



Commercial and financial aspects in Classification and Management

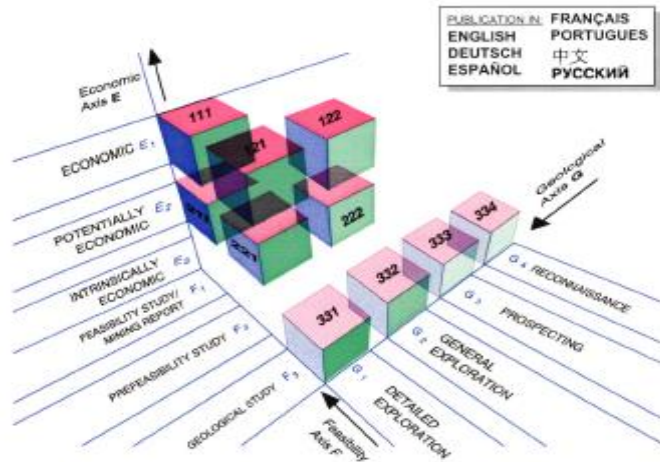
By Sigurd Heiberg, PETRAD and Carolina Coll, International Finance Corporation

Changes to UNFC and the SPE classifications



UNECE

UNFC 1997



UNFC 2009

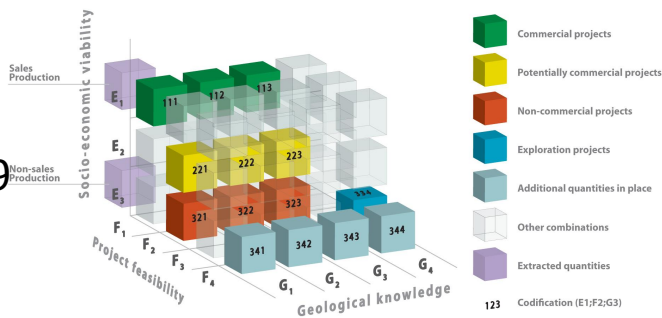


FIGURE 1 - RESOURCES CLASSIFICATION SYSTEM

		PRODUCTION		
		RESERVES		
		PROVED	PROVED plus PROBABLE	PROVED plus PROBABLE plus POSSIBLE
		CONTINGENT RESOURCES		
		LOW ESTIMATE	BEST ESTIMATE	HIGH ESTIMATE
		UNRECOVERABLE		
		PROSPECTIVE RESOURCES		
		LOW ESTIMATE	BEST ESTIMATE	HIGH ESTIMATE
		UNRECOVERABLE		
		← RANGE OF UNCERTAINTY →		
TOTAL PETROLEUM INITIALLY-IN-PLACE	DISCOVERED PETROLEUM INITIALLY-IN-PLACE			
	UNDISCOVERED PETROLEUM INITIALLY-IN-PLACE			
TOTAL PETROLEUM INITIALLY-IN-PLACE	COMMERCIAL			
	SUB-COMMERCIAL			

SPE 2009

		PRODUCTION		Project Maturity Sub-classes	
		RESERVES		On Production	
				Approved for Development	
				Justified for Development	
		CONTINGENT RESOURCES		Development Pending	
				Development Unclearified or On Hold	
				Development not Viable	
		UNRECOVERABLE			
		PROSPECTIVE RESOURCES		Prospect	
				Lead	
				Play	
		UNRECOVERABLE			
		← RANGE OF UNCERTAINTY →		↑ Increasing Chance of Commerciality	
TOTAL PETROLEUM INITIALLY-IN-PLACE (PIIP)	DISCOVERED PIIP				
	UNDISCOVERED PIIP				
TOTAL PETROLEUM INITIALLY-IN-PLACE (PIIP)	COMMERCIAL				
	SUB-COMMERCIAL				

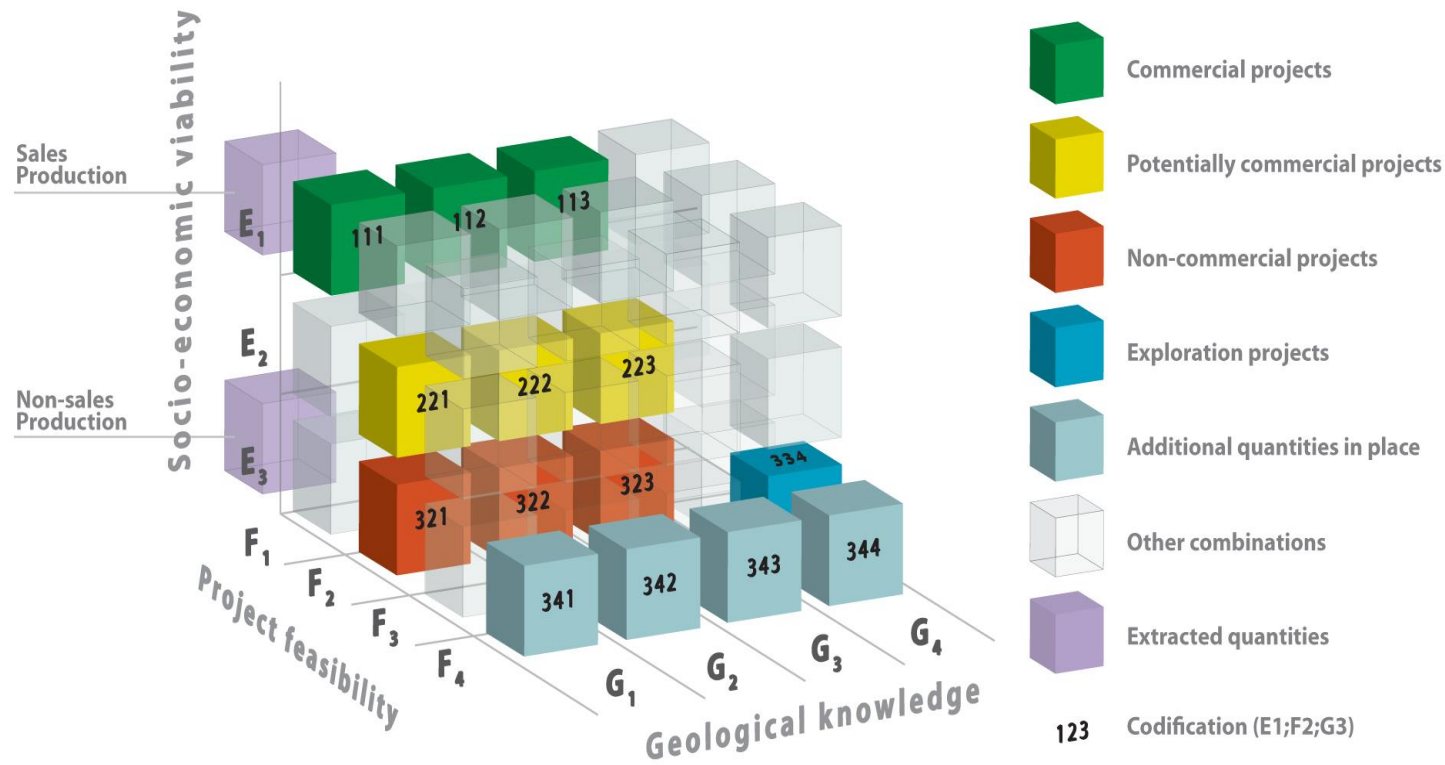
Not to scale

SPE PRMS 2007

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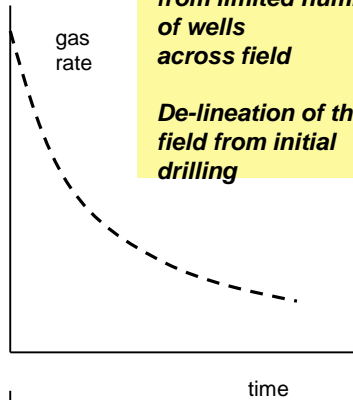
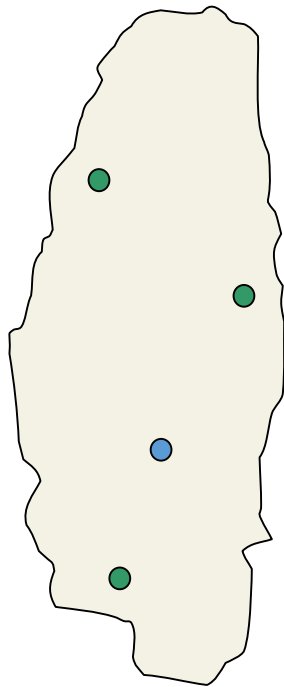


Conventional hydrocarbon reservoirs and continuous reservoirs (Shale gas in source rocks)



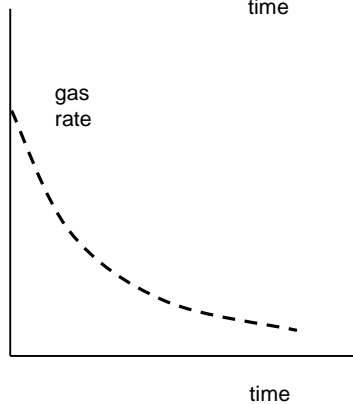
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Conventional

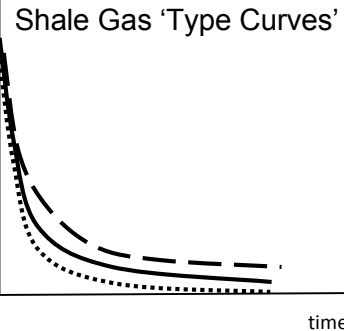
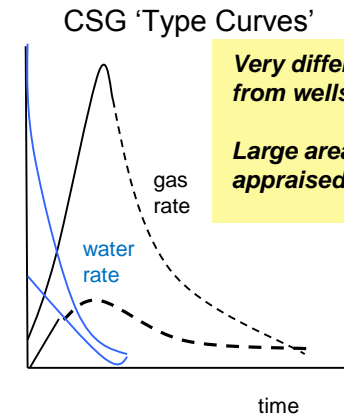
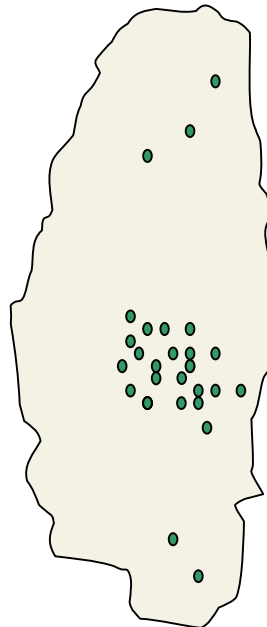


Typically, similar performance from limited number of wells across field

De-lination of the field from initial drilling



Unconventional



Very different performance from wells quite close together

Large areas of field not yet fully appraised

Geology (fractures, faults), Rock properties (por, k, brittleness, Fluid properties (type, viscosity)

Horizontal/vertical well spacing

Success of fracture stimulation critical – can vary significantly

Early production has major effect on economics

Importance of later behaviour of type curves:

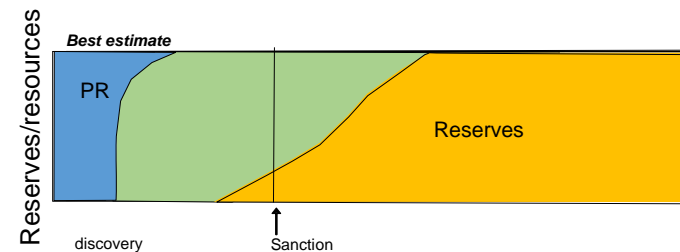
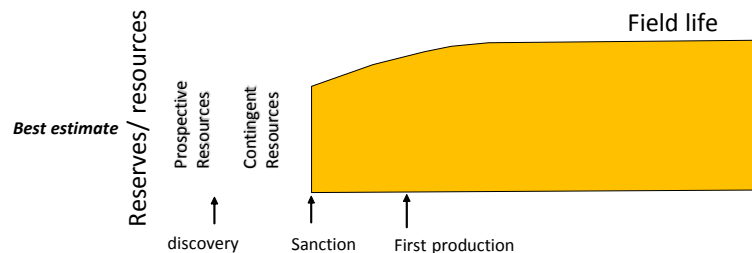
- only limited data available
- level of reserves booking very dependent on the late decline

Conventional vs. Unconventional Booking Methodology



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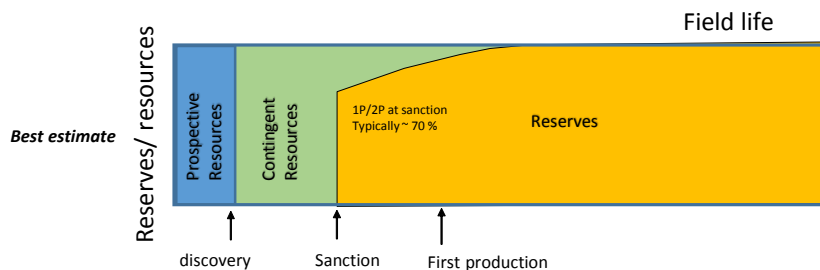
Conventional	Unconventional
Major uncertainty - volumes in place + water influx	Major uncertainty –number of wells needed to recover gas
Well deliverability defined with limited number of early appraisal wells	Deliverability changing considerable due to variability in reservoir properties
Development – limited number of major stages	Development- Continuous appraisal as field developed
Commitment typically when enough percentage of reserves are proved	Early commitment when Reserves to Total Resource ratios are low
Limited remedial action if initial reserves estimates incorrect	Under-performance could be overcome by infill drilling but economics then critical



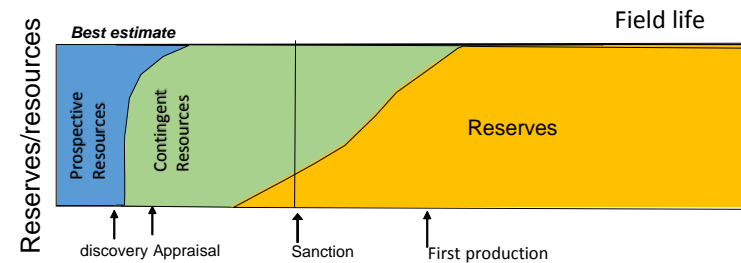
Conventional vs. Unconventional Booking Methodology

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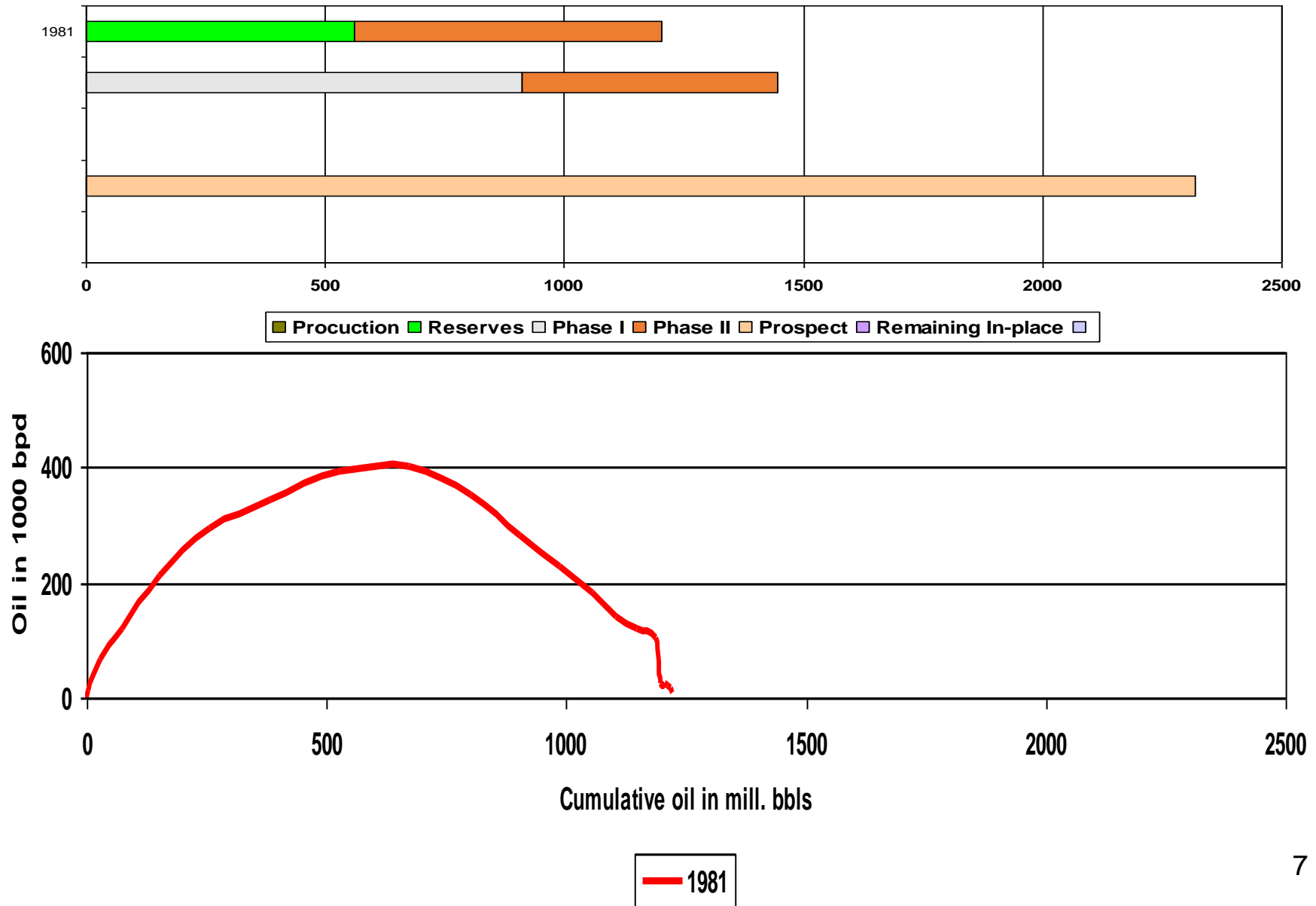
Development planned on basis of 2P reserves



**Development planned
On basis of Discovered Resources**



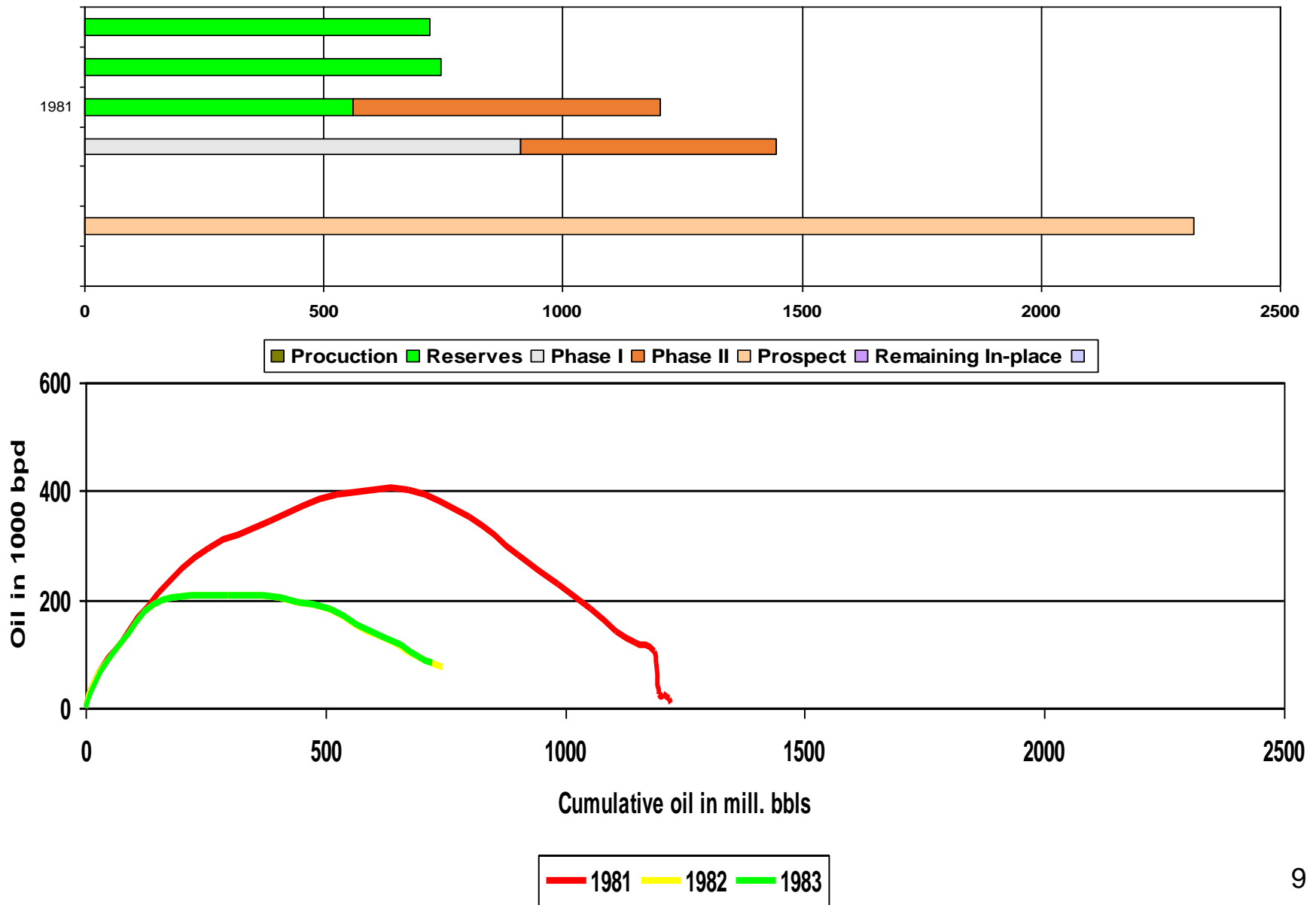
Gullfaks forecasts and production 1981 - 2005



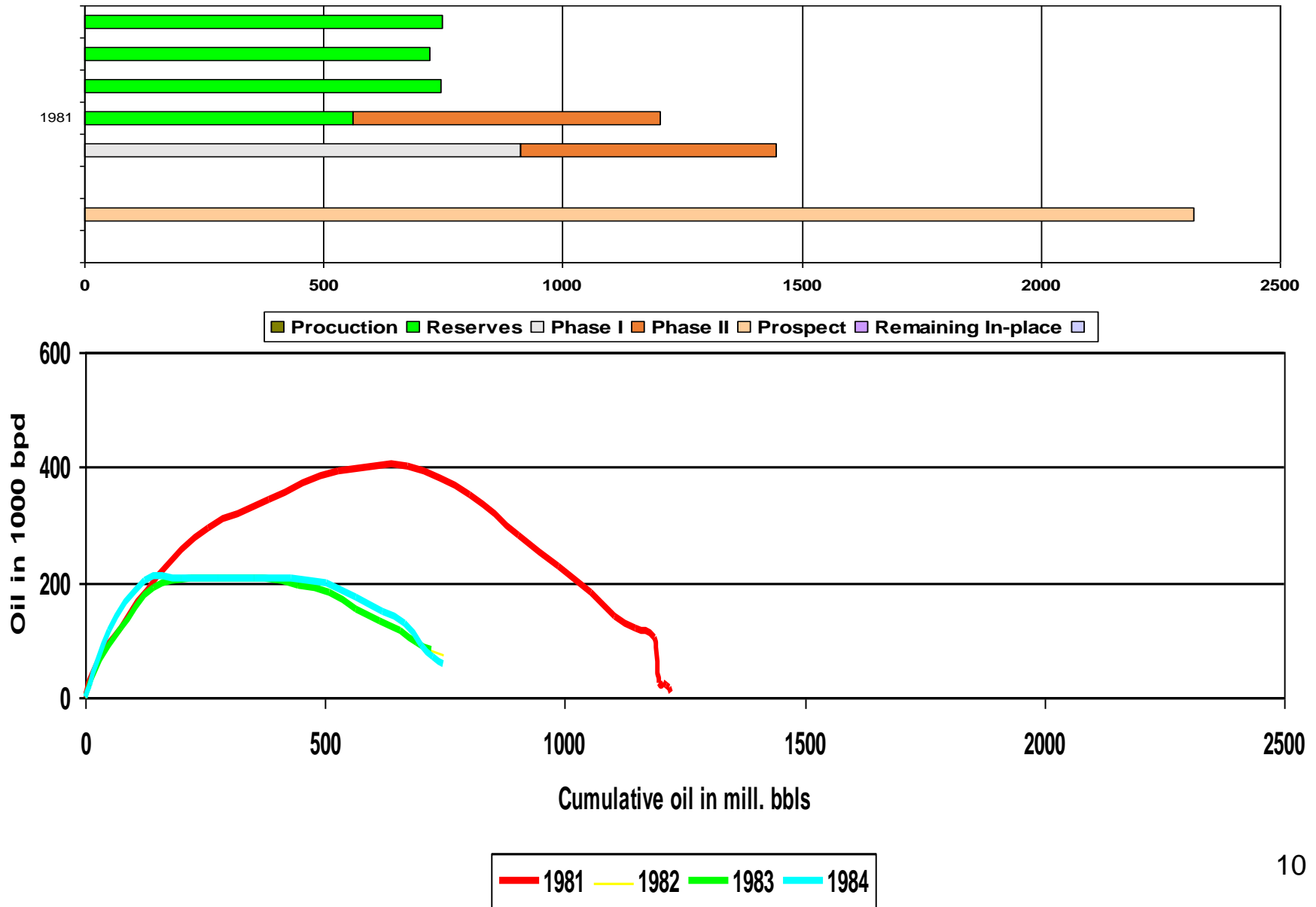
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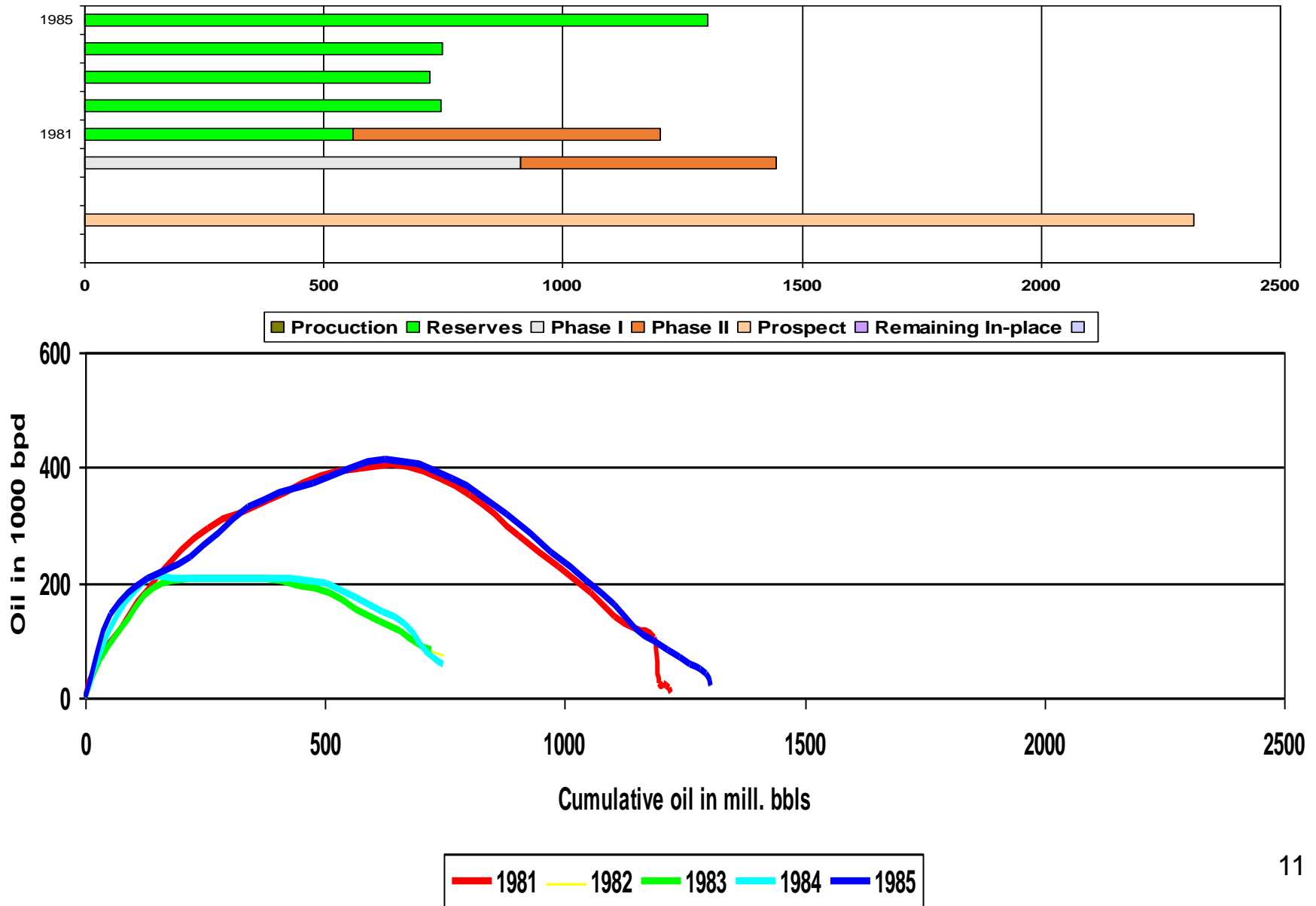
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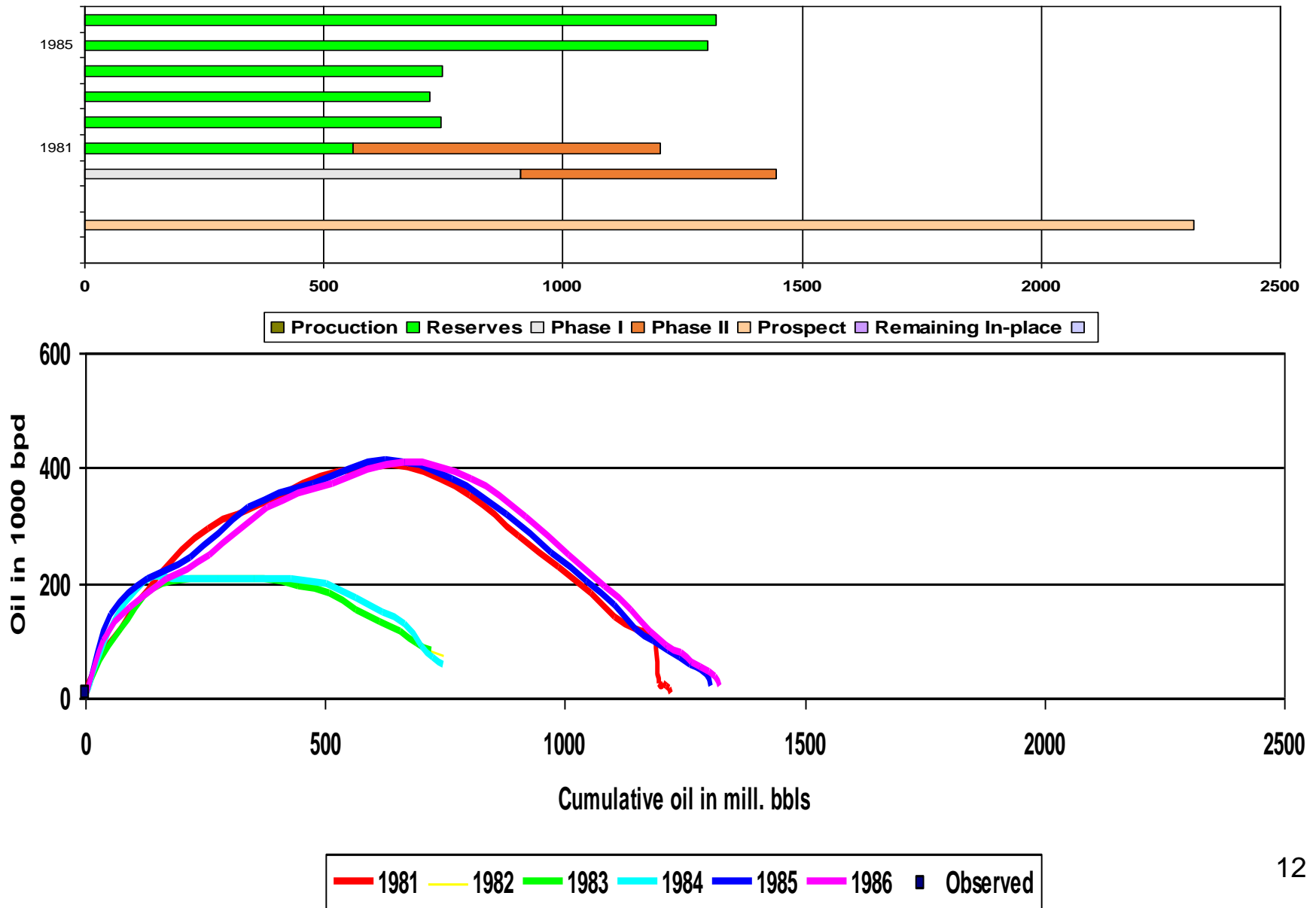
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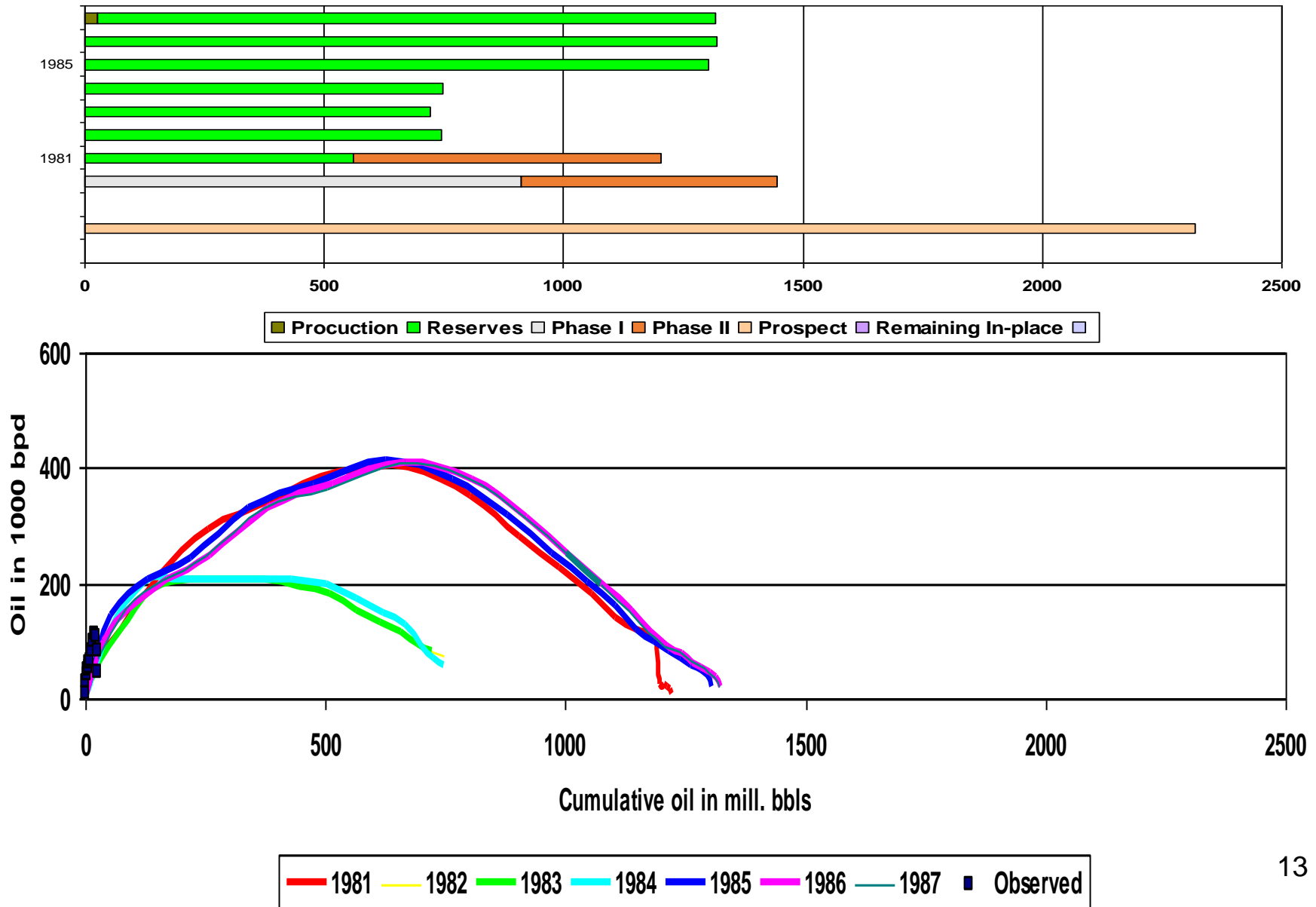
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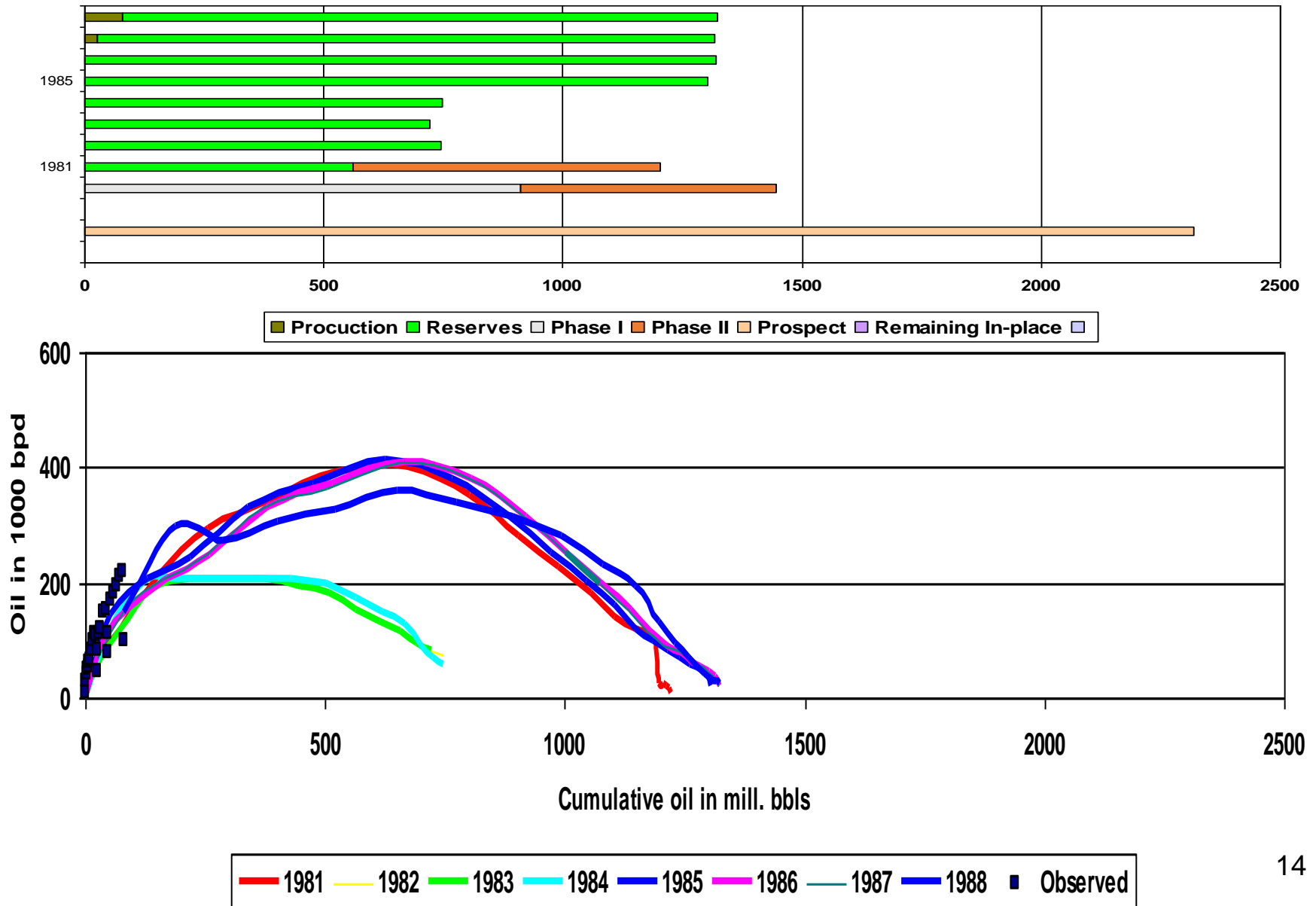
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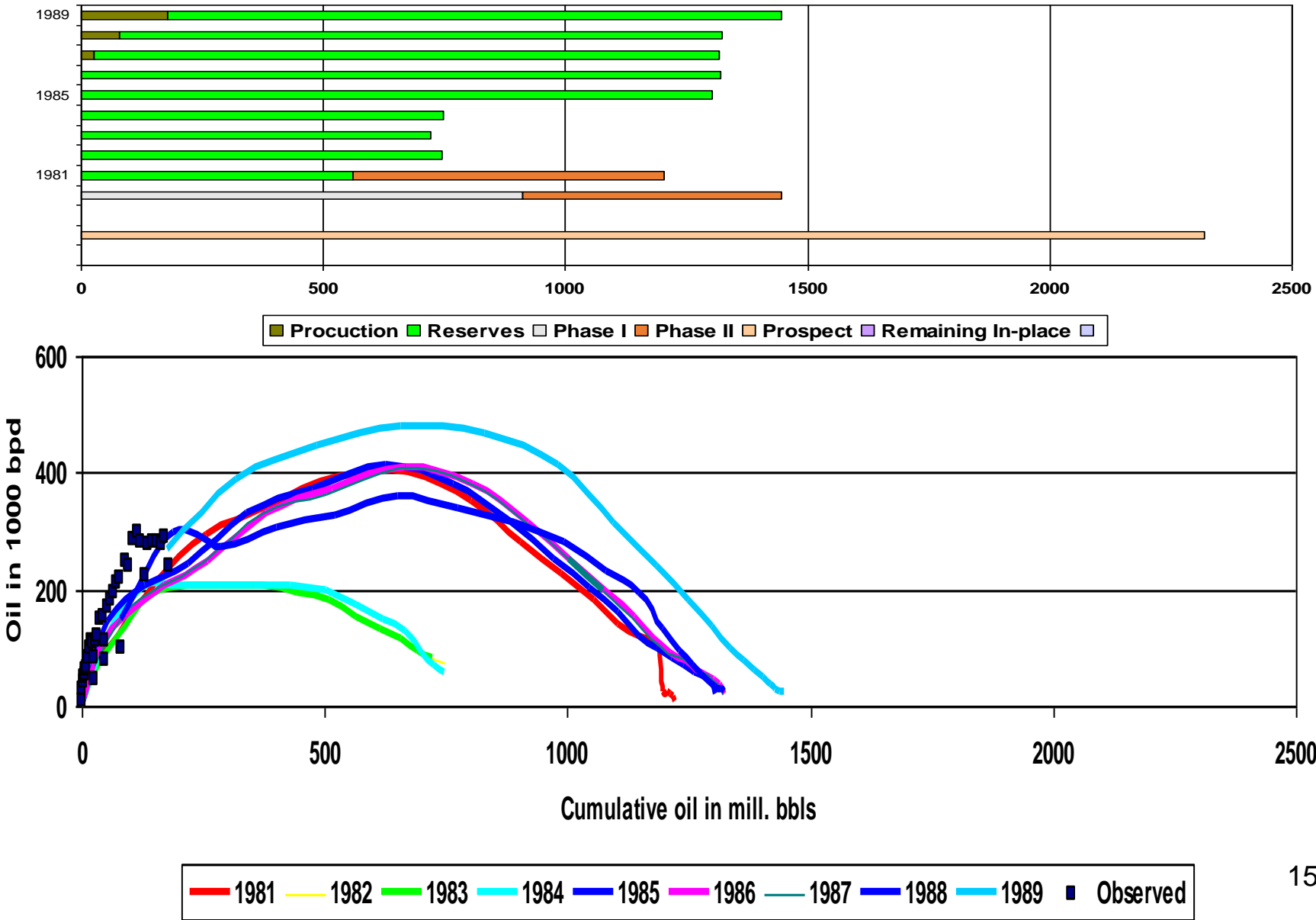
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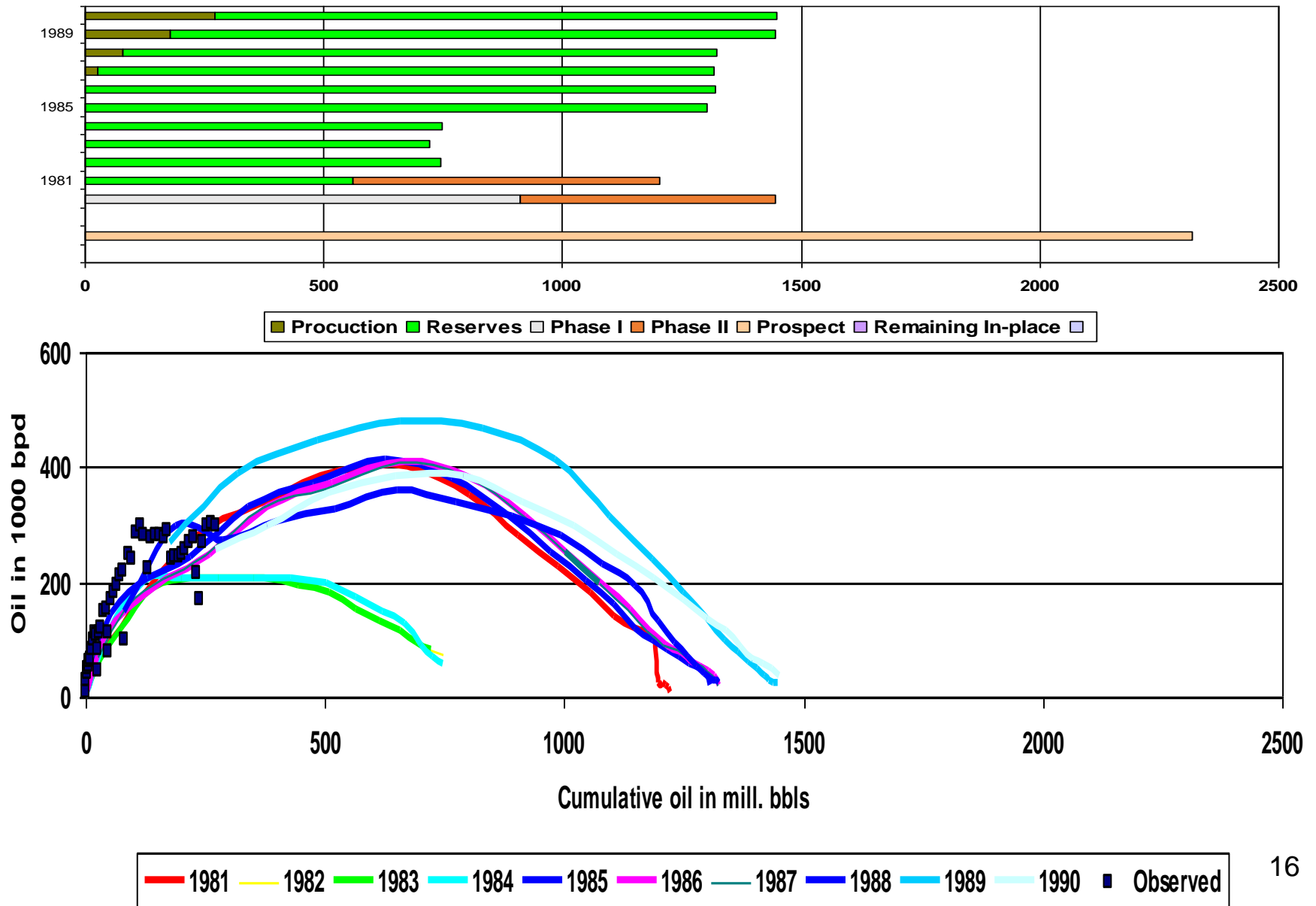
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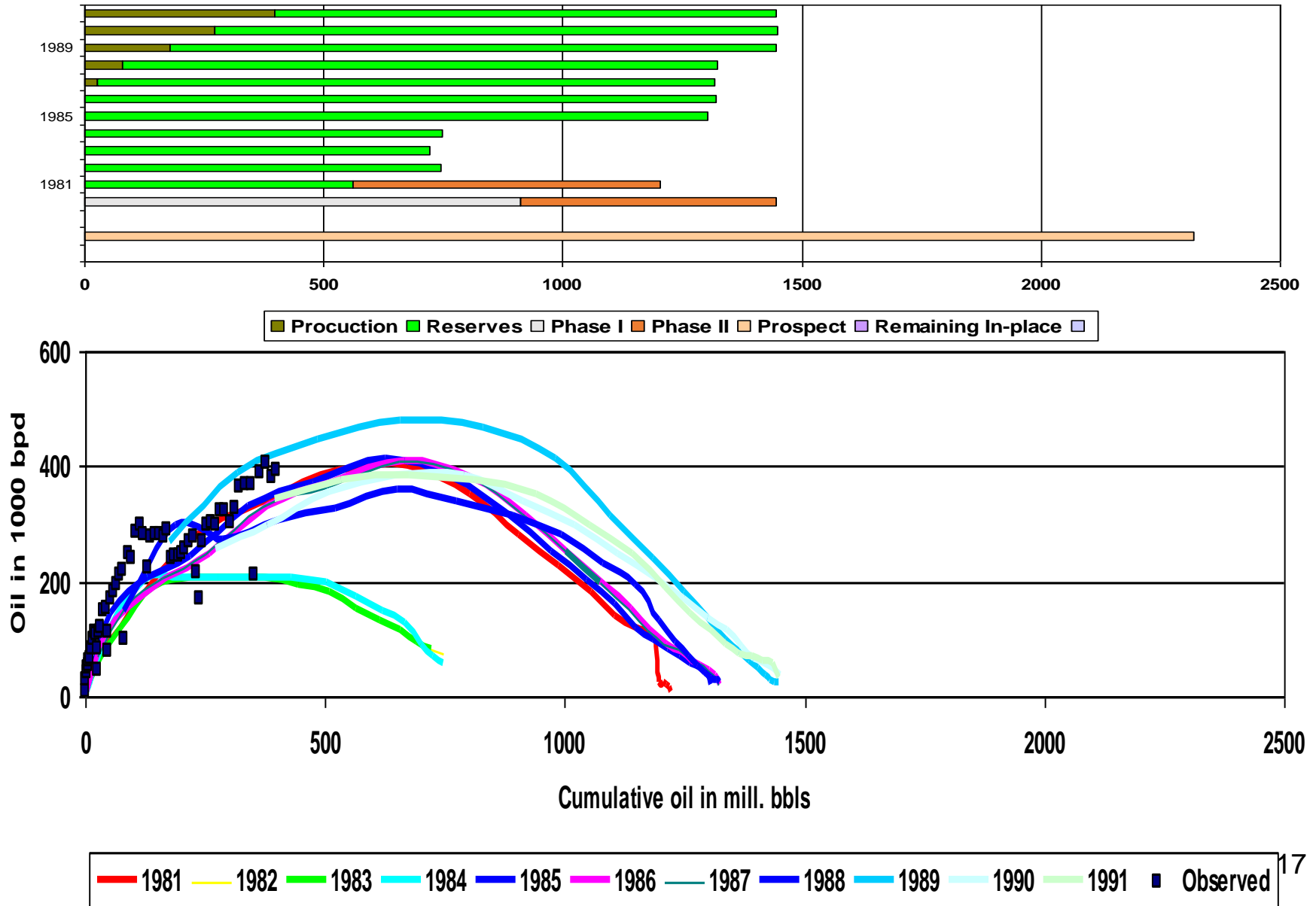
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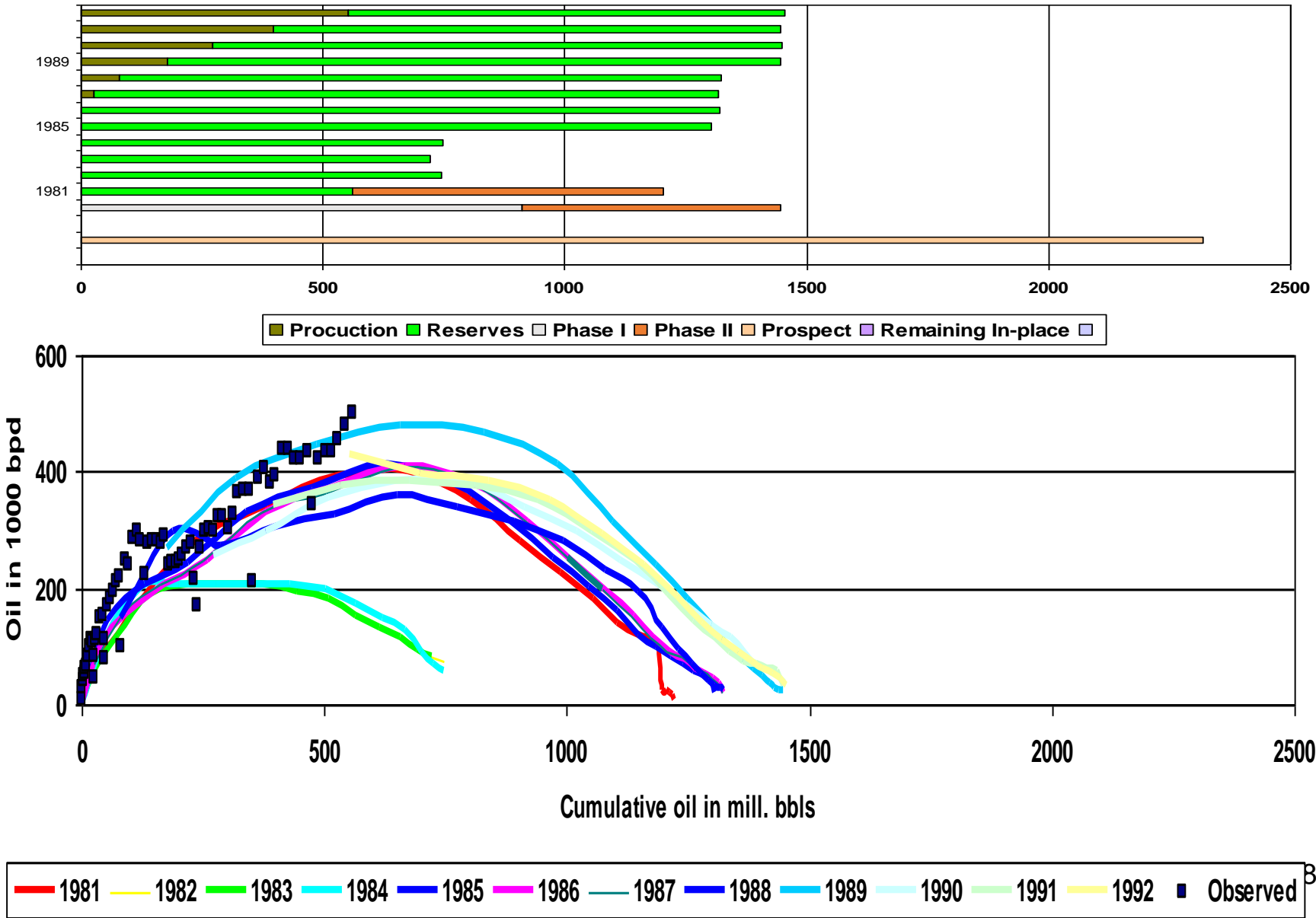
Gullfaks forecasts and production 1981 - 2005



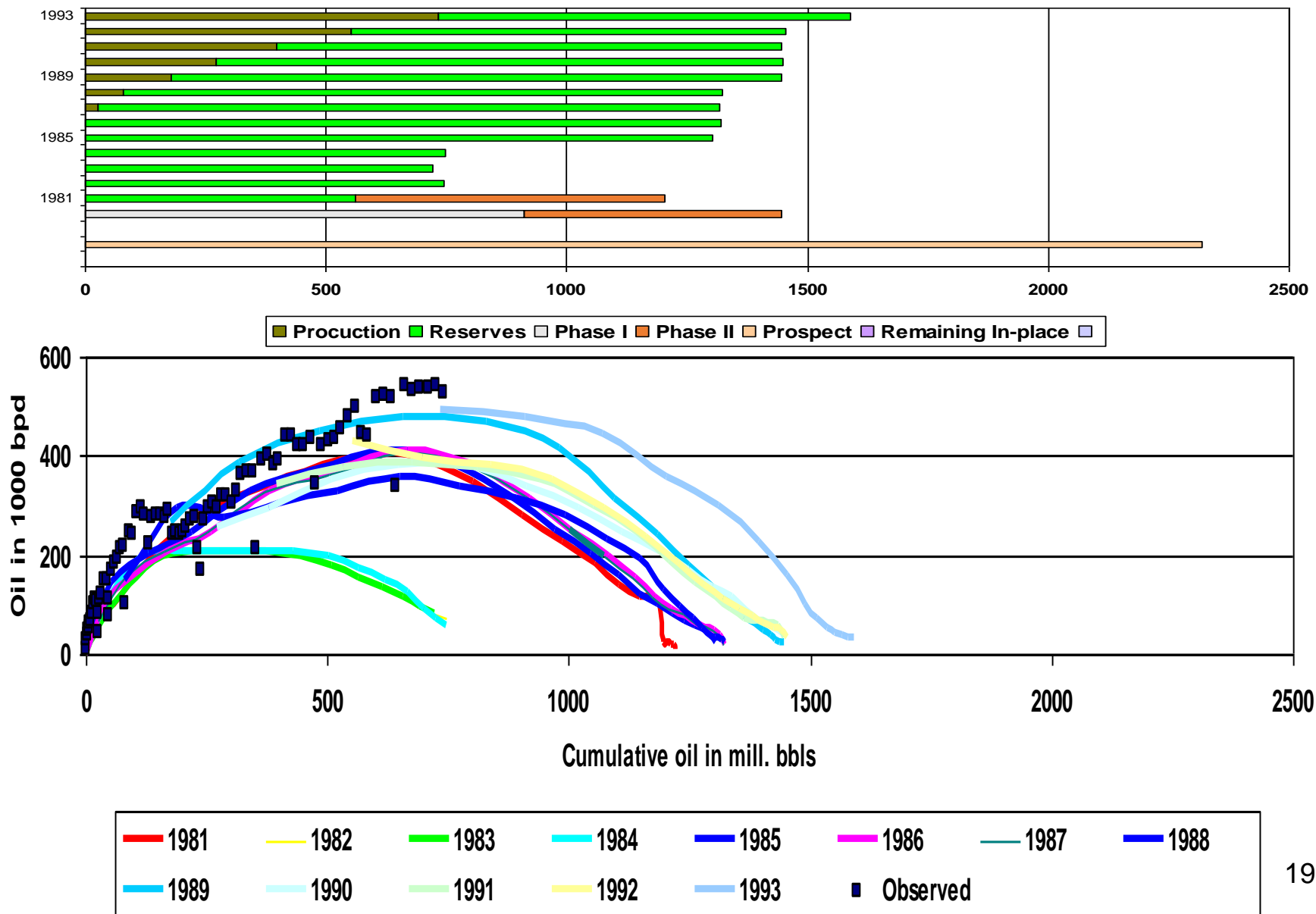
Gulfaks forecasts and production 1981 - 2005



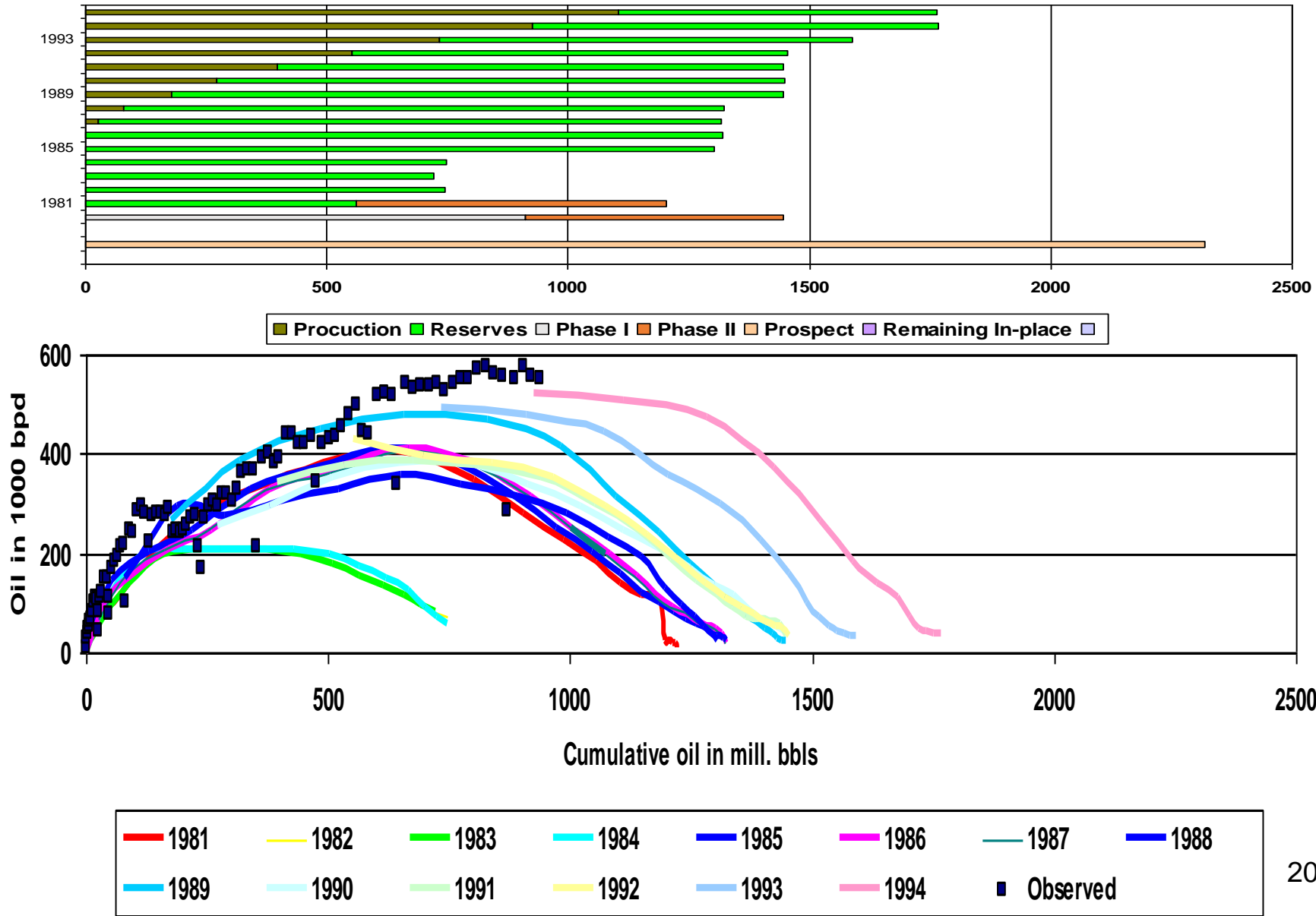
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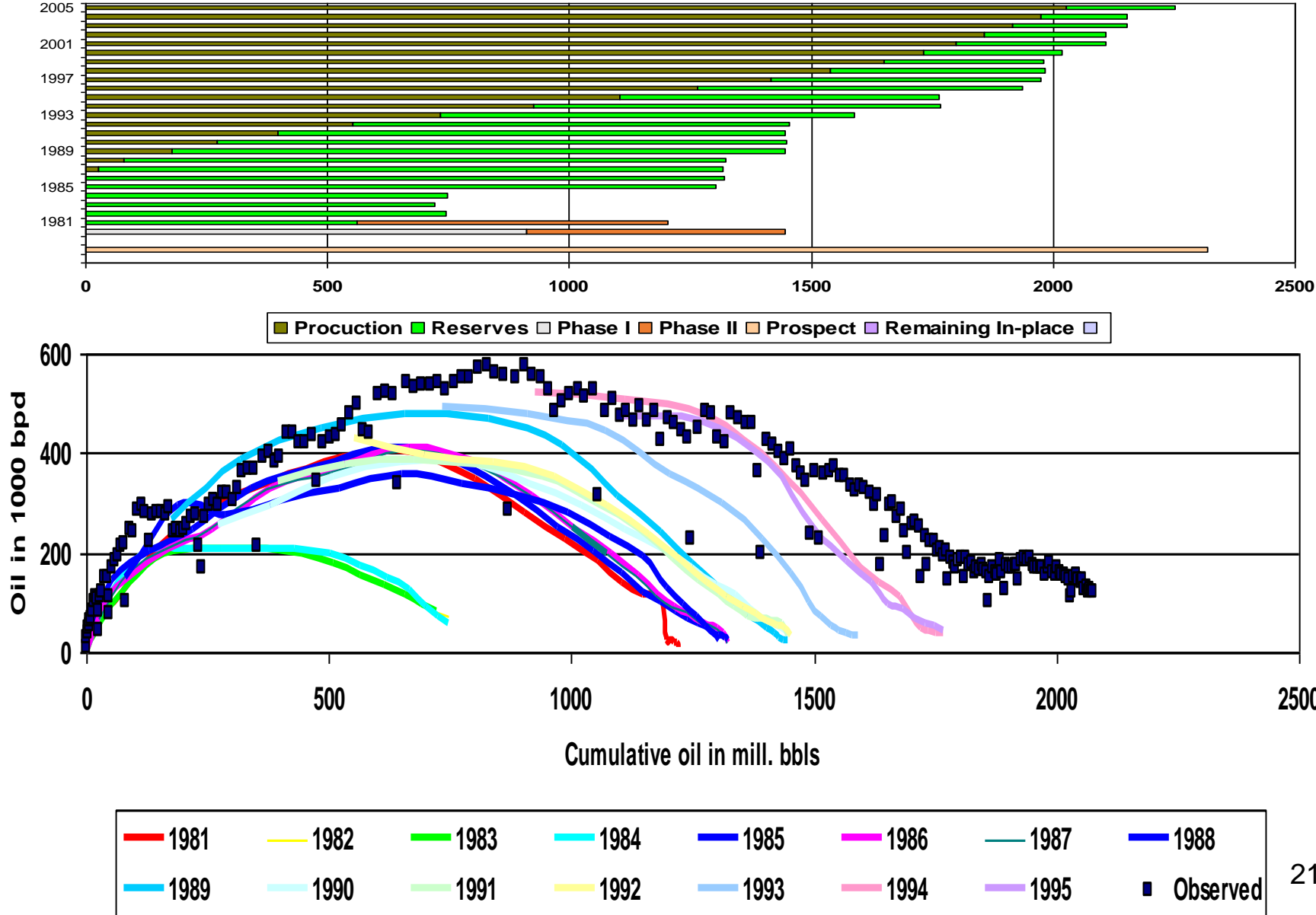
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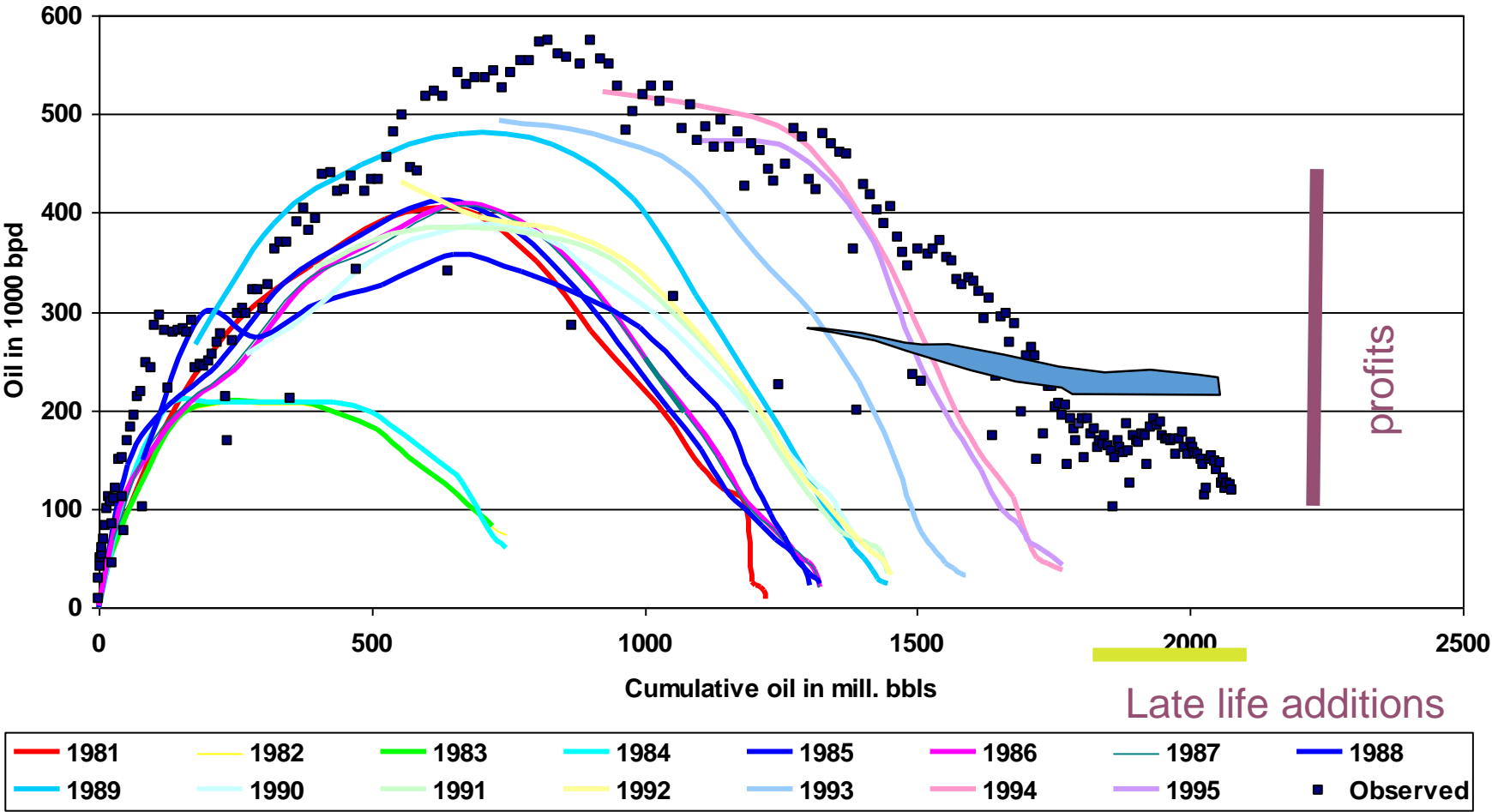
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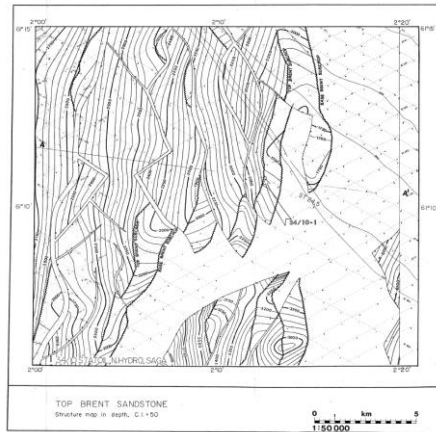
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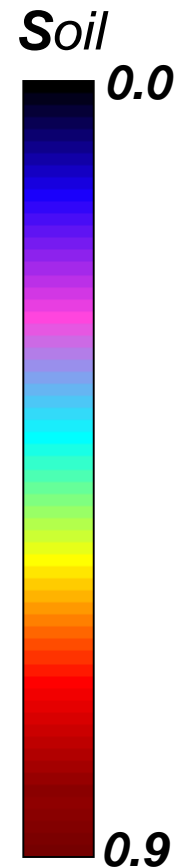
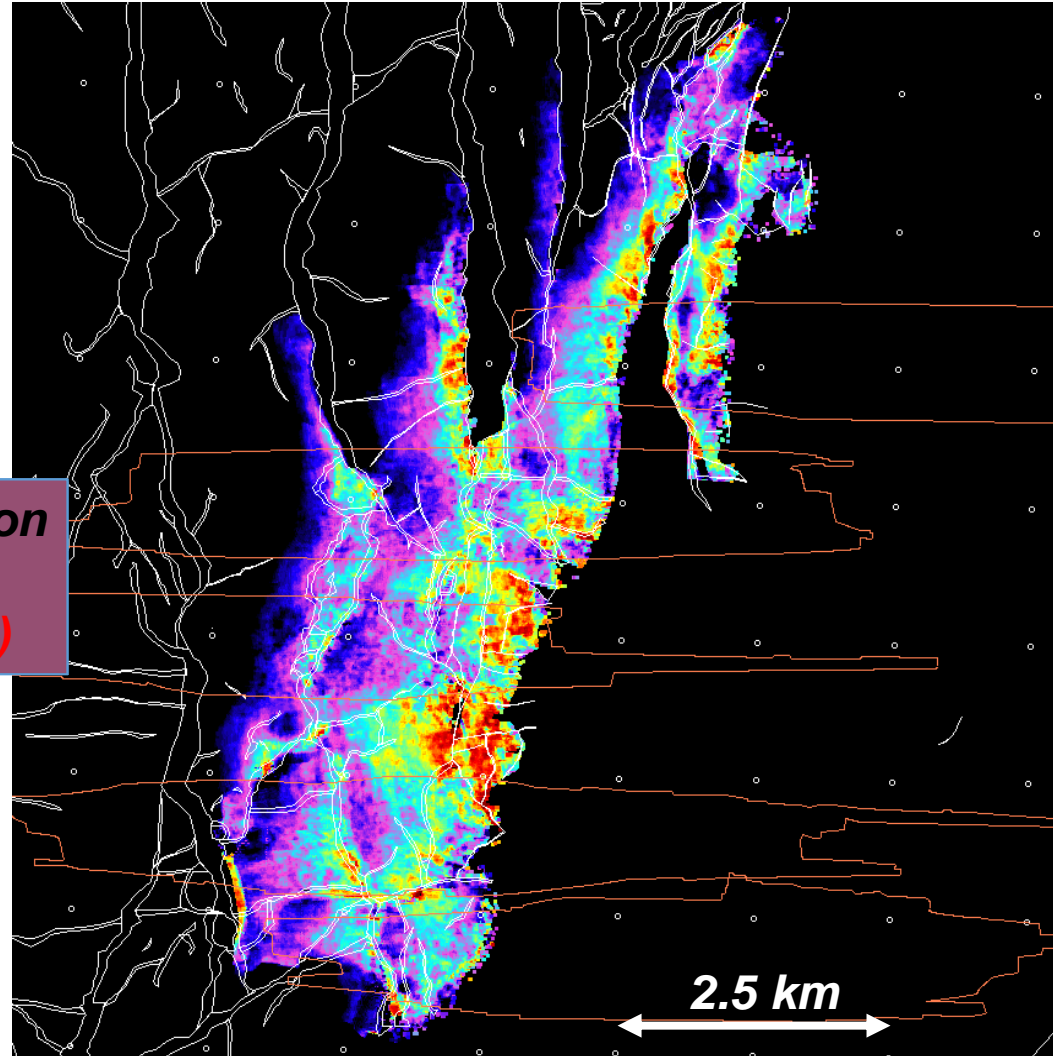


Oil Saturation Inversion



**Average Oil saturation
- Tarbert Fm –
2005 (4D inversion)**

Source: Statoil



Public sector value

Values arising from the legal, regulatory, fiscal and contractual frameworks



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- Government value comes inter alia from:
 - NPV or MBV of public cash flows from the project and their cost and revenue generating activities.
 - The value of information generated to the extent that information enhances the value of government assets
 - Value of capabilities (competencies and capacities) gained
 - Other values facilitating the task of governing.

Private sector values

Values arising from the legal, regulatory, fiscal and contractual frameworks



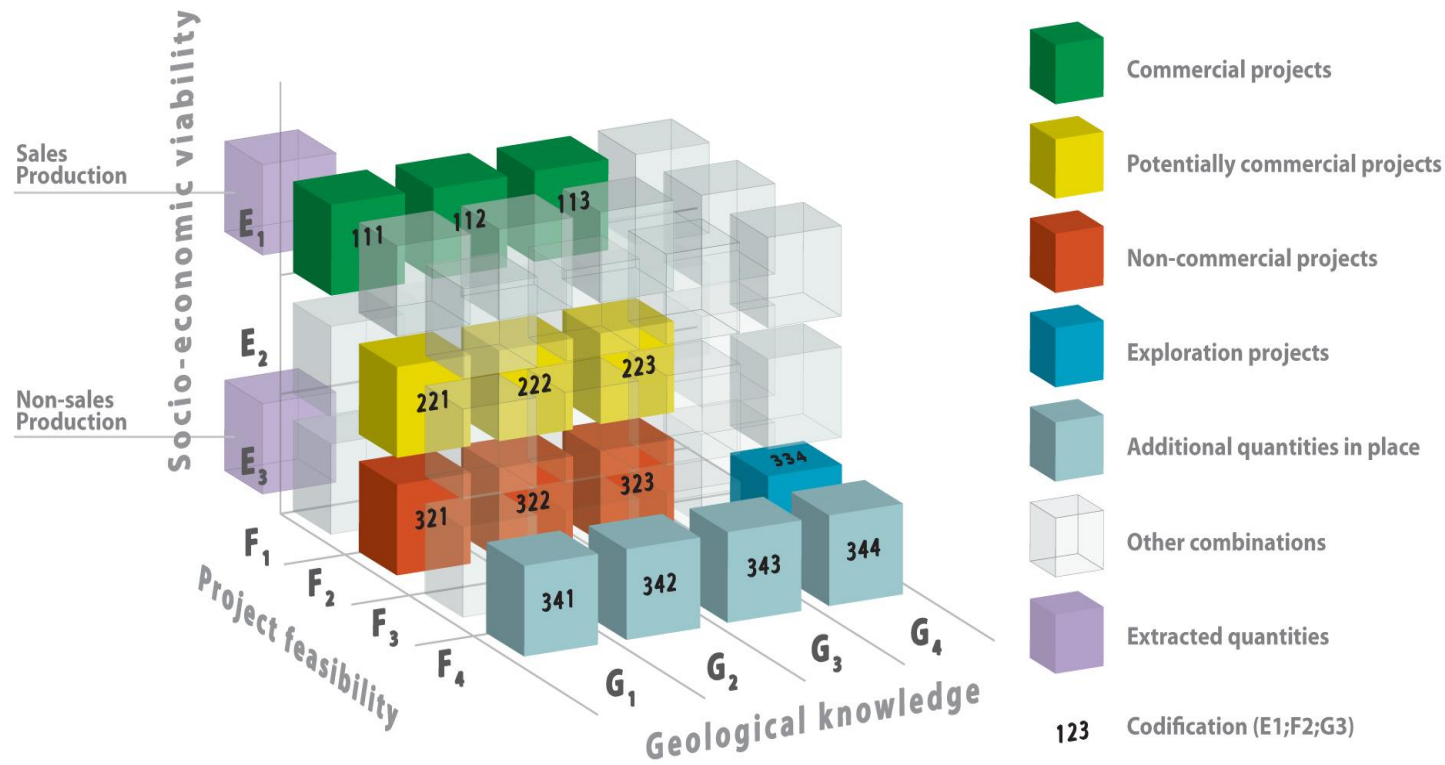
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- The value of the firms share of the cash flow
- The value of the asset
- The value of information
- The value of operations
- The value of capabilities
- The value to shareholders

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NPD Revised National Budget Report

Template



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Reporting to the revised national budget 2018 (RNB2018)

31.08.2017 According to Section 50a of the Petroleum Regulations, operators must submit data to the revised national budget (RNB).

RNB2018

Every autumn, on 15 October, all operators must report data and prognoses related to their fields, discoveries, transport and onshore facilities.

Objective

The reporting to the RNB is included in the basis for the state and national budget and the Government's oil and environmental policy. It is therefore very important that the reporting is of high quality and **that the deadlines are met, so that we can meet the deadlines set by the MPE.**

Schedule for the RNB2018 reporting process

Date	
15 October	First report from operators
30 October at 12:00	First feedback from NPD
6 November at 12:00	Second report from operators
10 November at 12:00	Second feedback from NPD
14 November at 16:00	Third report from operator

If there are significant changes to the reporting as a result of budgetary processes in the production licenses' management committees after 15 October, please contact the NPD as soon as possible to clarify whether there is a need to submit an updated reporting file.

Documents

The operators have been granted access to the following by 1 September:

REPORTING RNB

- Download the reporting file (excel)

QUESTIONS

Questions regarding the reporting should be sent to:
RNB2018@npd.no

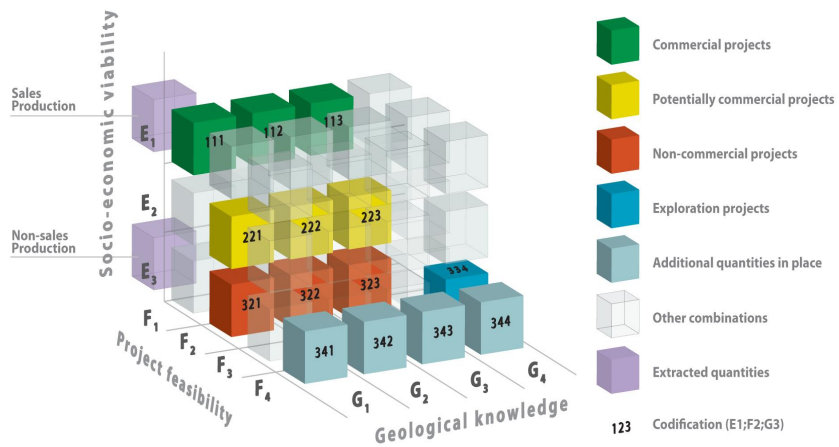
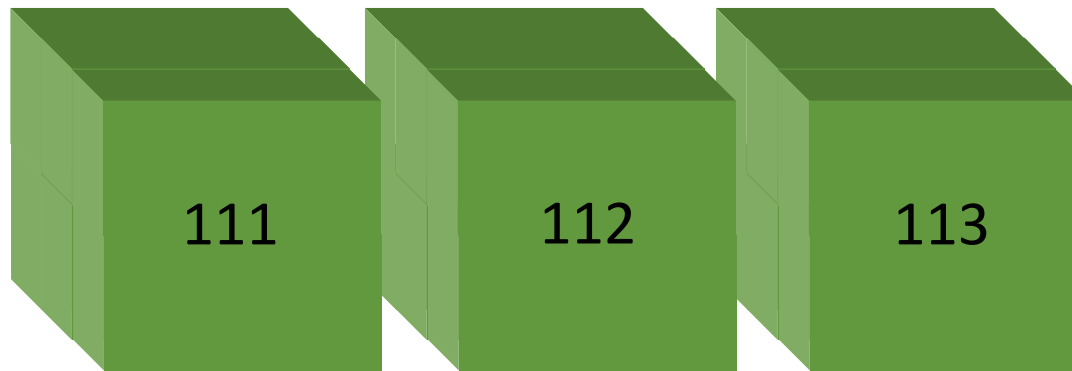
GUIDELINES

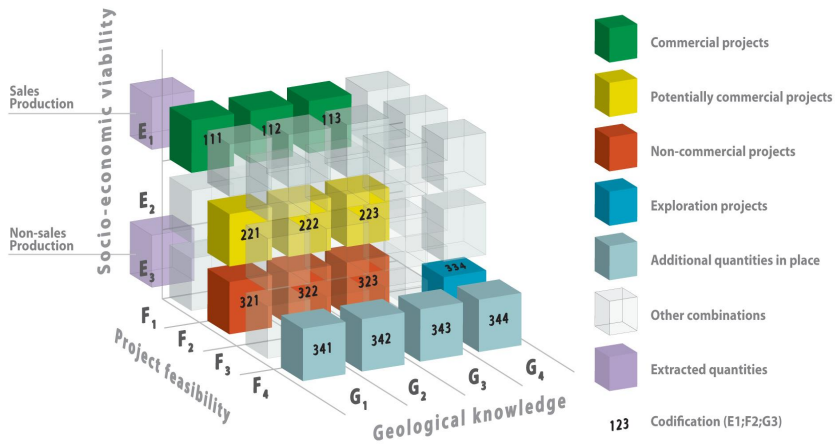
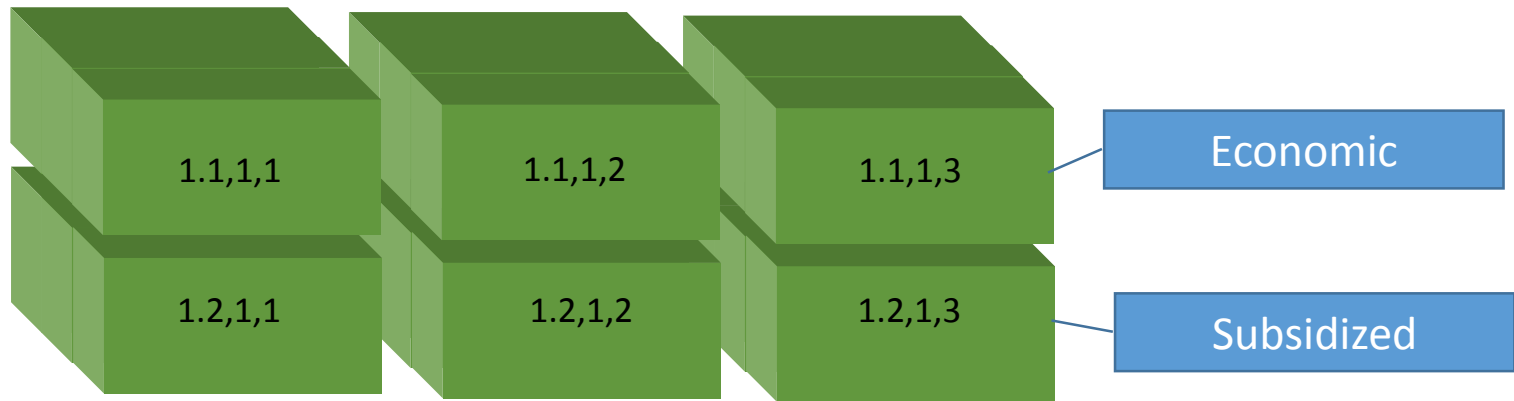
The guidelines are provided in English. Download the entire guidelines (pdf) or select a chapter topic:

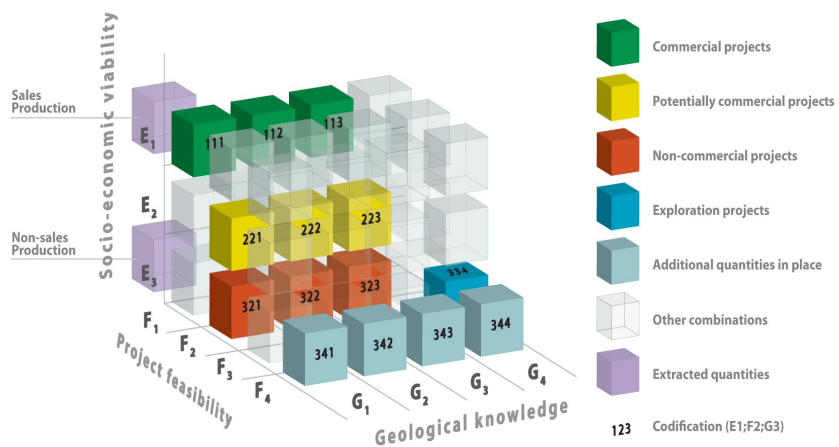
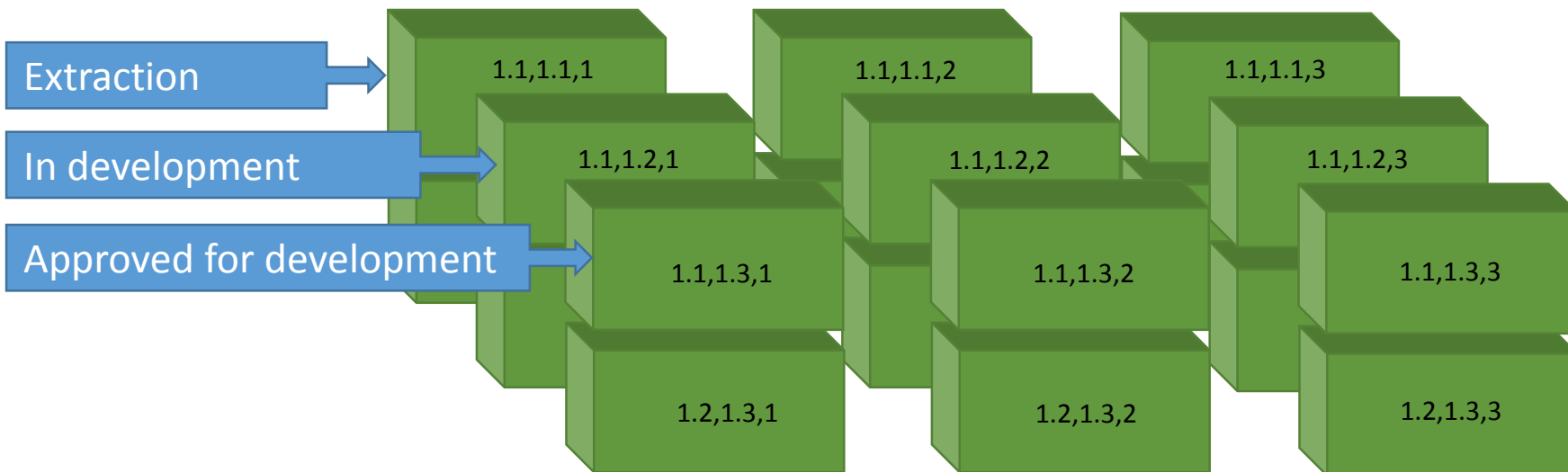
Content

1. The purpose of the reporting, timetable etc.
2. What to report
3. Resource classification
4. The reporting file
5. Completing the spreadsheet "Generell info og kommentarer"
6. Completion of the spreadsheet - "Profil_1-15 (=profile collections)"
7. Completing the spreadsheet "Tariffinntekter" and Tariff Costs
8. Completing the spreadsheet "Måneddata"
9. Quality Assurance
10. Error messages

Source: <http://www.npd.no/en/reporting/national-budget/?id=>







US Securities and Exchange Commission

Use recoverable quantities as a proxy for future revenues



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- Excluding produced quantities where the firm is not exposed to operational and market risks typical of exploration and production
- Excluding quantities purchased (not as reserves)
- Reporting reserves (E1F1)
 - Proved reserves (G1) mandatory
 - Strongly modified to exclude quantities that cannot be determined with a high level of certainty
 - Probable (G1+G2) and Possible (G1+G2+G3) optional
- No other classes can be reported except in conjunction with MD&A operations.

What about UNFC and SEC?

	UNFC-2009		NPD		SPE-PRMS (petroleum)		SEC
Known Deposit	Commercial Projects	On Production	Reserves	In production	Reserves	On Production	On Production
		Approved for Development		Approved for development		Approved for Development	Approved for Development
		Justified for Development		Decided for development		Justified for Development	Not allowed
	Potentially Commercial Projects	Development Pending	Contingent Resources	In planning phase	Contingent Resources	Development Pending	Not allowed
		Development On Hold		Recovery likely, but undecided		Development Unclarified or On Hold	Not allowed
	Non-Commercial Projects	Development Unclarified		Not evaluated / Improved rec. pot.		Development Not Viable	Non Allowed
		Development Not Viable	Recovery not very likely	Not Allowed			
Additional quantities in place		Not applicable		Unrecoverable		Not Allowed	
Potential Deposit	Exploration Projects		Undiscovered Resources	Prospect	Prospective Resources	Prospect	Non Allowed
				Lead and play		Lead	
				Play			
Additional quantities in place		Not applicable		Unrecoverable		Not Allowed	

- UNFC is consistent with SPE PRMS and NPD
- SEC only allows the disclosure of reserves once a FID has been made



Thank you!

Name Surname

Position

UNECE

Date ___ | ___ | 2018, Place

UNECE and CNH UNFC National Workshop and Pilot Test for Mexico, June 2018



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Backup

Valuation based on cash flows

Net present value(NPV)



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- Using continuous variables:

- $$NPV = \int_{t=0}^{\infty} (1 + r_c)^{-t} \cdot v(t) dt \quad (1)$$

- Where:

- r_c is the continuously compounded discount factor; and
 - $v(t)$ is the rate of expected cash flow over time t .

- There is a one-to-one relation between the continuously compounded discount factor and discount factors compounded over at fixed time periods, say annually. The formula for the NPV when discounted over fixed periods is:

- $$NPV = \sum_{i=1}^t \frac{V(i)}{(1+r)^i}$$

- Where:

- NPV is the net present value of forecasted cash flows;
 - i is the number of the time period (year number i);
 - $V(i)$ is the value element (cost or revenue) in period i ;
 - r is the discount factor per period i .
 - t is the total number of time periods

Valuation based on cash flows

Market based value(NPV)



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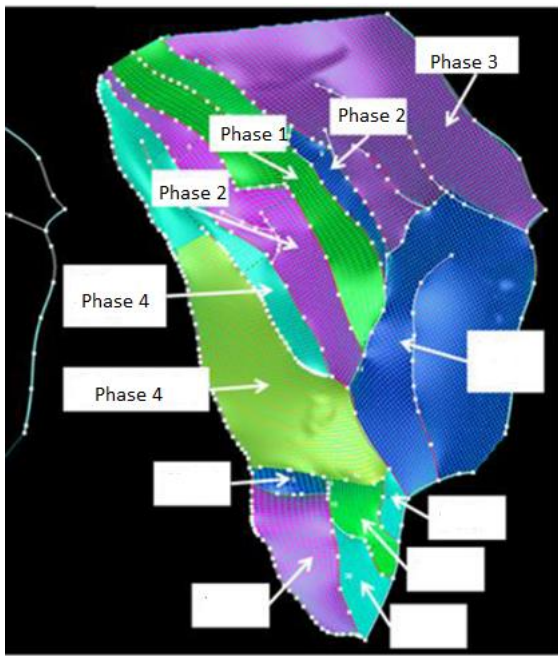
- Using continuous variables:

- MPV= The sum of $\int_{t=0}^{\infty} (1 + r_c)^{-t} \cdot v(t) dt$

- Where:

- r_c is the reduced continuously compounded discount factor for the relevant portions of the cash flow; and
- $v(t)$ is the rate of expected cash flow over time t , compensated for opportunities and risks using real option methods

Example Commercial Maturity: Multiple phase developments



A complex sandstone reservoir is under development by Company A

There are 4 different phases of development with Phase 1 corresponding to the current production phase

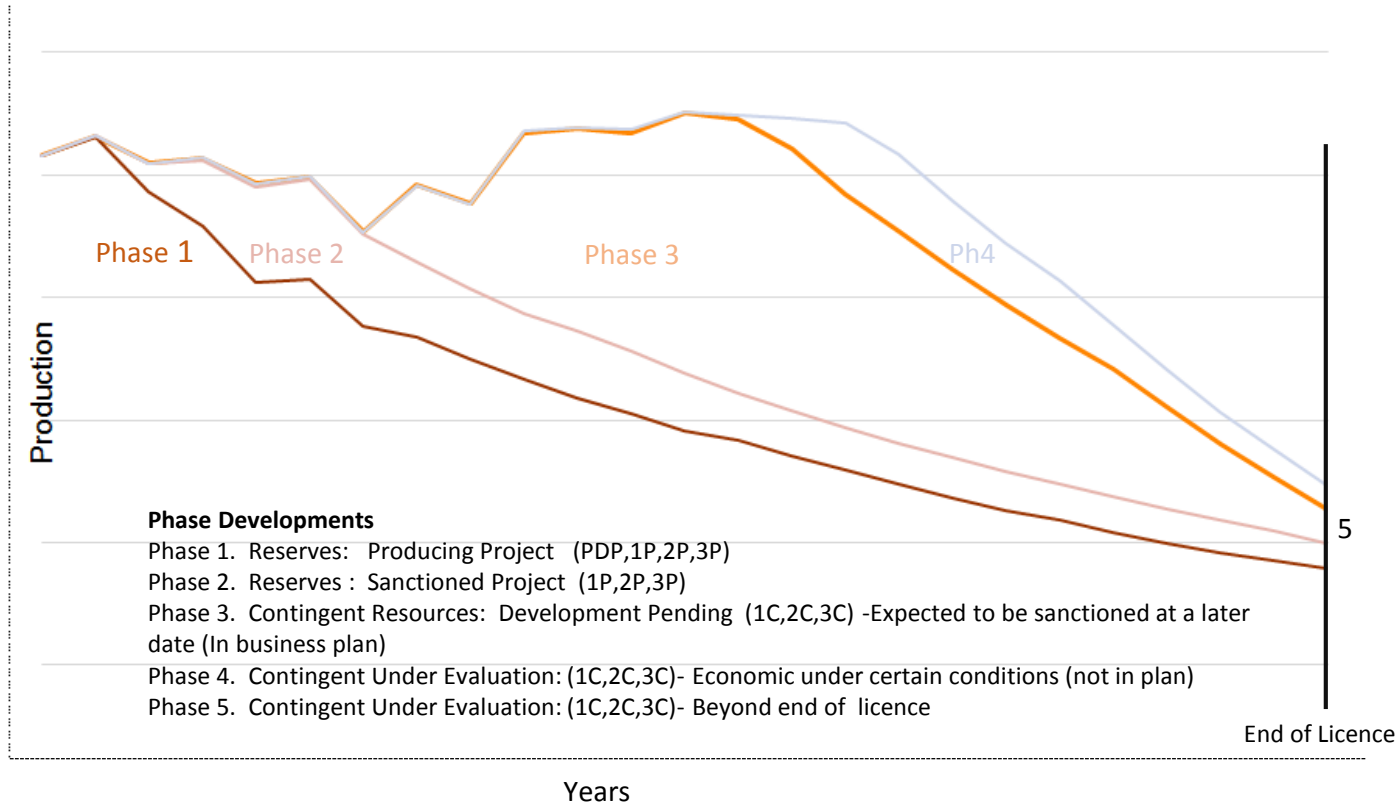
Phases 2 and 3 correspond to the development of adjacent fault Blocks to the one developed by Company A

Phase 4 corresponds to the development of other fault blocks Discovered after a drilling campaign

Let's see the production profiles

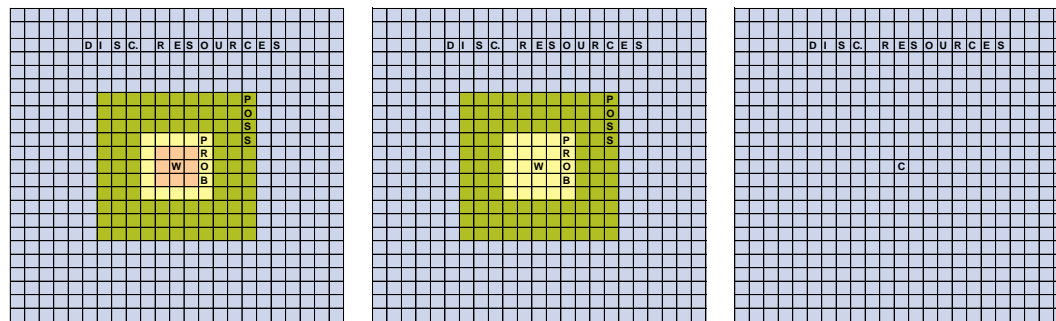
Booking Methodology for Conventional Reservoirs

Example Commercial Maturity: Multiple phase developments Classification



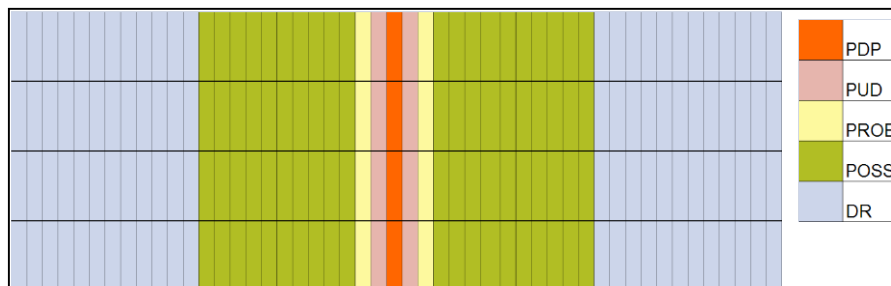
Booking Methodology for Unconventionals: Deterministic Methods

- Based on DSU by DSU spacing “mining conventions” and well spacing rules
- Legacy from old US SEC and N. American regulations
- Used in early phases (typically before investment decisions)
- Proved undeveloped (PUD): within 1 drainage radii from producing or tested economic well
- Probable: immediately adjacent to proved DSU’s. Typically 2 drainage radii away from PUD’s
- Possible: 2-3 drainage radii away from producing or tested economic well
- Resources: beyond possible up to 6 section radius with reasonable expectation of producibility

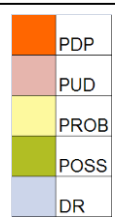


W = DST or Producing well W = DST or Producing well (develop beyond 5 years) C = Core well logged well not tested

Vertical Well
Early Phase

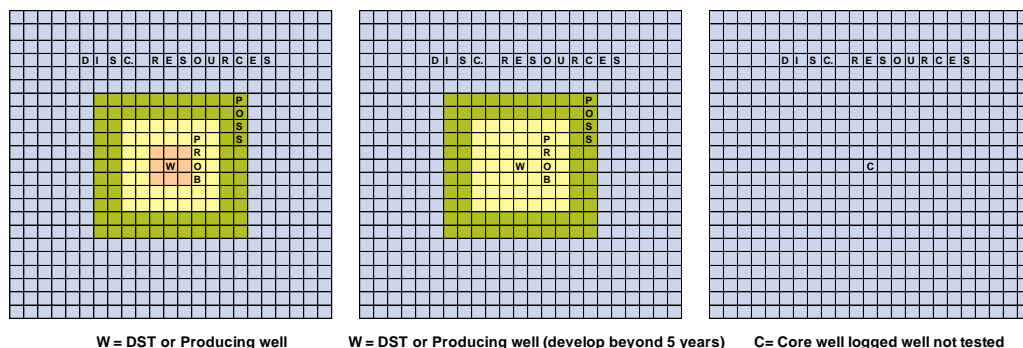


Horizontal Well
Early Phase

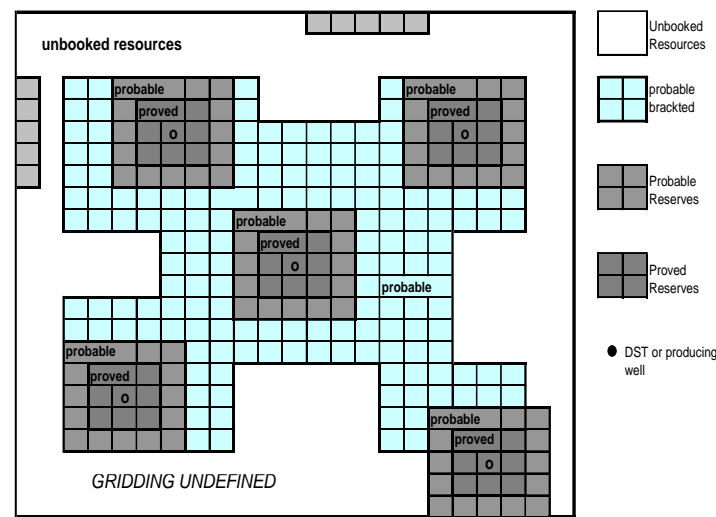


Booking Methodology for Unconventionals: Deterministic Methods

- As well count and drilling control increases, more PUD locations can be assigned around a drilled location
- PDP through bracketing methods and Probable DSU's normally double once the Resource Play enters the **Intermediate Phase**.
- In this phase traditional mapping methods (gridding) may still be used to define the areas for the different reserves classes but more DSU's may be claimed and bracketing is extensively used.
- Used in intermediate phases (typically after investment decisions supporting reserves) along with bracketing if geological continuity

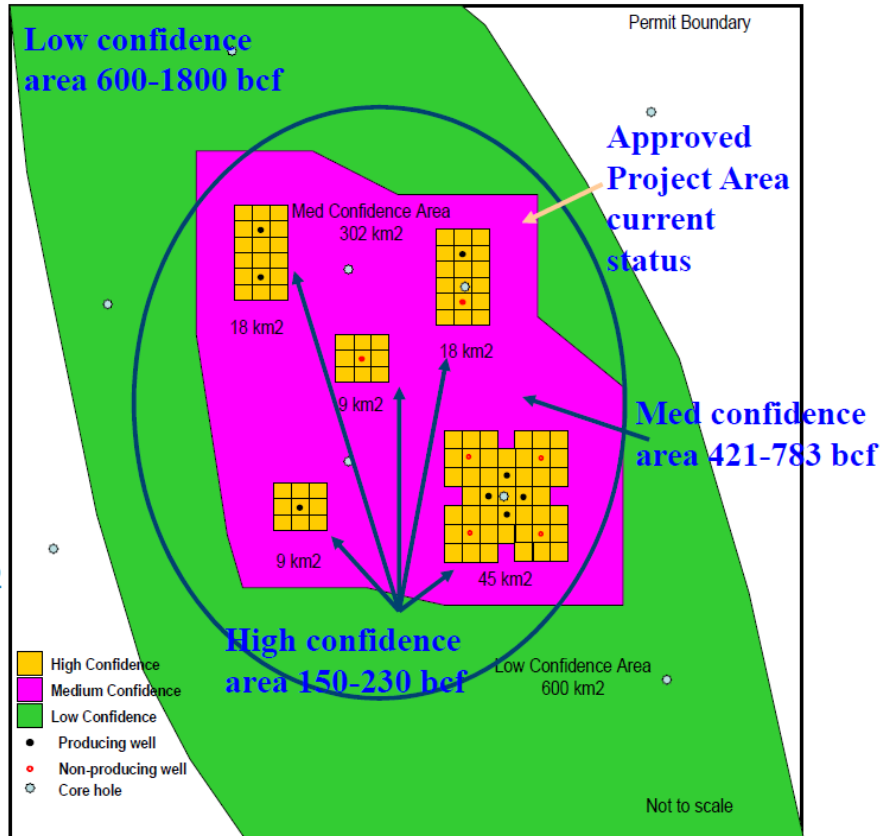


Vertical Well
Intermediate Phase



example of 'bracketing'

Example Unconventional Commercial Evaluation



* After Barker, G. SPE 117124

- ❑ Project area is **700 km²** with plans to drill more than a 2000 wells (low confidence area)
- ❑ More than **100 km²** are in areas with E&S issues
- ❑ Commercial development project is a **400 km²** (can attribute reserves) with plans to drill 400 wells
- ❑ Total project area of **700 km²** not yet approved (not reserves but contingent resources)
- ❑ Resources estimated using ranges of RF's to define reserves P90, P50 and P10 in the approved project area (400 wells)
- ❑ 1P deterministic is a 99 well project, versus 400 wells in 2P and 1000 wells in 3P
- ❑ From the project area 100 km² are located in areas with social and environmental issues and are classified as "development on hold"

Fiscal Regimes & Net Reserves

- Under Tax/Royalty regimes:-
 - Net reserves = W.I. reserves providing royalty paid in cash
 - If royalty paid in kind then net reserves would need to exclude royalty production
 - Reserves not normally greatly affected by prices except shorter/longer economic field life with lower/higher prices respectively
- Under PSC regimes :-
 - Generally net reserves < W.I. reserves
 - Net Reserves a combination of Cost Recovery bbls + Profit Sharing bbls
 - Higher prices normally resulting in lower Net Reserves due to lower Cost Recovery bbls
 - In some PSC's e.g. higher export prices could lead to higher Net Reserves due to much higher Tax bbls partially offset by lower Cost Recovery bbls
 - For a PSC field, net reserves are very sensitive to prices mainly due to the calculation of Profit Sharing bbls based on the Contractors' ROR
 - Low prices leading to more favourable Profit Sharing percentage for the contractors over time, resulting in much higher Net Reserves Entitlements
 - The opposite for high prices, resulting in much lower Net Reserves Entitlements

Summary Current Guidelines Unconventional SPEE/SPE PRMS/SEC

- ❑ **SPEE COGEH Volume 3** was published in 2007 by the SPEE
 - COGEH Volume 3 is compliant with the old SEC rules
 - Accepted by the ASC, CSA
 - Determinist Methods (DSU per DSU) mapping system

- ❑ **New SEC (2009)** rules allow for the use of both deterministic or probabilistic methods

- ❑ **SPE PRMS** allow for the use of both deterministic or probabilistic methods

- ❑ **SPEE Monograph 3** published by the SPEE in Dec 2010 for Resources Plays
 - Valid for most resource plays (Shale Gas, Coal bed Methane, Tight Gas, Basin Centered Gas)
 - Committee kept mindful of the new SEC and SPE PRMS for consistency and compliance
 - Recommends using both deterministic and/or probabilistic methods based on resource play phase