = 1 - Risk



Probability vs risk scale

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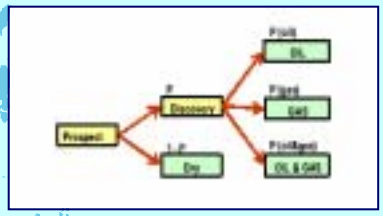
- **Probability of one of several mutually exclusive events:**

Either Outcome A, or outcome B then:

$$P = P_A + P_B$$



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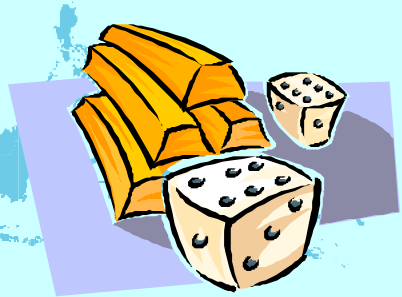
◆ Throwing of dices:

What is the probability of getting either 1 or 2, when throwing a die only once?

$$P_{1or2} = P_1 + P_2 = 1/6 + 1/6 = 2/6 = 0.33$$



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◆ Probability of simultaneous occurrence of several independent events:

Both outcome A, outcome B and outcome C, then:

$$P = P_A \times P_B \times P_C$$

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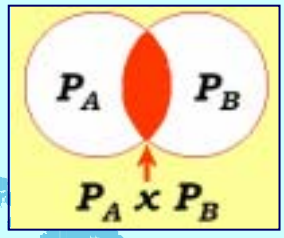
- "Either one or another event, or both events"

The "risk" approach: $1\text{-}P = (1- P_A) \times (1- P_B)$

Quantity considerations:

$$P = P_A + P_B - (P_A \times P_B)$$



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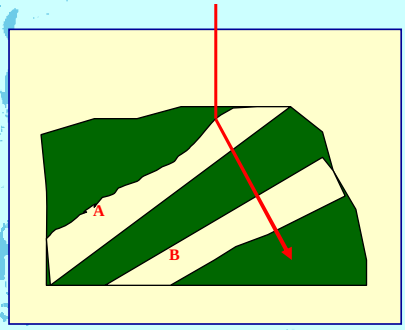
- Assuming 2 types of source rocks at different strat levels (A & B), where:
  - Probability of effective source rock (P_A) = 0.5
  - Probability of effective source rock (P_B) = 0.2

What is the probability of an effective source rock in the area?

$1- P = (1 – P_A) \times (1 – P_B)$ or $1- P = (1-0.5) \times (1-0.2)$

$$P = 1- (0.5 \times 0.8) = 0.6$$



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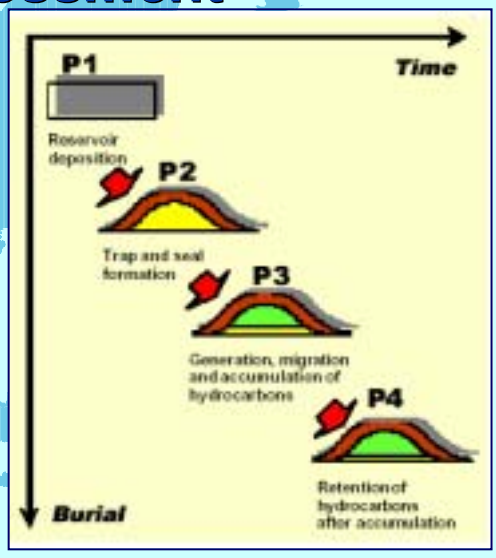
Probability Categories

- Stochastic probabilities
  - Measured values
  - Success rates, etc
- Objective probabilities
  - Logical arguments
  - Analogue events, etc
- Subjective probabilities
  - Beliefs
  - "guts feeling", etc

Geochronological Risk Assessment

This principle is mainly applied to avoid double risking



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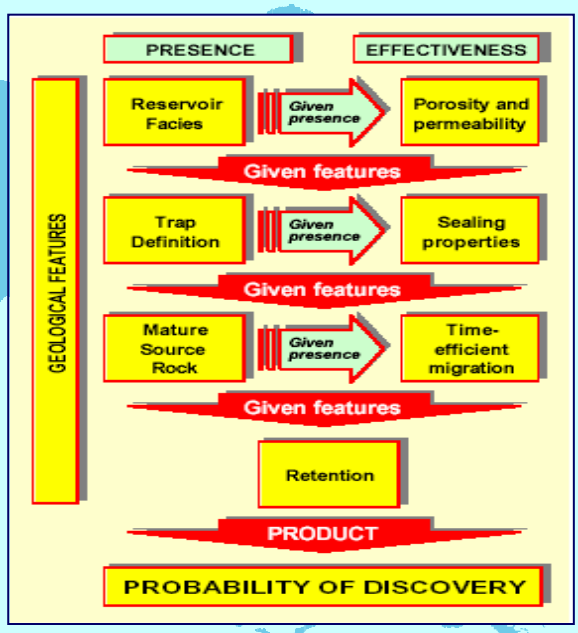

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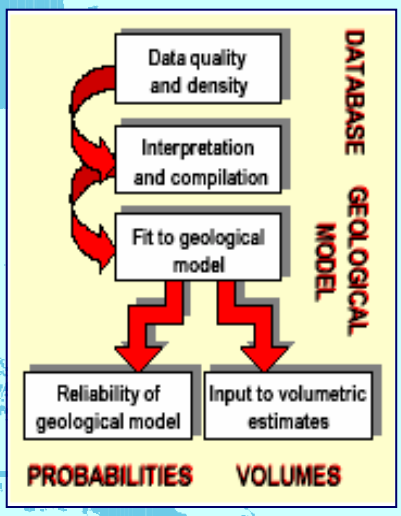
- Database must be also be assessed with respect to the prospect under evaluation
- Database consists of geological, geochemical and geophysical data
- Interpretation and compilation in most cases by interpolation and extrapolation to establish a model for the geological factors



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P	General Scale	Analogue or Theoritical Models	Proven Geological Models	P
1	Condition is virtually to absolutely certain. Data quality and control is excellent	Only possible modelm applicable for the concerned area. Unfavourable models are	Identical geological factor to those found in fields and discoveries in immediate vicinity. Conditions are verified by unambiguous well and seismic control	1
0.9		The model is very likely to absolutely certain. Unfavourable models can be applied		0.9
0.8	Condition is probable. Data control and quality is good. Most likely interpretation	The model is very likely. Only minor chance that unfavourable models can be applied.	Similar geological factor successfully tested by wells in the trend. Lateral continuity is probable as indicated by convincing well and seismic control	0.8
0.7		The model is likely to very likely. Unfavourable models can be applied		0.7
0.6	Condition is probable or data control and quality is fair. Favourable interpretation	The model is more likely than all other unfavourable models	Similar geological factor is known to exist within the trend. Lateral continuity is probable as indicated by convincing well and seismic control	0.6
0.5		Likely model, however, unfavourable are also likely		0.5
0.4	Condition is possible or data control and quality is poor to fair. Less favorable interpretation	Unfavorable models are more likely than applied model	Similar geological factor may exist within the trend. Valid concepts, but unconvincing data only hints at possible presence of the feature.	0.4
0.3		The model is questionable and unfavorable models are likely to very likely		0.3
0.2	Condition is virtually to absolutely impossible. Data control and quality is excellent	The model is unlikely and very questionable. Unfavourable models are very likely to certain	The geological factor is not known to exist within the trend. Conditions are verified by unambiguous well and seismic control.	0.2
0.1		The model is unlikely and highly questionable. Unfavourable models are very likely to certain		0.1

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- **Model with direct data** — **Probability**
  - Favorable — 0.7 – 0.9
  - Unfavorable — 0.1 – 0.3
- **Model with indirect data**
  - Encouraging — 0.5 – 0.7
  - Questionable — 0.3 – 0.5

(Otis and Schneiderman, 1977)

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Conditional Probabilities

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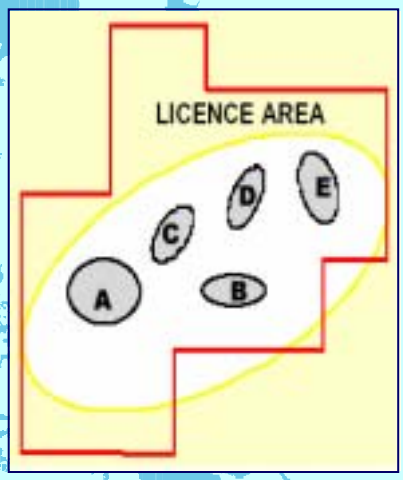
◆ **Bayes Theorem**

" Interdependency between prospects means that the result of the drilling of any one prospect (discovery or otherwise) will impact on the probability of making a discovery in all of the other prospects"



Play Probabilities

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Defined as a group of prospects within a geographically delimited area, where a set of mutually related geological factors must be present concurrently in order to permit the discovery of hydrocarbons

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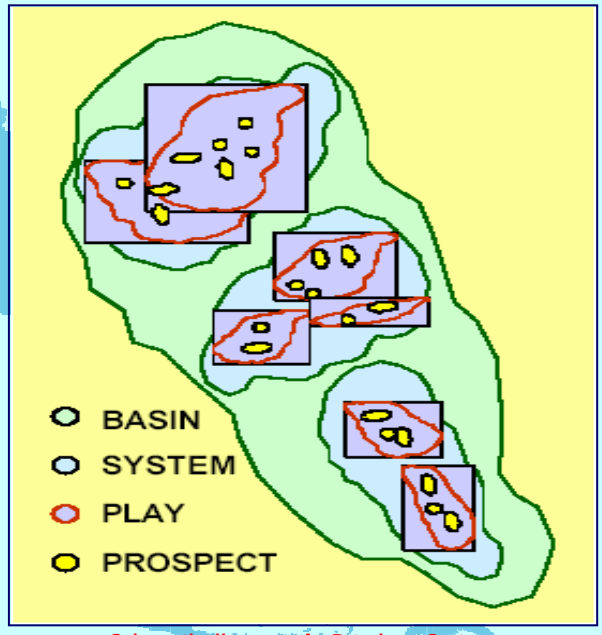

Schematic diagram of a Petroleum System

Summary

- It is important for Governments to determine the total petroleum risked resources
- Ranking of basins as well plays and prospects within the basin is an important tool for government to determine appropriate strategies for exploration, licensing and investment promotion
- A risking guideline helps reduce subjectivity in risking and provides a consistency in the calculation of the resources
- Member Countries can advantage of the guidelines published by CCOP

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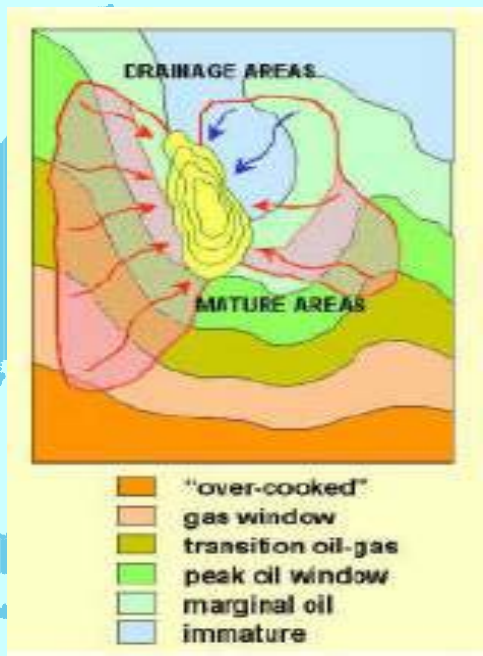
Maturity map with drainage areas and migration paths



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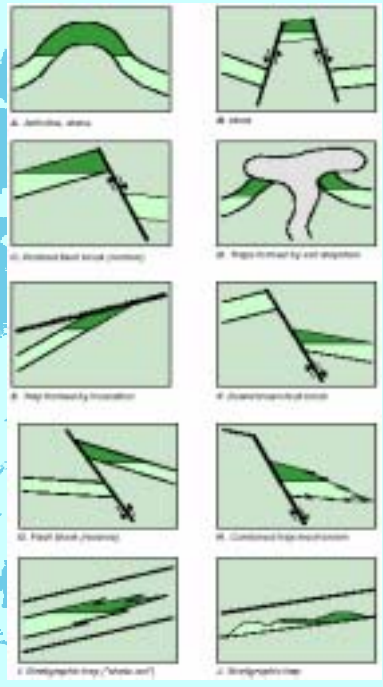
Examples of trap mechanism



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Probability of an Effective Charge

Factors to be evaluated

-quality and maturity of the potential source rocks

--what type of hydrocarbon are generated

-- volume of mature source rock within the drainage area

-- points in time for onset and end of oil migration

-- points in time for onset and end of gas migration

-- mapping of drainage area and migration routes,

-- mapping of "fill-spill" relationship

PROBABILITY OF EFFECTIVE PETROLEUM CHARGE

P3 = P3a x P3b, where:

P3a: Probability of effective source rock in terms of the existence of sufficient volume of mature source rock of adequate quality located in the drainage area of the mapped structure.

P3b: Probability of effective migration of hydrocarbons from the source rock to the mapped structure.

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	DATA RELEVANCE	DATA COVERAGE	DATA QUALITY
SEISMIC DATA	Critical for prospect identification and mapping. Also important for mapping of basin configuration.	Seismic grid density compared to prospect acreage.	Critical for prospect identification and mapping.
WELL DATA	Critical for correlation to seismic data, and determination of geological models.	Number of wells penetrating relevant stratigraphic intervals.	Critical for correlation to seismic data, and determination of geological models.
SURFACE DATA	Limited relevance for prospect identification, quite useful for determination of geological models	Sampling density critical for establishment of correct geological model.	Only useful if correlation to seismic data is possible (direct or indirect).
GRAV./MAG. DATA	Useful mostly for establishing regional geological models; identification of basement highs, estimates of total sediment thickness, basin configuration and occasionally for prospect definition.		
GENERAL	Depending on distance to prospect.	Critical for interpolation and extrapolation of geological models to given prospect.	Must be evaluated with respect to existence of alternative interpretations and models.

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Thank you!
http://www.ccop.or.th/projects/PPM.html
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