

2025 PESA Webinar Series



PESA
Energy Geoscience

The God's Must Be Crazy: Unbelievable
Play Defining Discoveries Providing
Analogues for Future Success

Mark Lisk (Ascendience Geoscience)

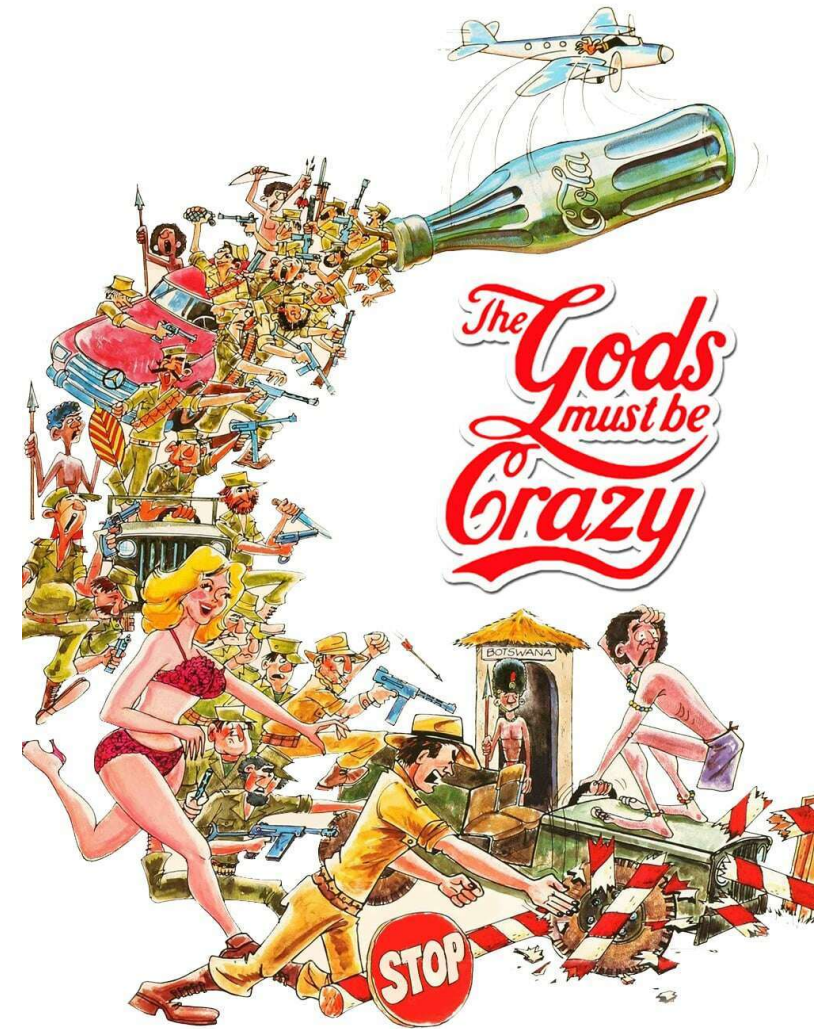
Mark Lisk



- Dr Mark Lisk is the Chief Geologist for the Ascendience Group.
- Mark has a career spanning more than 30 years, with diverse experience across Petroleum, Geological Storage of CO₂, Geothermal and Mineral systems, with a focus on the delivery of innovative exploration and R&D solutions
- Mark graduated from the University of Auckland in 1990 and holds a PhD from Curtin University. Mark has published widely on various aspects of petroleum systems in Australia and Internationally.
- Prior to establishing Ascendience Geoscience in 2021, Mark spent 15 years engaged as an explorationist for Woodside Energy working basins in Australia and across the world. Before joining Woodside in 2005 Mark worked for CSIRO as a research scientist developing new approaches to assessment of petroleum systems across many Australian sedimentary basins.
- Mark's interests now lie in providing experienced consulting services and innovative data and technology products to the energy industry.

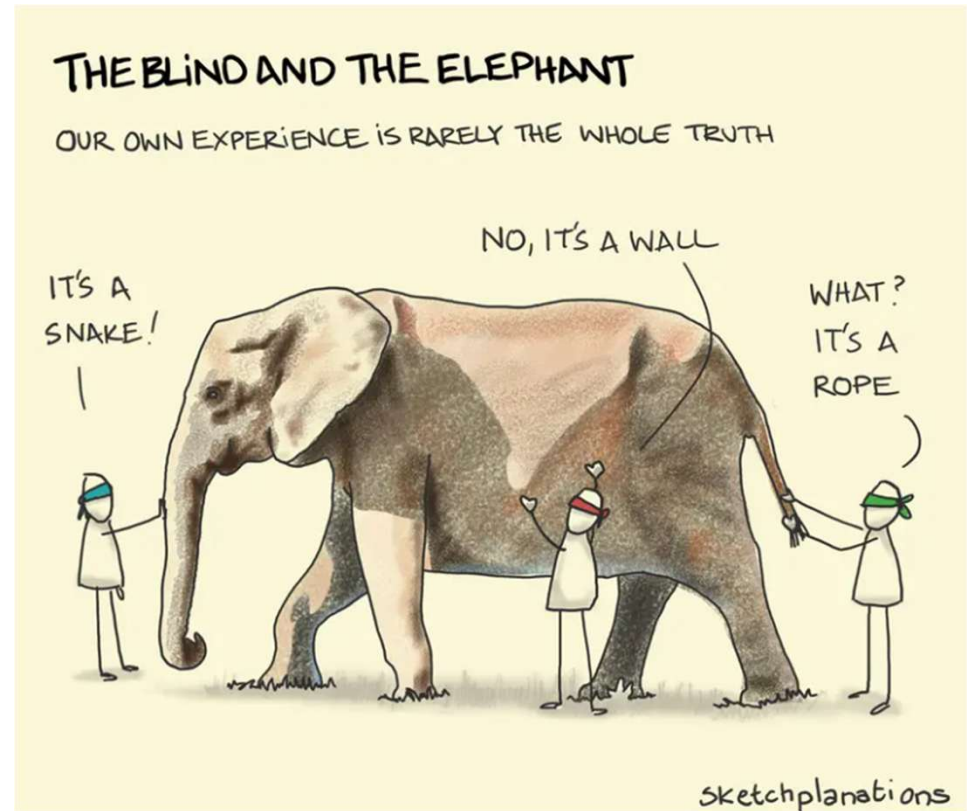
The God's Must be Crazy

Unbelievable Play Defining Discoveries Providing Analogues for Future Success



Introduction

- Seeing the big picture when presented with incomplete information is a critical skill
- Teamwork, shared experience and a use of analogues allows educated judgements to be made within the constraints of risk tolerance
- More importantly analogues enable other opportunities to be recognised, not just the one being evaluated
- Analogues remove the blindfolds and help reveal the full extent of the opportunities

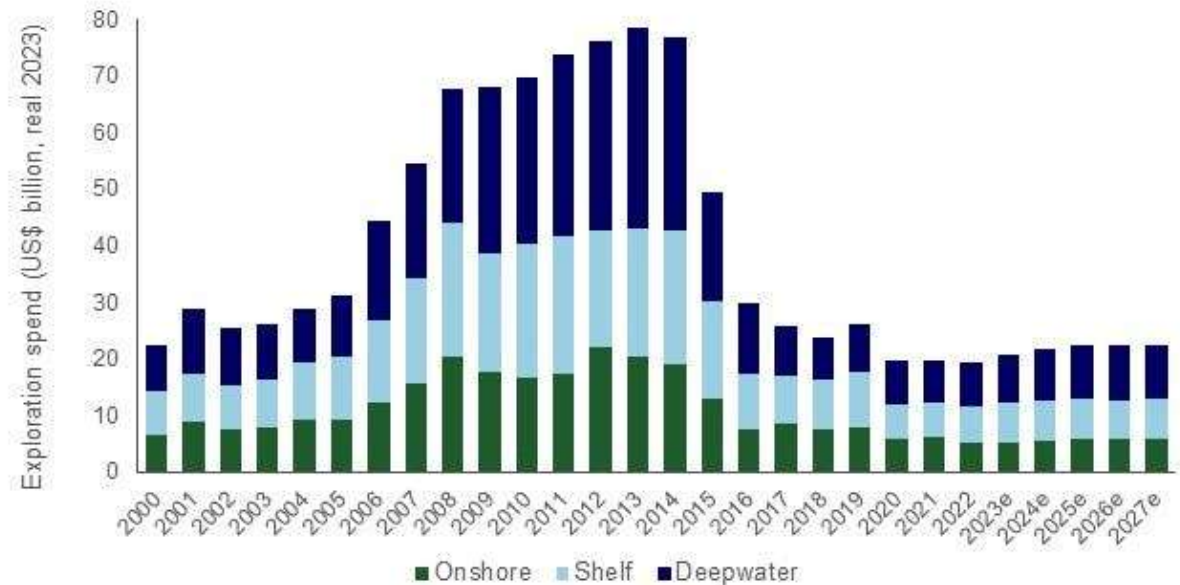


<https://sketchplanations.com/the-blind-and-the-elephant>



Less Drilling More Thinking

- Since 2000 Woodmac show that exploration spend in the last 2 decades exceeds **2 Trillion USD**
- Since the halcyon days of the last boom exploration spend is lower and growing but only slowly
- Analogues are a dividend that can be collected on that sunk cost
- Drawing value from sunk cost makes good commercial sense



<https://www.ogj.com/general-interest/economics-markets/article/14297802/woodmac-oil-gas-exploration-spending-to-average-22-billion-yr-through-2027>



Questions or Answers?

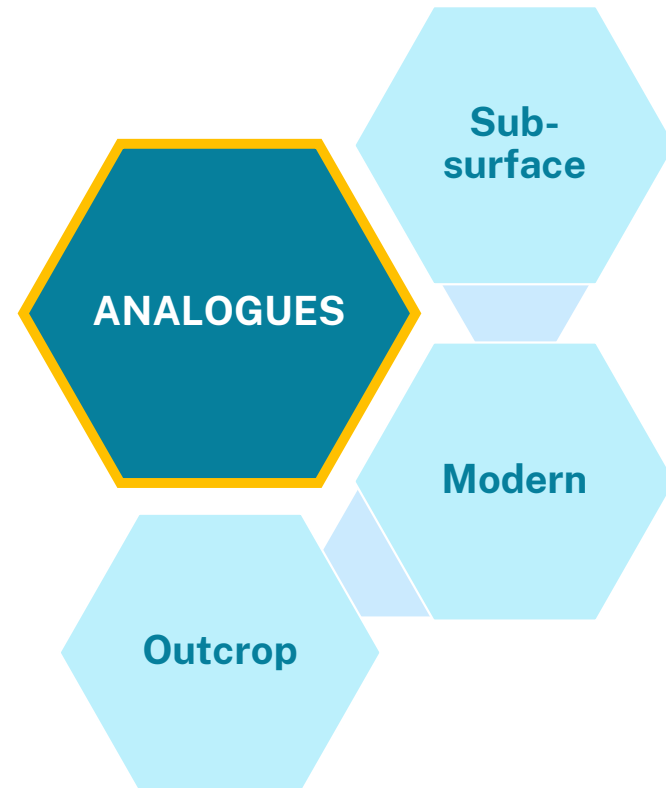
What do analogues give us?

- Commonly we rely on analogues as a source of data to help narrow sub-surface uncertainty
- We tend to be overly deterministic with analogues rather than consider alternatives in a probabilistic way
- Analogues do help to answer questions, but they also challenge answers with new questions
- Those new “questions” reveal opportunities that may not have been previously considered



Geological Analogues

- We utilise a variety of analogue types to help fill in the gaps of our incomplete data



Outcrop Analogues



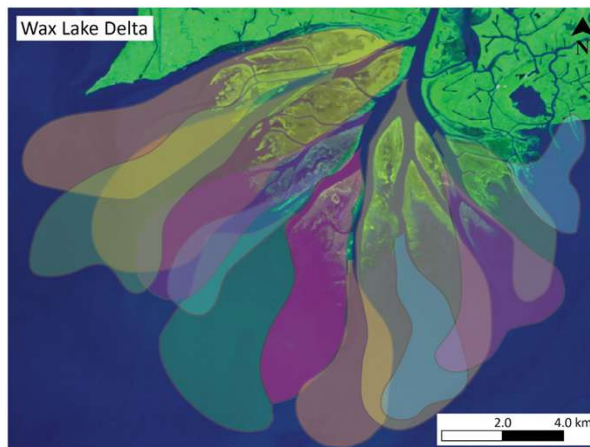
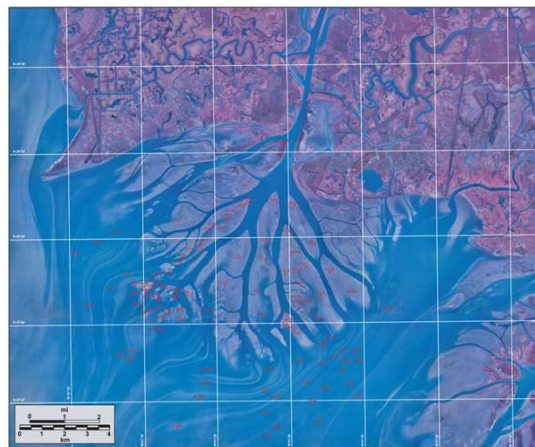
- Field training provides an opportunity to walk inside our reservoirs and learn to “be the oil” (or gas, water or CO2)
- Analogues are not just for the rock lickers; geophysicists, engineers and even non-technical staff have much to gain
- COVID led to a collapse in field-based training that is only just starting to recover
- Loss of expertise within companies has exacerbated this situation for junior staff
- Opportunity to engage with colleagues in the field should be a fundamental requirement but is often seen as a “luxury” that can easily fall victim to cost-cutting initiatives



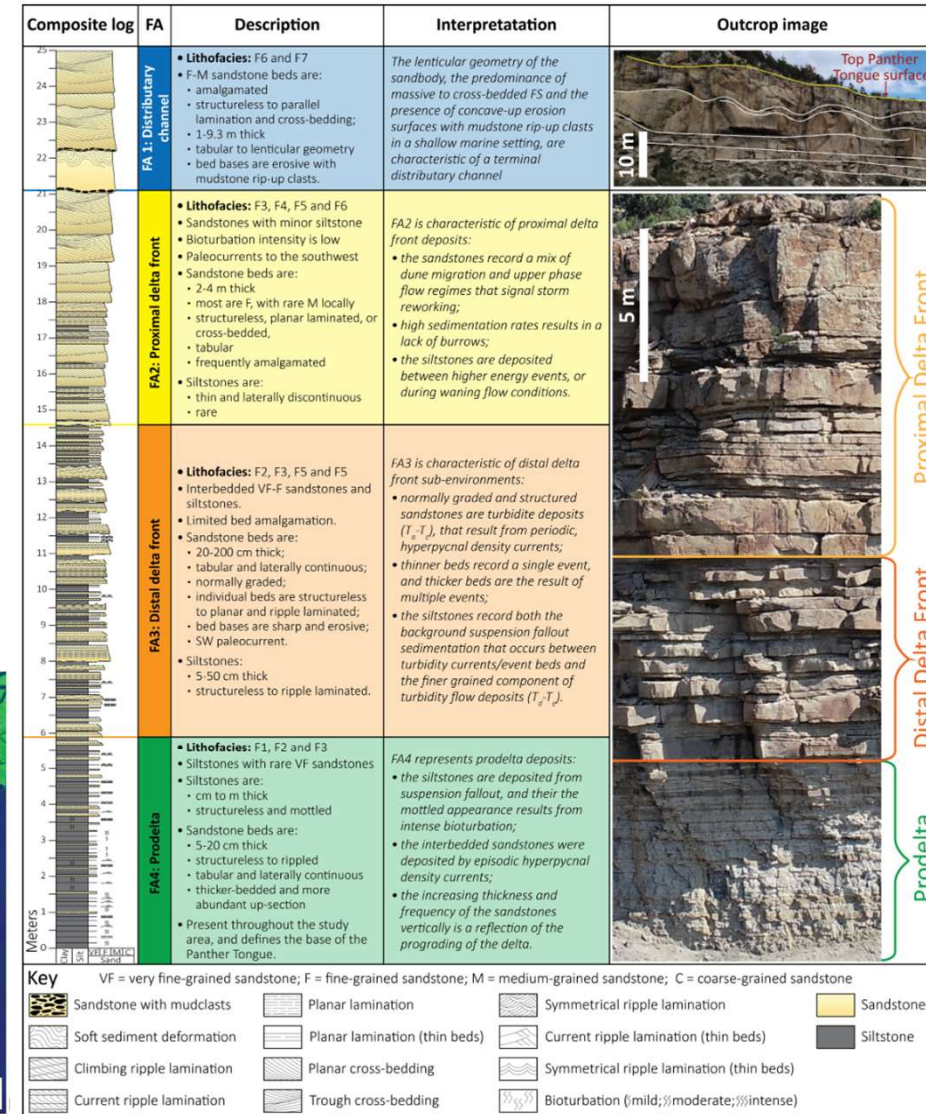
Value of Outcrop Analogues

- The Panther Tongue, an ancient delta system is a classic outcrop section of the Book Cliffs in Utah
- Architecture of this delta system described using thickness, sedimentary structures, grain size, and bed length is used to describe the system in great detail
- The Wax Lake delta in Louisiana allow process, preservation and scale to be further understood using a modern depositional system analogue

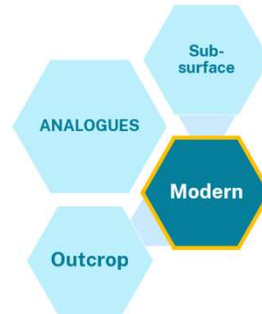
Robert et al., 2005, Jet-Plume Depositional Bodies – The Primary Building Blocks of Wax Lake Delta



Atlas et al., 2023, New approaches to the architectural analysis of deltaic outcrops: Implications for subsurface reservoir characterization and paleoenvironmental reconstruction



Modern Analogues



- Modern tidal ripples demonstrate depositional processes observable at high resolution across a range of different scales
- The palaeo-ripples in Silurian to Ordovician aged Tumblagooda sandstone in Kalbarri was formed on tidal flats of an ancient sea
- Uniformitarianism is a fundamental pillar in the interpretation of the geological past making modern depositional systems highly relevant as analogues



Value of Modern Analogues

- There is a tendency to consider classic crescent shaped barchan dunes as a default for aeolian oil and gas reservoirs
- Most eolian reservoirs consist of a mélange of complex lithofacies derived from process frameworks operating at multiple scales
- Awareness of potential complexity helps to avoid costly mistakes that unconstrained assumptions can deliver

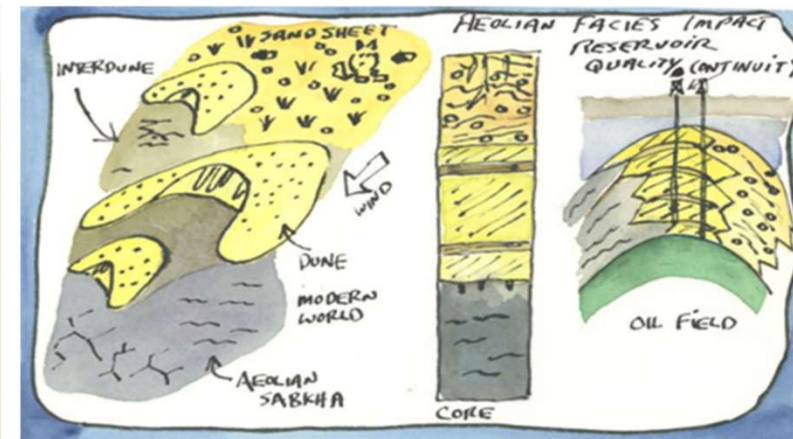
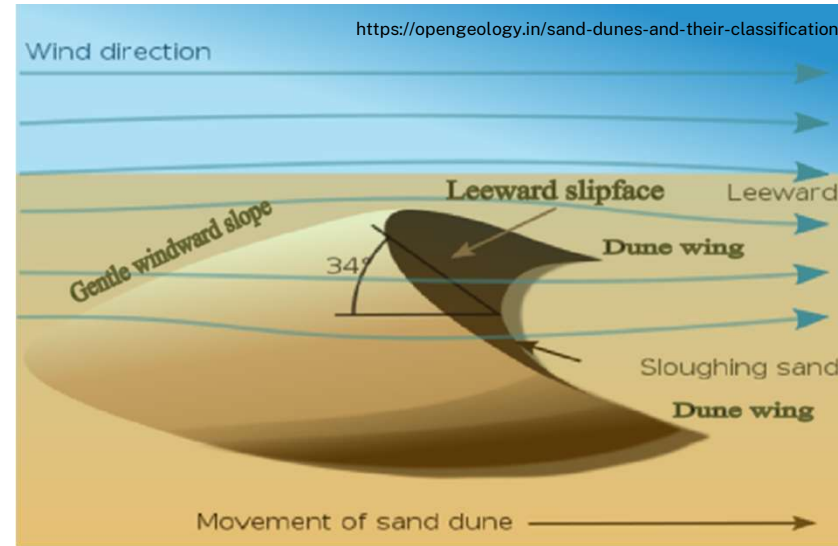


PS Modern and Ancient Analogues for Complex Eolian Reservoirs*

Steven G. Fryberger¹, Caroline Y. Hern², and Nick Jones³

Search and discovery Article #51401 (2017)**

Posted August 7, 2017

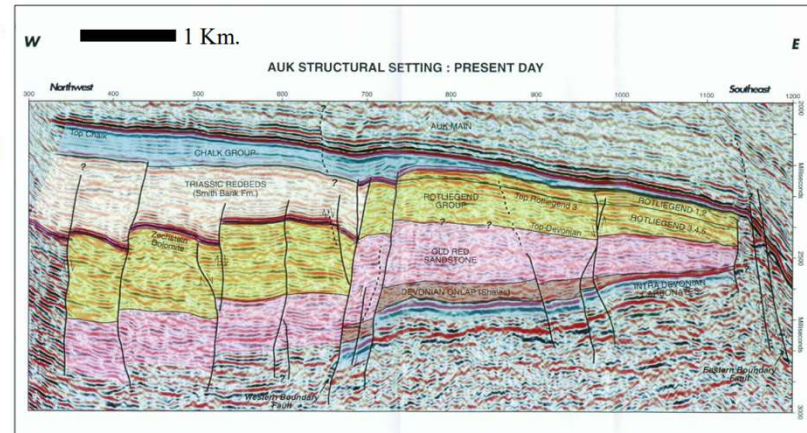


Fryberger and Hern, 2014, Geometric Approach to the Analysis of Global Eolian Hydrocarbon Reservoirs

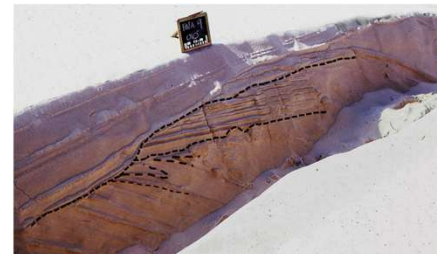
Tripartite Analogue Use



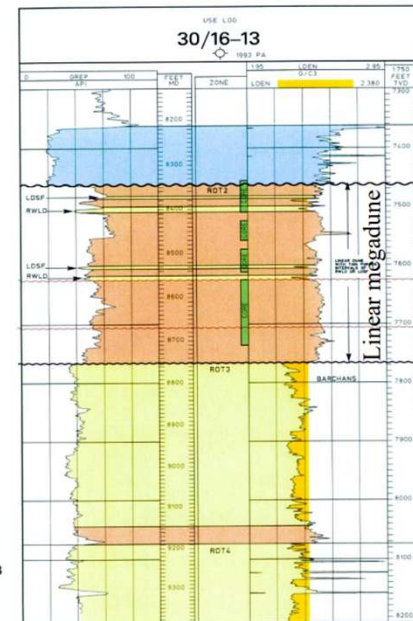
- Combining modern, outcrop and sub-surface analogues should be the default but rarely is in practice
- Auk field (UKNS) example from Fryberger et al., 2017 relies on Hawks Nest (Australia) modern analogue and Hopeman outcrop analogue from UK Moray Firth
- No one analogue is perfect so multiple analogues should be used to cover off low and high-side outcomes
- Analogue data is incredibly cheap compared to the cost of retrospectively fixing sub-optimal outcomes



A seismic line across Auk Field to illustrate structural closure and stratigraphy. Yellow shading shows the Rotliegend Group, which in this area, overlies the Old Red Sandstone.

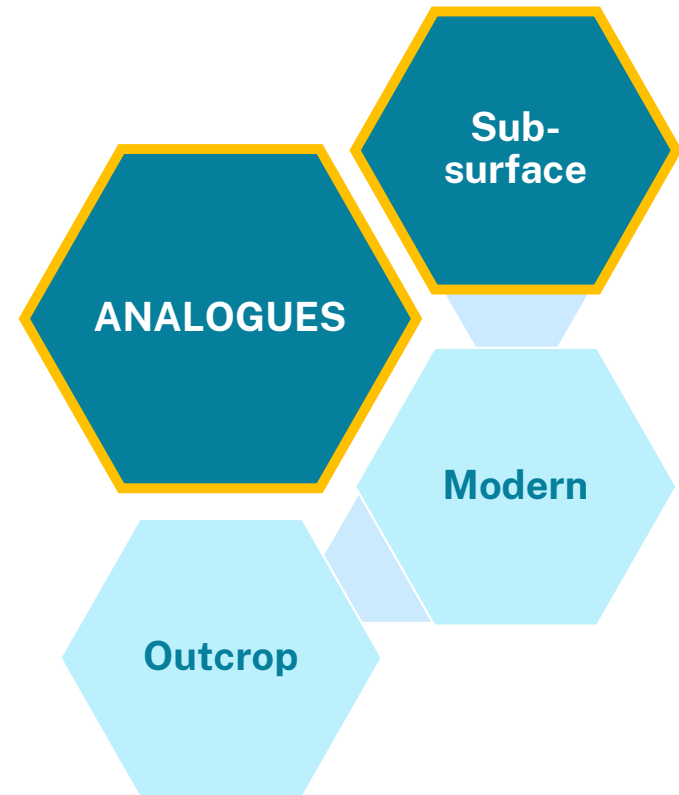


HOPEMAN SANDSTONE COVESEA : OUTCROP ANALOG FOR LITHOFACIES IN AUK OIL FIELD PART 1



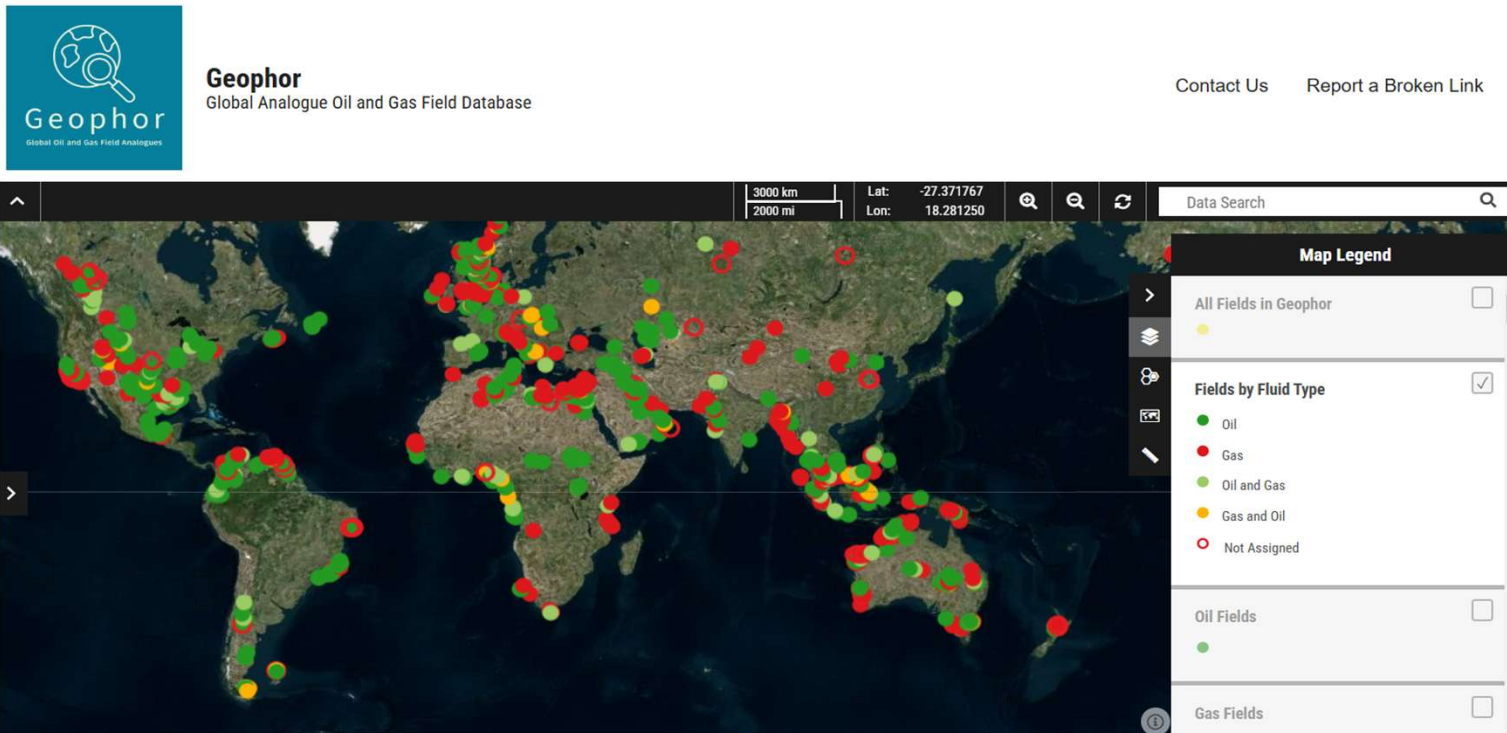
Geological Sub-surface Analogues

- The remainder of today's presentation will focus on the benefits that can be gained from awareness of successful play types illustrated by previous discoveries



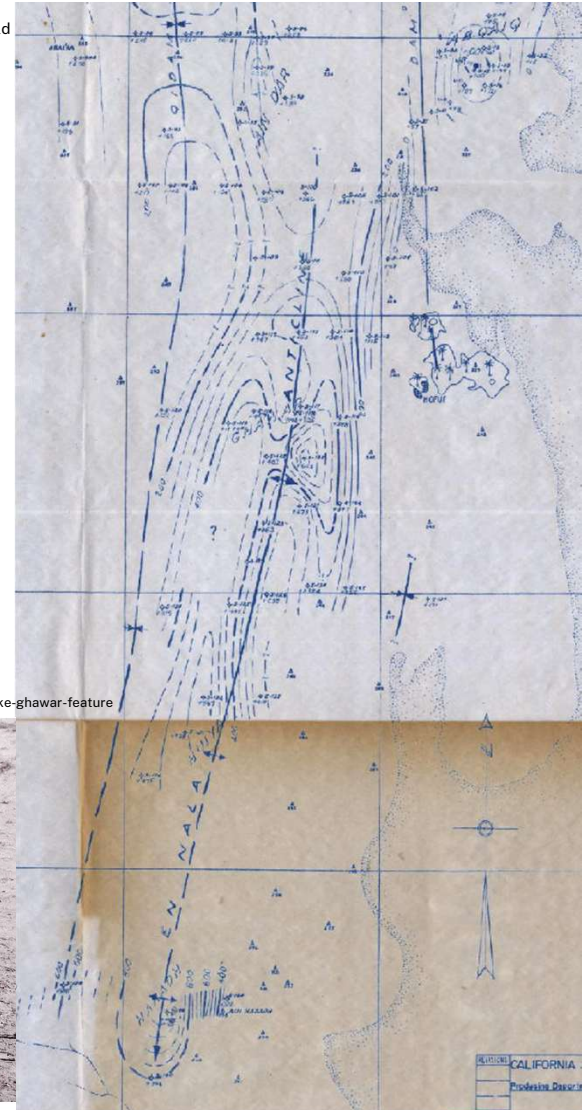
Power of Analogue Databases

- Analogue database products provide a wealth of accumulated experience to reduce the likelihood of unnecessarily repeating the mistakes of others
- Construction of the newly developed Geophor global oil and gas field analogue database provided the content that has been used to build this presentation drawn more than 1500 fields across the world



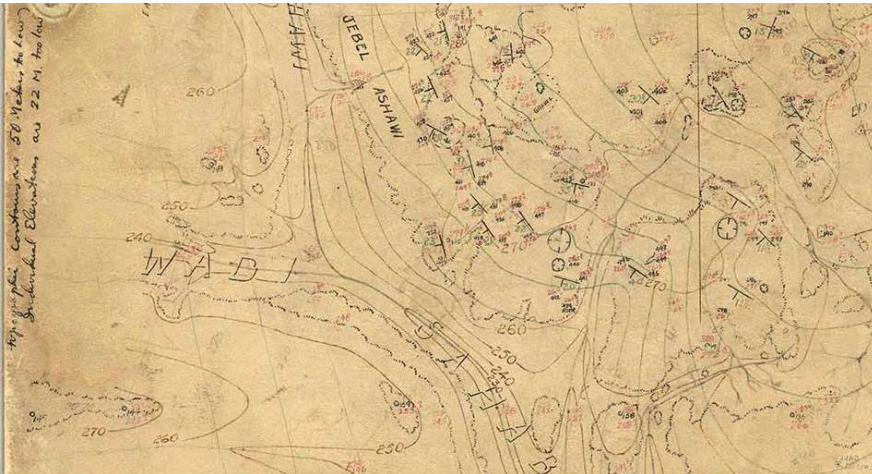
The Ghawar Field

- Careful geological mapping coupled with “structure drilling” (a new technique where a grid of wells were drilled to test for shallow structure) was employed
- Early drilling results were not encouraging and in early 1938 Chief Geologist Steineke was recalled to San Francisco with SoCal wanting to pull the plug
- Steineke convinced them to keep drilling and the rest is history
- Awarded the Sidney Powers Medal in 1951 the citation read:
 - "The methods he developed probably resulted in the discovery of greater reserves than any other geologist"



<https://www.aramcoexpats.com/articles/paying-tribute-to-max-steineke-s-drive-to-help-discover-ghawar/>

<https://www.aramcolife.com/en/publications/the-arabian-sun/articles/2022/week-32-articles/max-steineke-ghawar-feature>



Geologists Tom Burger, Wali Hoag, Max Steineke and Jerry Harris, left to right, pause during surveying near Sabwah in 1932.

Ascendence Geoscience 2025

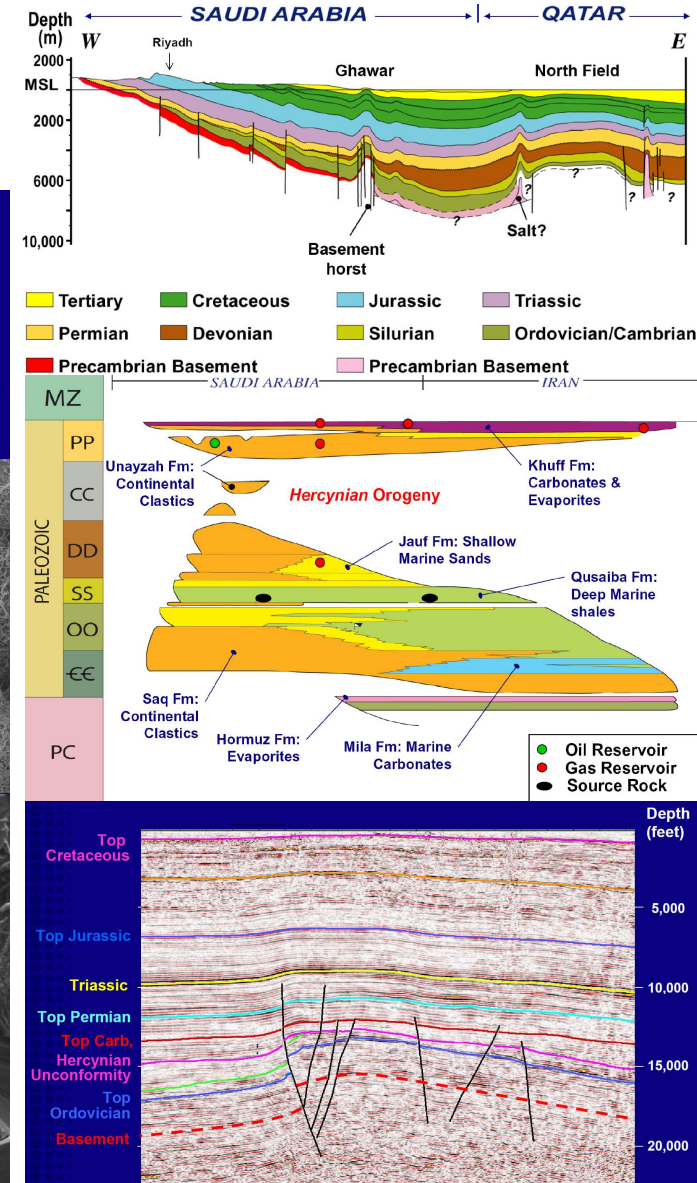
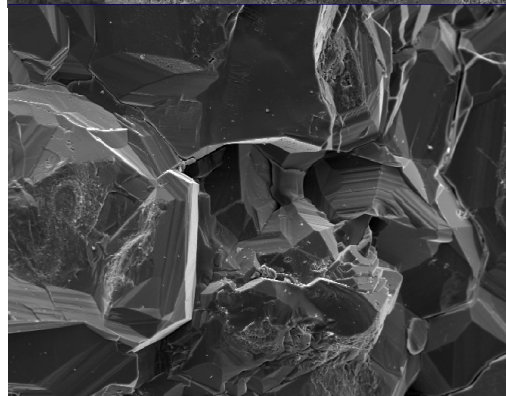
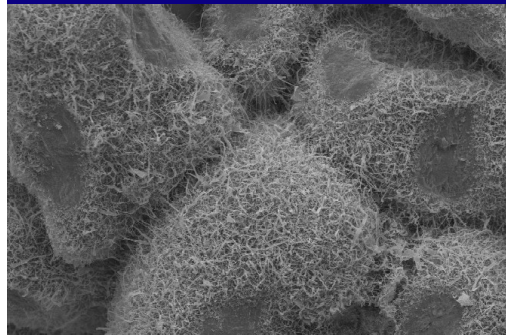
Continuous Improvement

- The Ghawar Field has been actively explored throughout its life
- Grain coats preserving porosity led to the discovery of significant new gas reserves in 1994
- This new discovery challenged perception on the depth of the porosity floor
- Even in mature fields a new play concept can yield great success
- Near-field exploration often gets prioritised so the chance to reveal new potential on existing fields should never be ignored



Afifi, 2004, Ghawar: The Anatomy of the World's Largest Oil Field

- 1948 • Oil Reservoirs
 - Jurassic Arab-D
- 1975 • Gas Reservoirs
 - Permian Khuff
- 1982 • Permo-Carboniferous Unayzah
- 1994 • Devonian Jauf



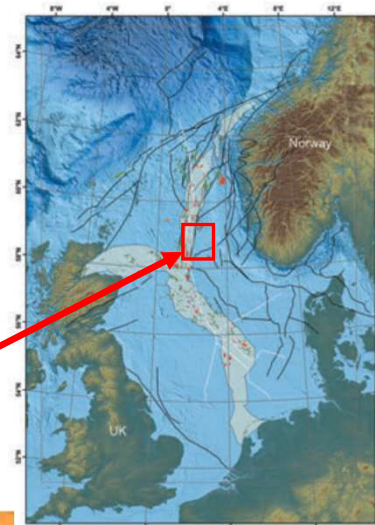
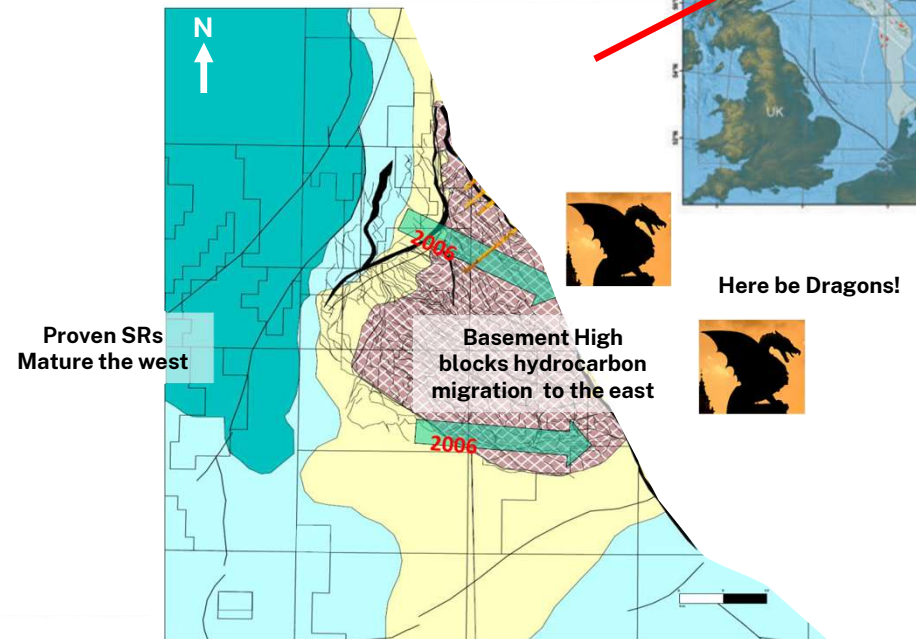
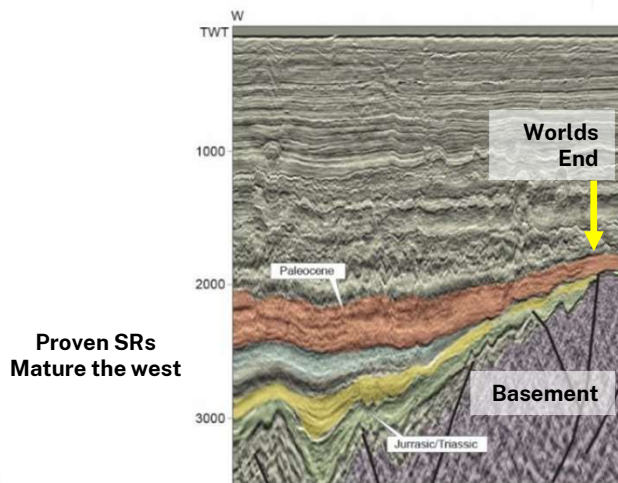
Key Takeaway Elements

- Analogues are like old keys; you're not quite sure exactly what door they unlock
- Today I hope to leave you with 3 key messages:
 - Ideas find hydrocarbons, technology is the enabler to achieve success
 - Rediscovery plays a major role in finding play-opening discoveries
 - Geological success looks painfully obvious in hindsight



Play Example 1 – Paradigm Busters

- Conventional wisdom decreed that migration beyond a major basement high was too high risk to warrant exploring
- Paradigms are there to be challenged, dragons to be slayed



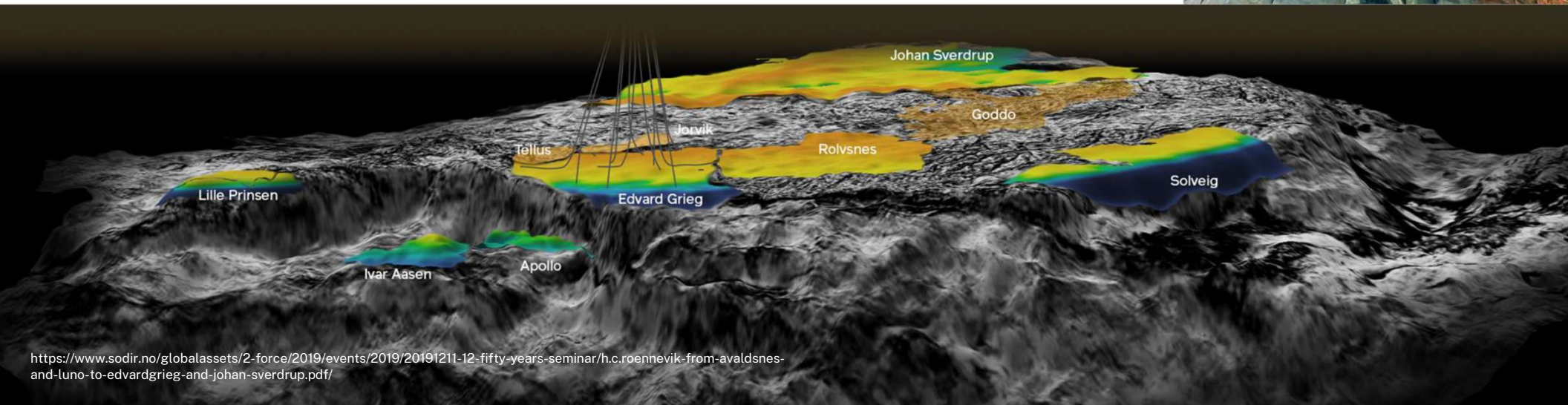
Modified from Rønnevik et al., 2017, The discovery process behind the giant Johan Sverdrup field



Analogue Field 1 – Johan Sverdrup

Lundin: Will and Skill Combine

- Lundin brought new ideas and great success by employing a different way of doing business
- Discovery of the Giant Johan Sverdrup Oil Field Complex in Norway provides a great example of new ideas bringing stunning results



<https://www.sodir.no/globalassets/2-force/2019/events/2019/20191211-12-fifty-years-seminar/h.c.roennevik-from-avaldsnes-and-luno-to-edvardgrieg-and-johan-sverdrup.pdf/>

Lead a Close-knit Team

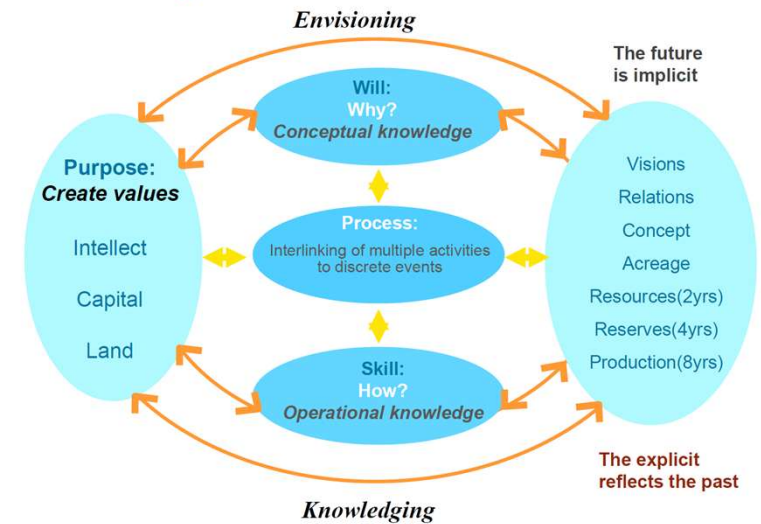
- Hans Rønnevik, a legendary explorer widely credited for being the guiding force for Lundin’s success
- Teamwork was a key element of the ethos:

“Continuity and hands on experience from all phases and disciplines within 10 metres”

- You have the skill, but do you have the will?



A strategy must include all stakeholders

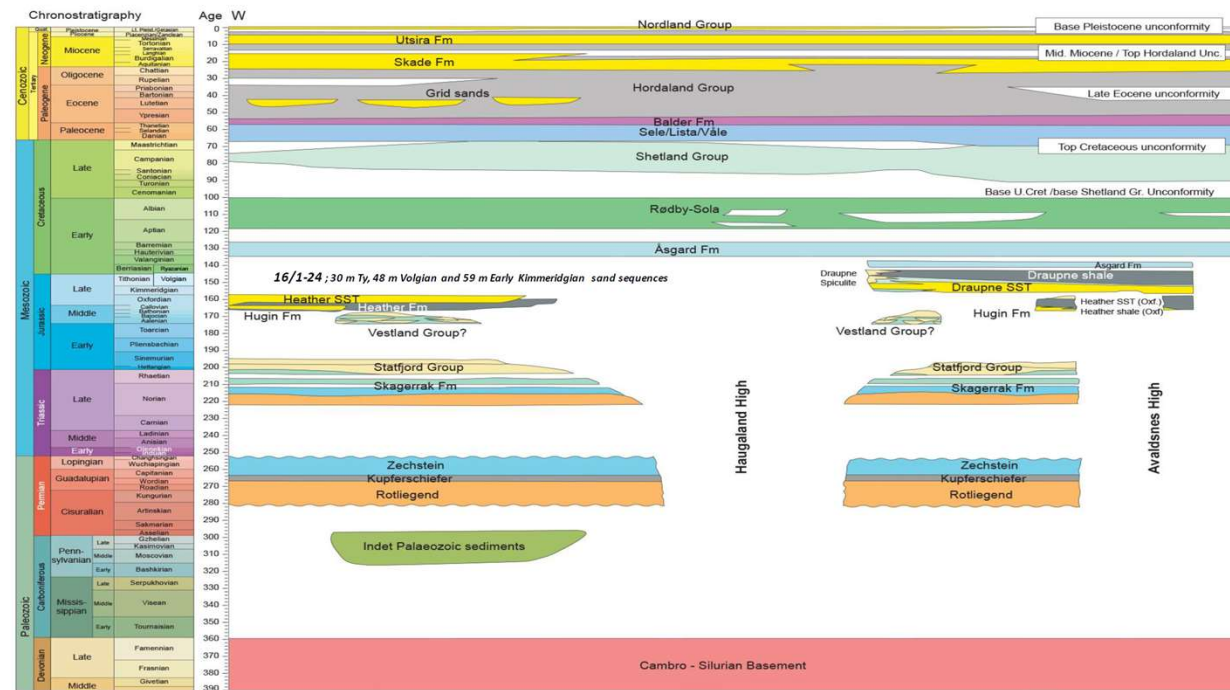


Rønnevik and Jørstad, 2014, Unfolding by Holistic Thinking, Giant and Significant Oil Discoveries in a Mature Area



Rønnevik Challenged Traditional Thinking

- “The usefulness hides in the emptiness”
- “Ideas must be calibrated by facts, but we should seek possibilities not the expected” to find play-opening success
- “New knowledge is created outside 2 standard deviations”



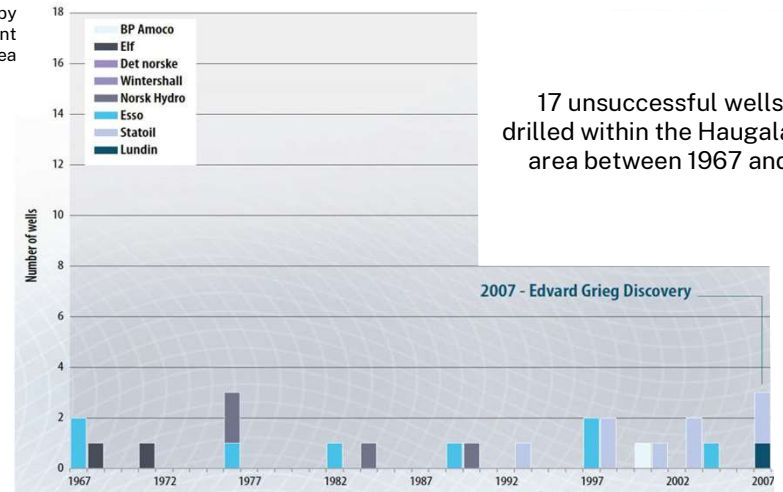
Rønnevik et al., 2017, The discovery process behind the giant Johan Sverdrup field



Bust the Paradigm

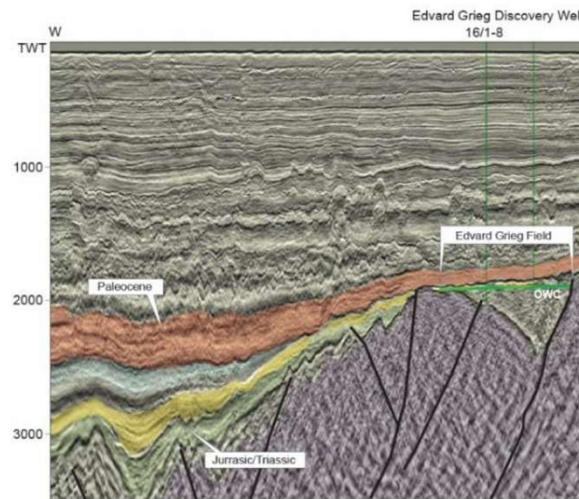
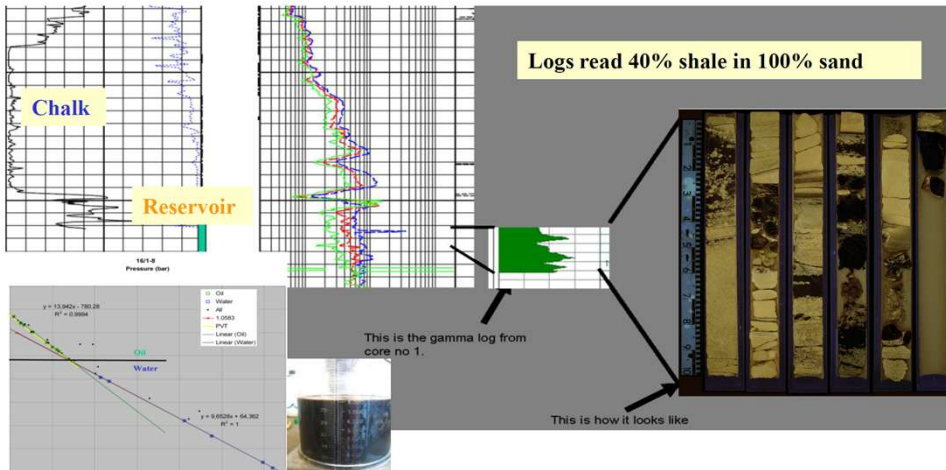
- 22nd well in 40 years of exploration
- 16/1-8 well drilled beyond the pinch-out to test the concept and resulted in the Edward Grieg oil discovery
- Due to the reservoir composition logs incorrectly calculated high Vshale
- Acquisition of core avoided the prize being missed

Rønnevik and Jørstad, 2014, Unfolding by Holistic Thinking, Giant and Significant Oil Discoveries in a Mature Area

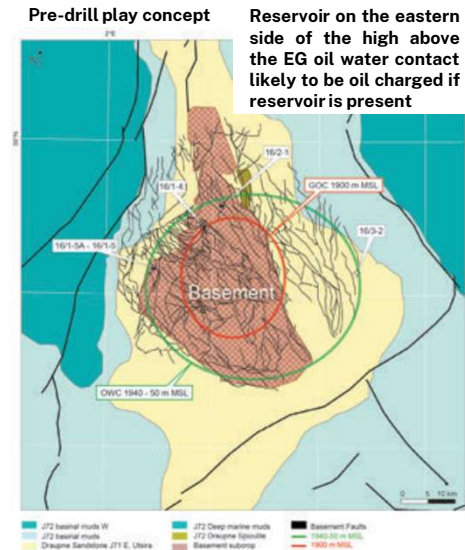


17 unsuccessful wells were drilled within the Haugaland High area between 1967 and 2007

Without core no discovery of the Edvard Grieg Field



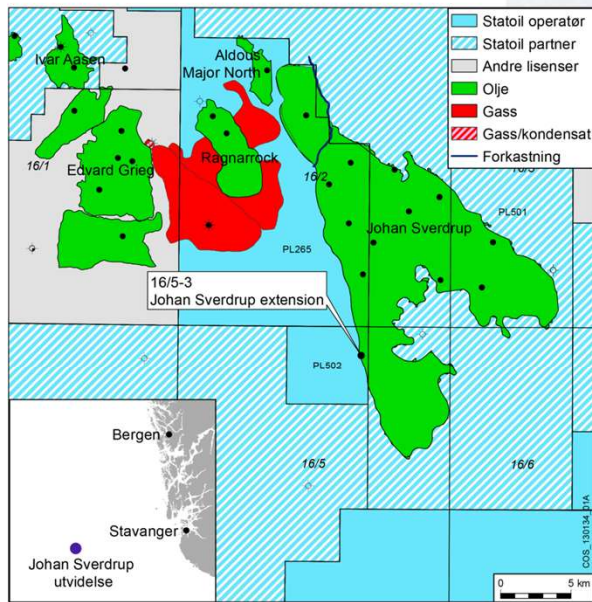
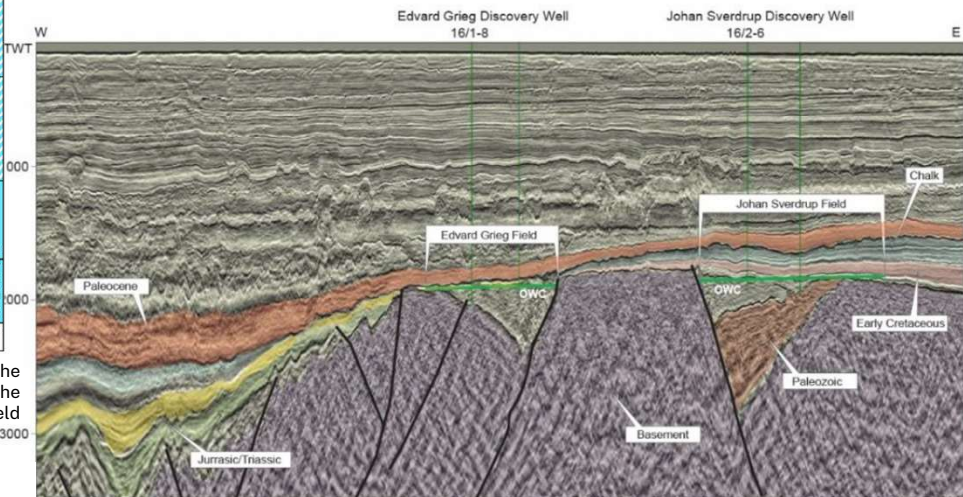
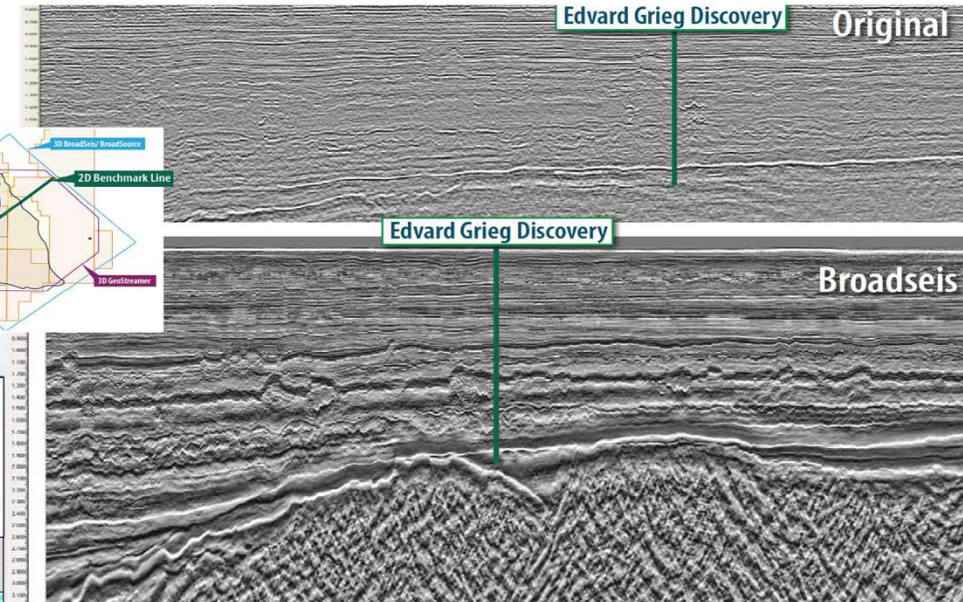
Rønnevik et al., 2017, The discovery process behind the giant Johan Sverdrup field



Technology the Enabler

- Thinking came first then technology delivered the required information to de-risk
- Modern seismic data and new processing methods enabled ideas to be tested

Broadband gives character from shallow to deep



Rønnevik and Jørstad, 2014, Unfolding by Holistic Thinking, Giant and Significant Oil Discoveries in a Mature Area

Rønnevik et al., 2017, The discovery process behind the giant Johan Sverdrup field

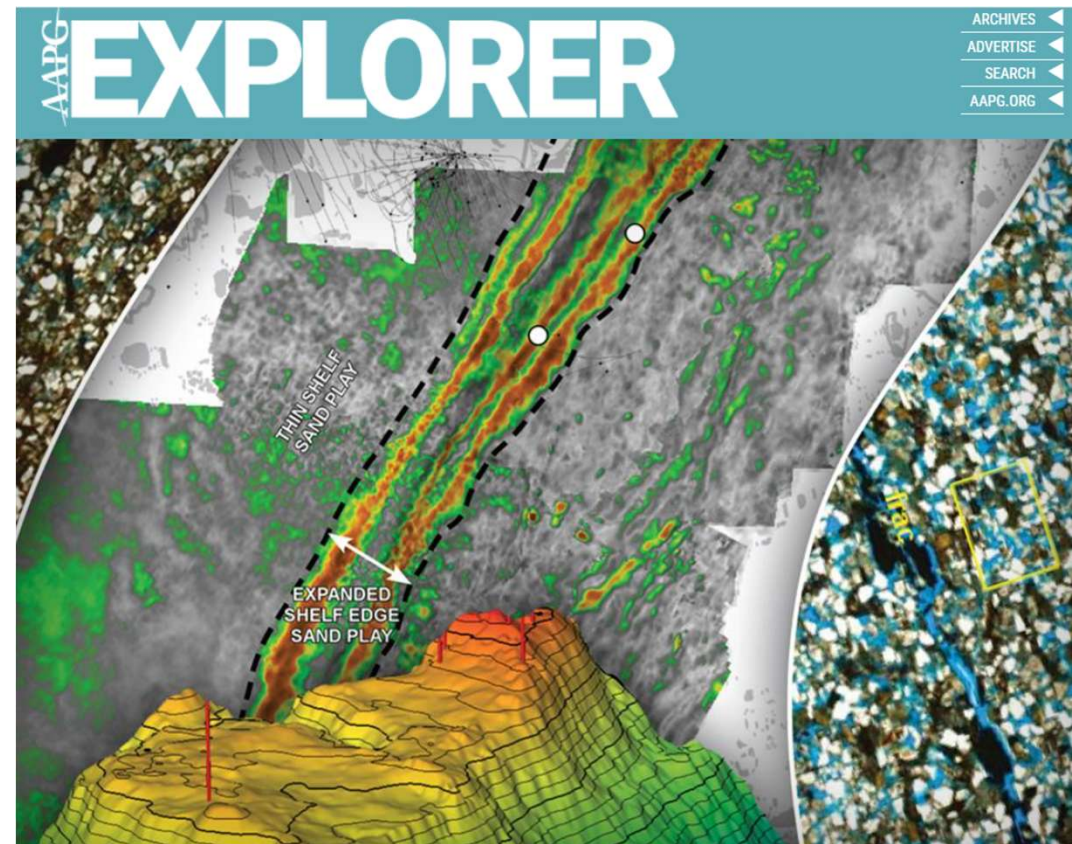


Society effect of Lundin activities:

- Revitalized exploration on NCS
- Proven 2.5-3 billion bbls in resources
- Proven 500 million bbls in reserves
- 140K bbls/day from Aluheim/Volund
- 90K bbls/day from Edvard Grieg
- 380K+ bbls/day from Johan Sverdrup (Phase1)
- Created substantial activity on land

AAPG Discovery Series

- A long-running format that brings together creative and successful explorers to try and tease out the art of exploration success
- Discovery Thinking began in 2008, more than 180 speakers worldwide have been invited to share their stories of exploration that have led to large, challenging and surprising discoveries. Over the years, more than 12,000 have attended and been inspired by the forums
- Essential viewing!
- Do we need a PESA equivalent?



Play Example 2: Guyana – Senegal Conjugate

- Very much enjoyed Rod Limbert's 2024 talk on his experience as Exploration manager for the Stabroek block in Guyana for ExxonMobil
- Having worked the Senegal side of the conjugate margin the simplicity of the play concept is pretty striking
- Rare to have an insight from a super major

PESA WA July Evening talk: Guyana – 10 billion barrels and counting

Tuesday, 4 July, 2023 @ 6:00 pm - 8:00 pm (Australia/Perth time) FREE – \$50.00



Guyana: 10 billion barrels and counting...

Rod Limbert

in



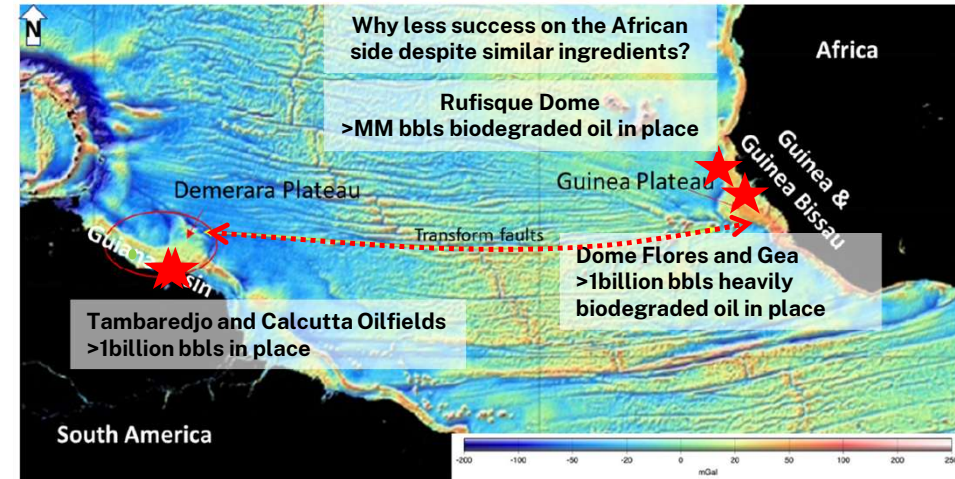
Guest Speaker(s): Rod Limbert

Rod Limbert has a BSc (Hons) from the University of New England. He worked as a geophysicist at WAPET for 7 years before joining Esso Australia, initially working as a geophysicist before undertaking a number of management assignments. He then spent 4 years in Indonesia as Exploration Manager before being assigned to Houston with Exxon and then ExxonMobil. He spent 15 years in Houston in exploration management positions in the US onshore, Canada, Yemen, South America and New Business development. During the time he was Exploration Manager for South America he was responsible for the identification and capture of the Stabroek Block in Guyana which is the subject of his talk.



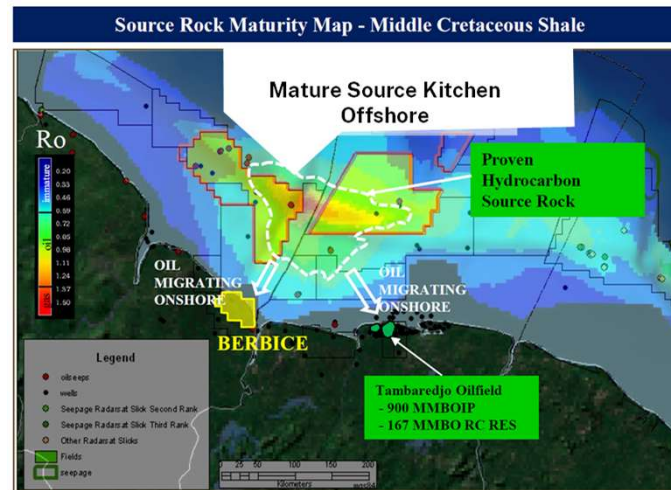
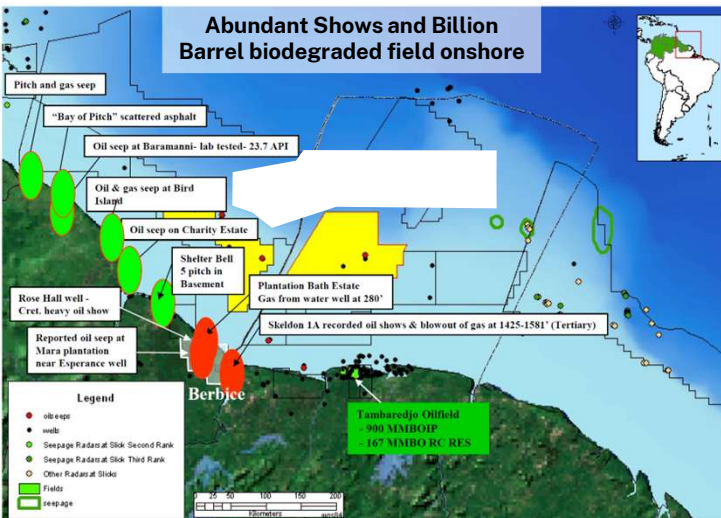
Play Concept Summary

- Heritage data from mid-last century (wells and seismic) point to an attractive opportunity to polarise the play with modern seismic and deepwater drilling capability
- Hard to understand why this play on both sides of the conjugate not chased earlier
- Different players on either side of the conjugate margin also a bit hard to fathom?
- Looks like a great example of the KISS principal



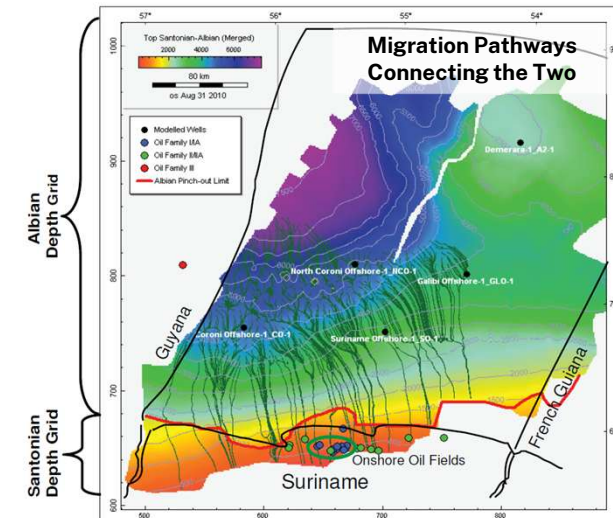
https://www.researchgate.net/publication/341029358_The_discovery_of_a_major_hydrocarbon_occurrence_in_the_Guiana_Basin_offshore_Suriname_a_blessing_or_a_curse?

<https://cgxenergy.com/wp-content/uploads/2020/10/Berbice-Block-Website-11-October-2020.pdf>



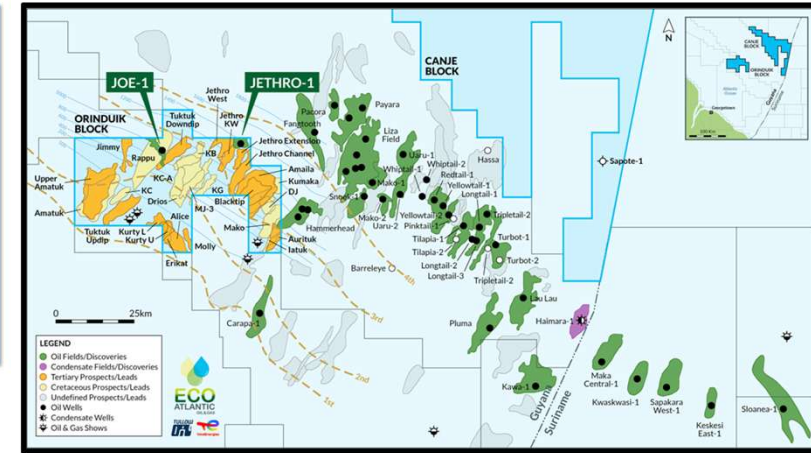
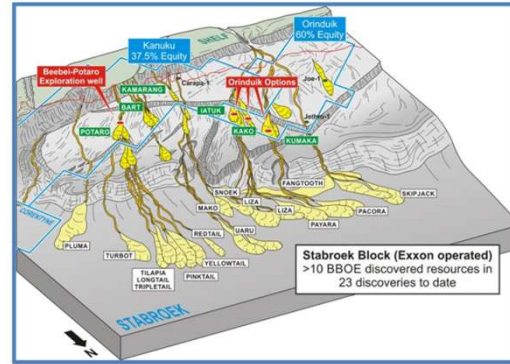
Ascendence Geoscience 2025

https://www.searchanddiscovery.com/documents/2014/30355bihariesingh/ndx_bihariesingh.pdf

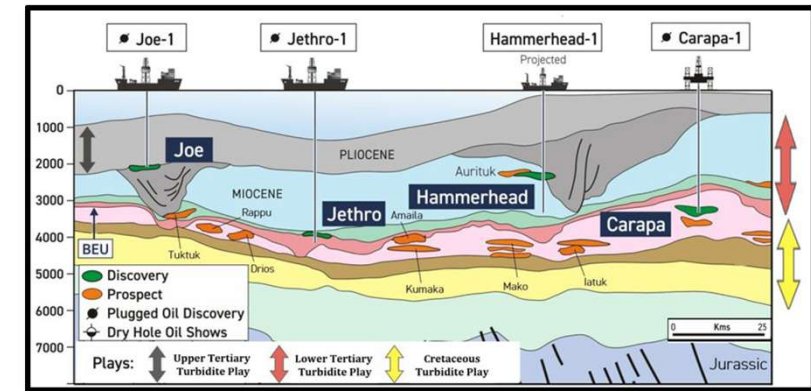


Analogue Fields 2: My Cup Runneth Over ...

- Simple geological thinking coupled with latest technology working hand in glove to deliver stunning result
- Sequence of discoveries with resources found of over 10 billion barrels with more to play out

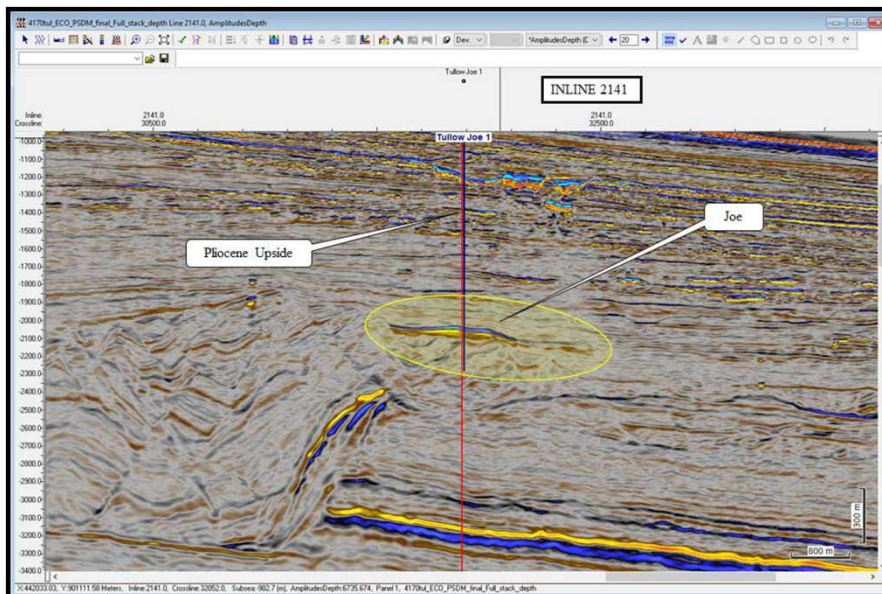
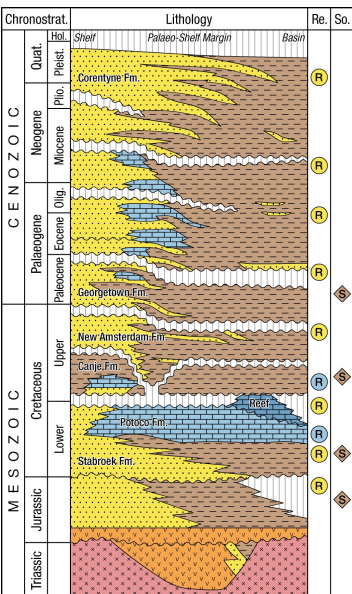


<https://wp-ecooilandgas-2020.s3.eu-west-2.amazonaws.com/media/2022/03/AIM2022CP-ECO-Report-final-3-22-2022.pdf>



<https://wp-ecooilandgas-2020.s3.eu-west-2.amazonaws.com/media/2019/03/AIM2019CP-ECO-Orinduik-reporMar2019Final-.pdf>

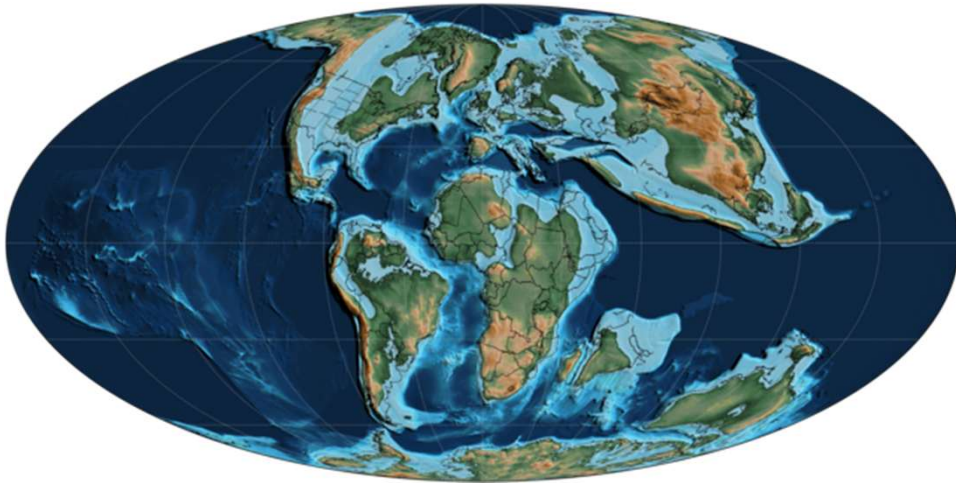
<https://geoexpro.com/sandwiched-between-two-major-petroleum-provinces-surinames-shallow-offshore-bid-round-acreage-will-be-popular/>



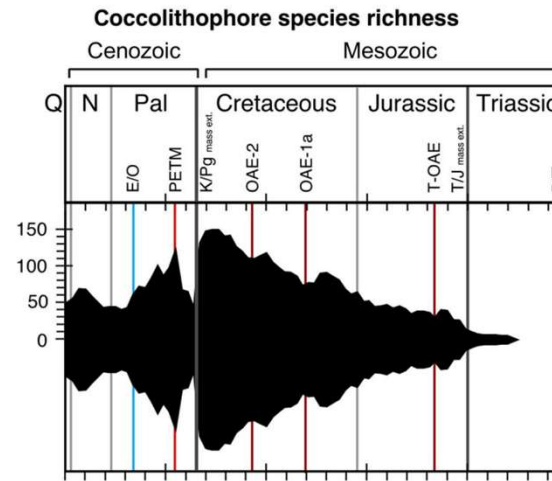
Play Example 3 – Chalk

- Typically having high porosity but low permeability chalk reservoirs have been prolific in the North Sea and the USA but require specific circumstances to work

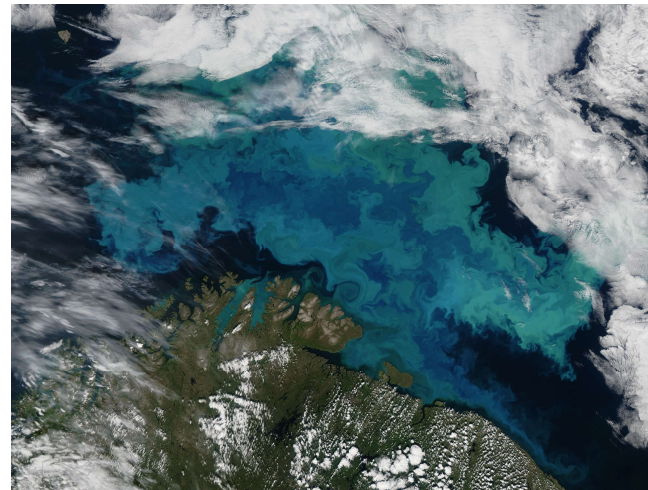
Late Cretaceous Paleogeography



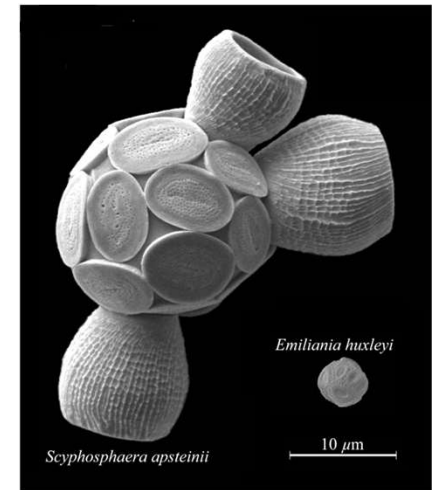
[https://en.wikipedia.org/wiki/Late_Cretaceous#/media/File:Mollweide_Paleographic_Map_of_Earth_85_Ma_\(Santonian_Age\).png](https://en.wikipedia.org/wiki/Late_Cretaceous#/media/File:Mollweide_Paleographic_Map_of_Earth_85_Ma_(Santonian_Age).png)



Monteiro et al., 2016, Why marine phytoplankton calcify



<https://earthobservatory.nasa.gov/images/51765/bloom-in-the-barents-sea>



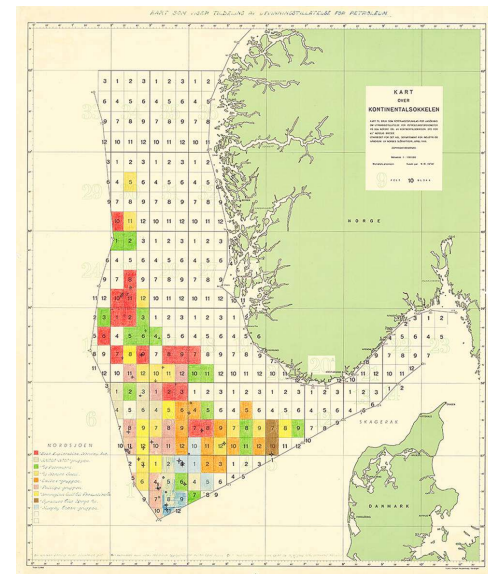
<https://en.wikipedia.org/wiki/Coccolithophore>

Analogue Field 3 – Ekofisk

- Post success at Groningen gas field in 1959 the chance that the North Sea basin extended into the Norwegian sector had been declared “out of the question”.
- Phillips Petroleum postulated that the North Sea Basin might go a lot further north and approached the Norwegian government to seek rights to explore all the NCS, none of which was gazetted at the time
- Norway declined but did subsequently gazette the area with Phillips acquiring blocks in 1962
- Drilling proved the North Sea Basin extended into Norway by after >32 dry holes hopes were fading
- Phillips still had one last commitment well to drill – drill or forfeit \$1million (ca. \$9 million today) – decision – DRILL!

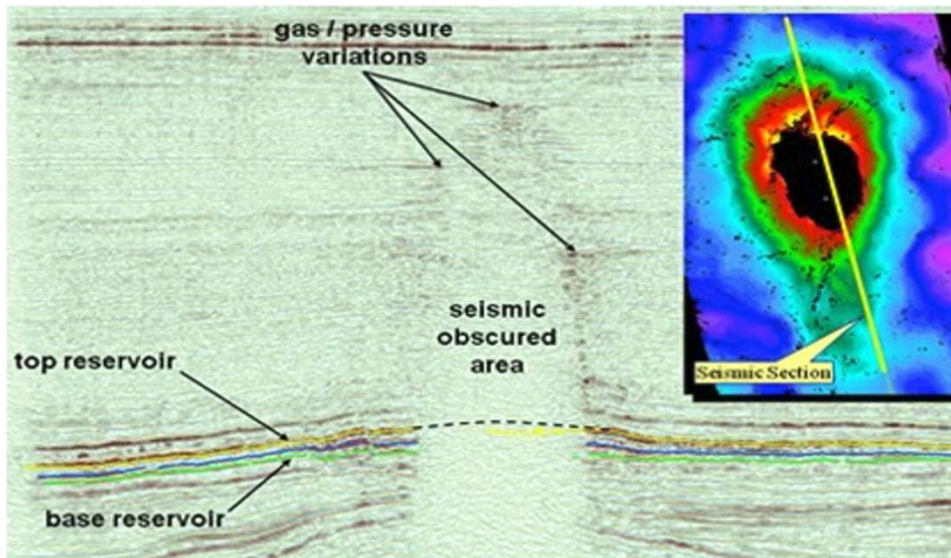


The Ekofisk Field - the North Sea's first giant oilfield



Ekofisk – Norway’s First Giant Oilfield

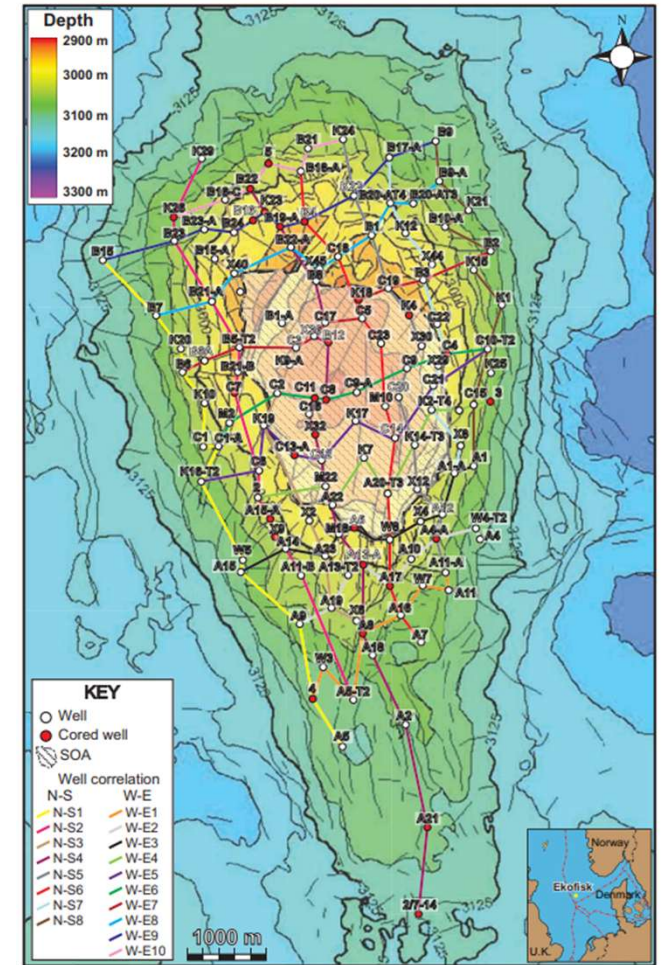
- Commitment well 2/4-1 was drilled to test Paleocene sandstones
- No reservoir was encountered but a decision to drill ahead was made ensure a complete Paleocene section was drilled
- Chalk was encountered below the Paleocene section with copious oil noted across the shakers and Norway’s oil industry was born
- Ekofisk has produced more than 4.2 billion BOE



Trove, 2021, The Ekofisk Field - the North Sea's first giant oilfield

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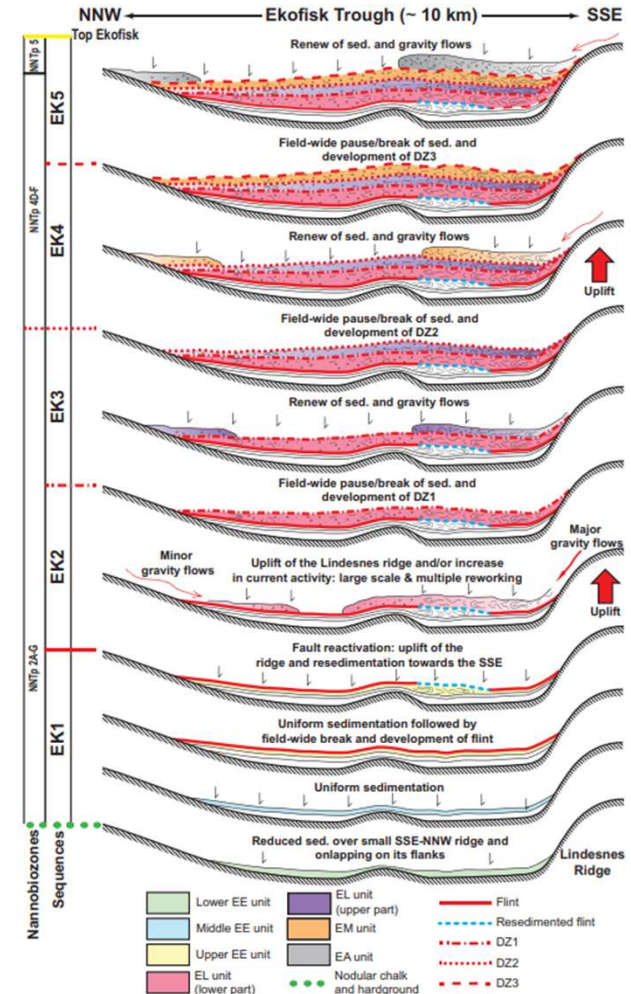
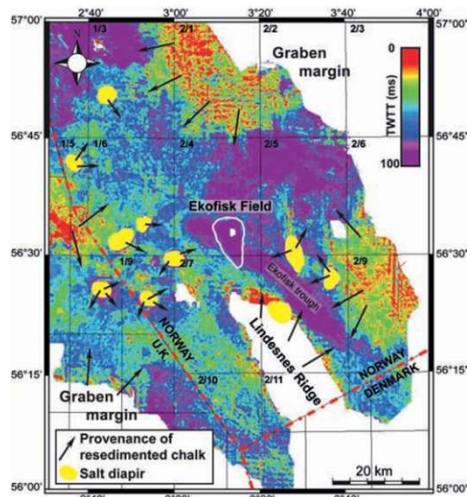
Trove, 2021, The Ekofisk Field - the North Sea's first giant oilfield



Learnings from North Sea Chalk Fields

<https://www.lyellcollection.org/doi/abs/10.1144/petgeo2012-013>

- The anatomy of the play has specific requirements for success:
 - Pure chalk fractures more readily producing more permeability
 - Permeability enhancement is usually required either by remobilisation after deposition or fracturing due to tectonism or halokinetic processes
 - Remobilised chalk in the form of debris flows and low density turbidite deposits produces the best reservoirs
 - Low permeability increases capillary entry pressure so effective hydrocarbon migration relies on overpressure development

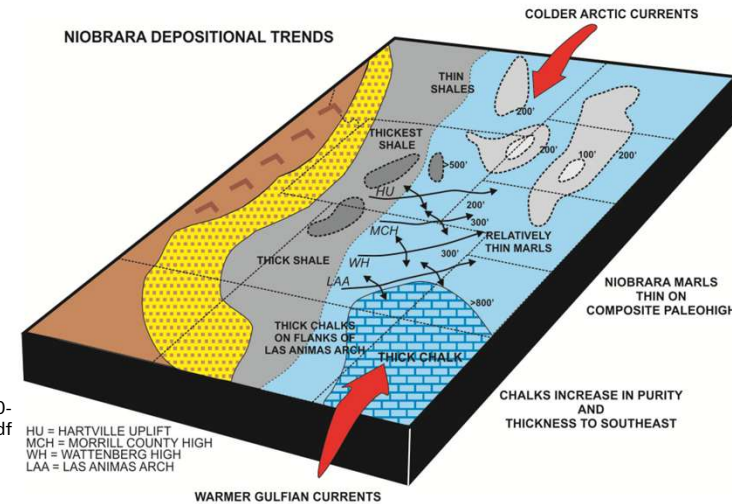
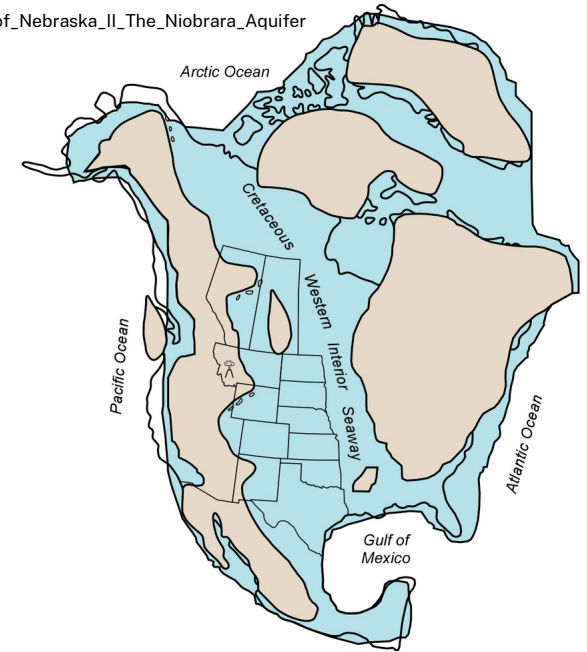


<https://www.lyellcollection.org/doi/abs/10.1144/petgeo2012-013> Ascendence Geoscience 2025



Learnings from Elsewhere

- US Gulf Coast, the Austin Chalk has yielded more than a billion barrels of oil and over 6 TCF of gas since 1920
- The Niobrara play in the Western Interior Seaway has also been productive since the 1920's
- The role of ocean circulation patterns in controlling chalk deposition was recognised in the Niobrara play with warmer north flowing currents resulting in the thickest chalk sections

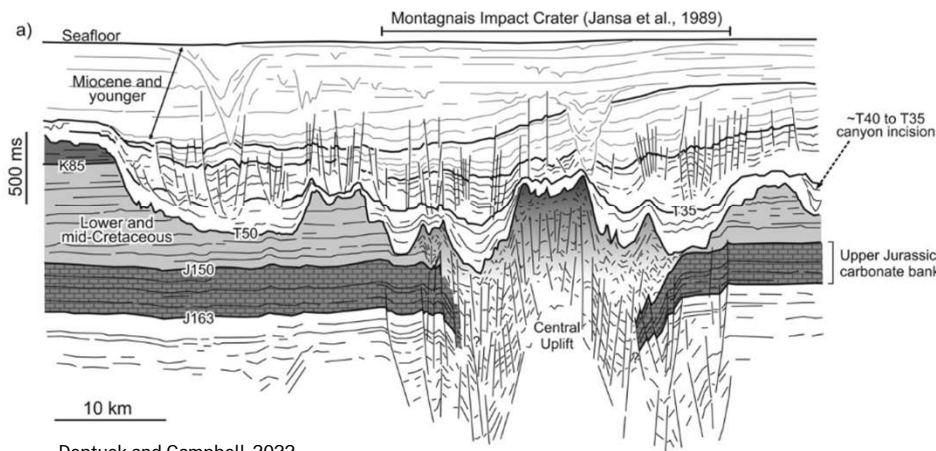
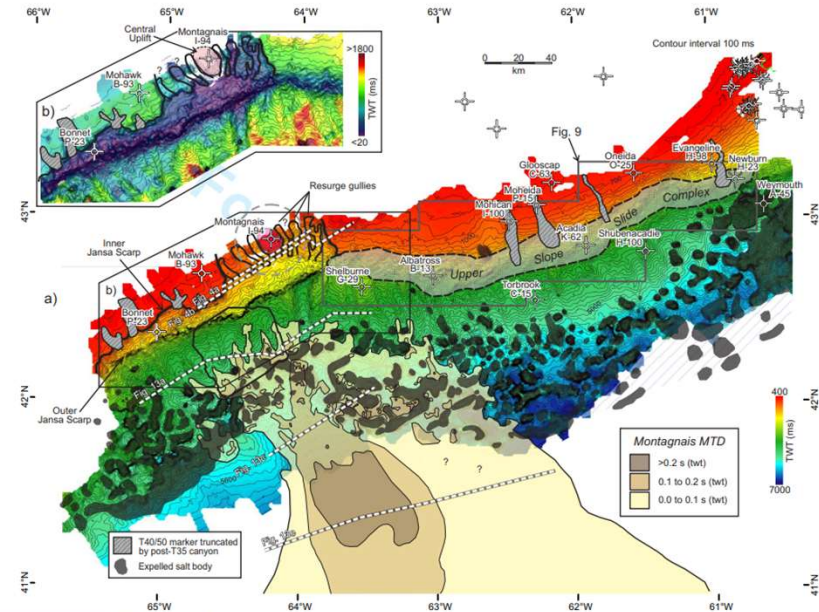


<https://wpfiles.mines.edu/wp-content/uploads/mudtoc/presentations/2020-fall/Scott%20K%20Manwaring%20-%20Consortium%20Presentation%20November%202020.pdf>

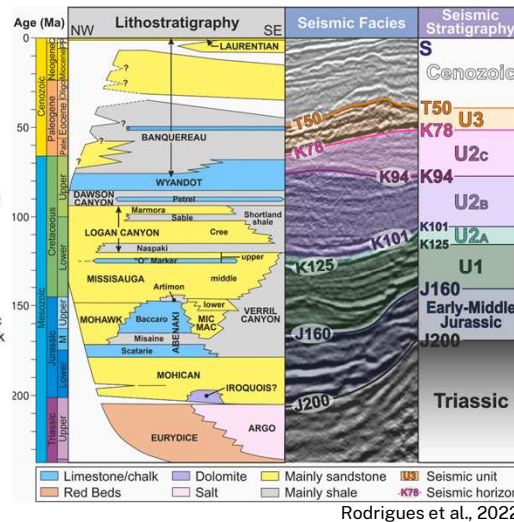


Application – Montagnais

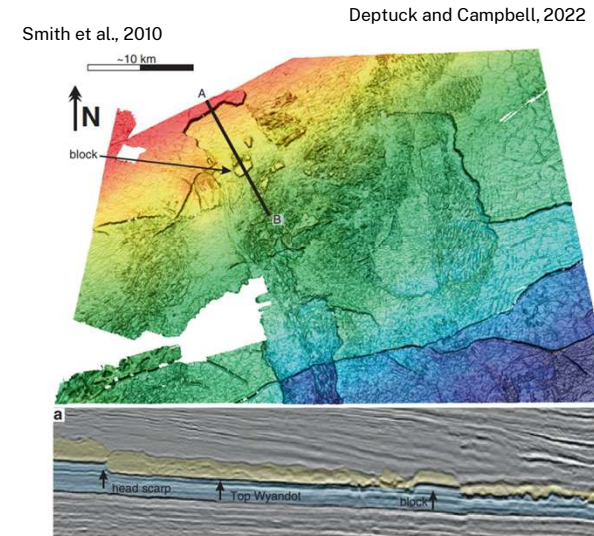
- The mother of all mass transfer complexes
- Eocene bolide impact with re-sedimentation of the Wyandot chalk and most of the Mesozoic section
- I can still hear the review team sniggering at the initial KOKO meeting
- Meteorite impacts and oil and gas success, surely a load of old codswallop?



Deptuck and Campbell, 2022



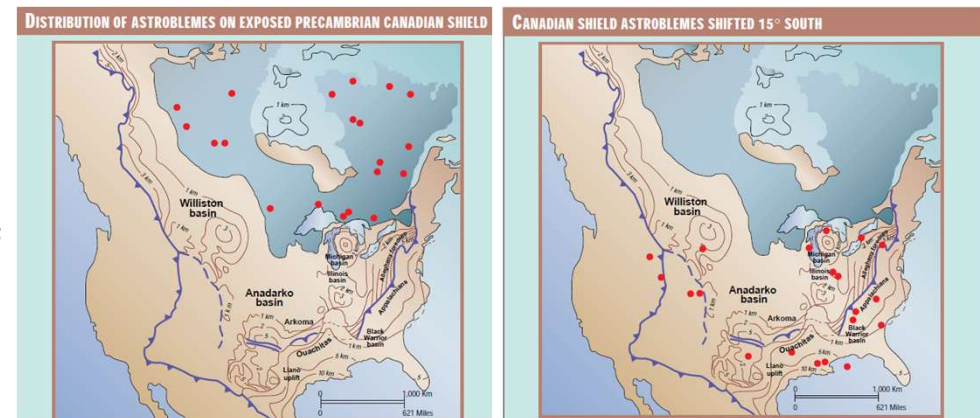
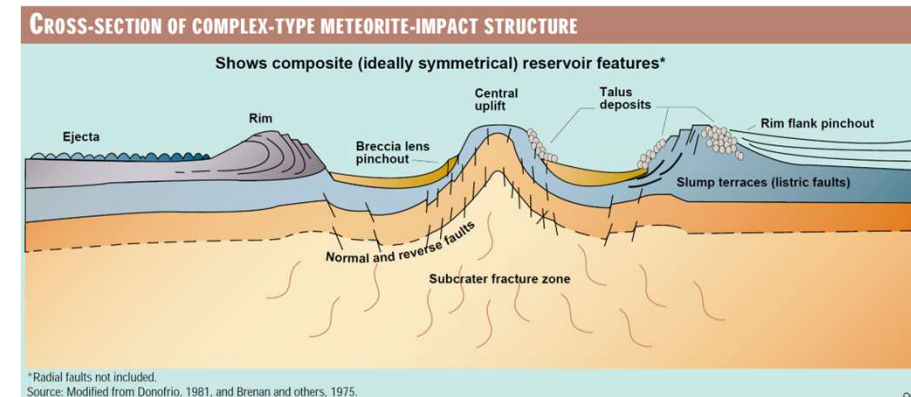
Rodrigues et al., 2022



Play Example 4 – Impact Craters

- My ignorance about meteorite impacts was challenged
- Impact craters produce most petroleum systems needs:
 - Deformation produces structure extending well beyond the main impact zone
 - Impacted stratigraphy produces breccias and promotes remobilization as gravity flows
 - All rocks become potential reservoirs
 - Ejecta fall out produces effective seals
- 17 confirmed fields in North America, 9 commercial
- None inferred as impact structures pre-drill!
- Success rates for NFW into confirmed astroblemes of about 21% and 77% for all wells

<https://www.parwestlandexploration.com/docs/og.pdf>



Potential of Australian Impact Craters

- Australia has a good number of impact craters
- Tookoonooka, a large meteorite impact structure in the Eromanga Basin has a spatial relationship with producing oil fields
- Other impact craters show some relationship with the location of key ore deposits

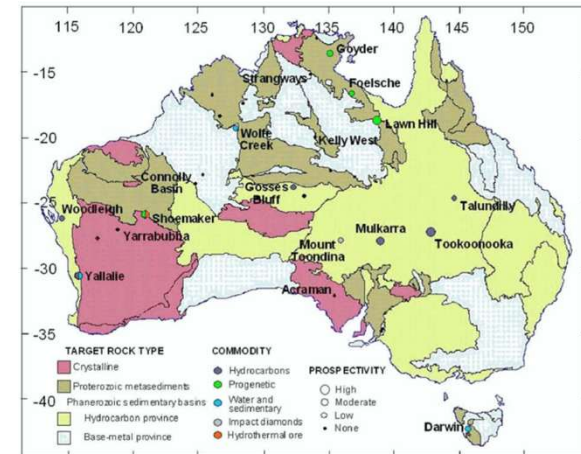
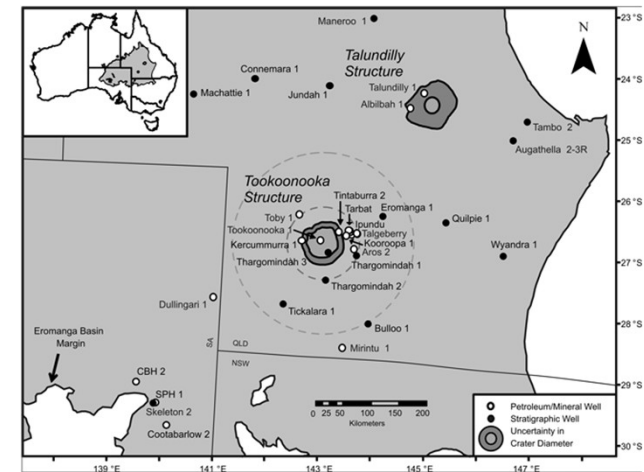


Figure 2. Locations of Australian impact structures and features of suspected impact with assessed potential to host economic resources. Simplified tectonic map courtesy of Geoscience Australia. Named structures are discussed in the text.

Hawke and Dentith, 2019



Bron and Gostin, 2012



Analogue Field 4 – Cantarell

- Cantarell, a local fisherman, kept getting his nets covered in oil as he trawled for shrimp in the early 1970s across the Bay of Campeche
- Assuming that the oil came from Pemex operations, he regularly hauled his oil-stained nets hundreds of miles to the nearest Pemex offices to seek compensation.
- Finally, local Pemex officials say, the oil giant grew so exasperated with Cantarell that it went to check out his story
- The field was discovered in 1976 and put on production in 1979.

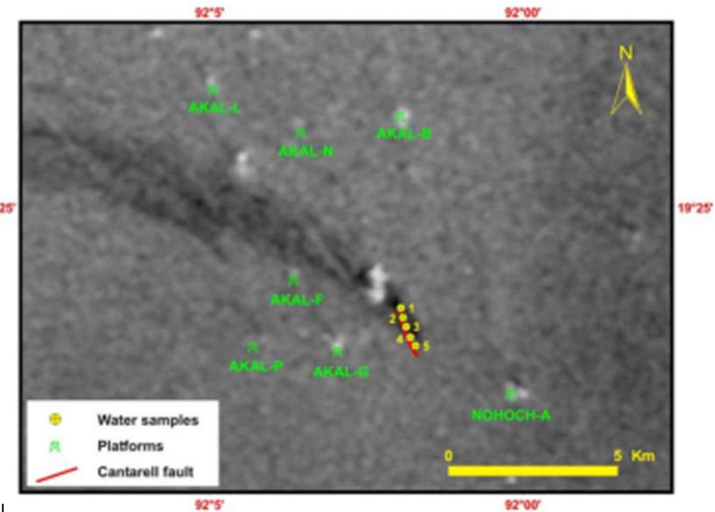


Natural Oil Seepage in the Cantarell Field area

Rudesindo Cantarell



https://english.elpais.com/elpais/2015/06/29/inenglish/1435582397_411669.html

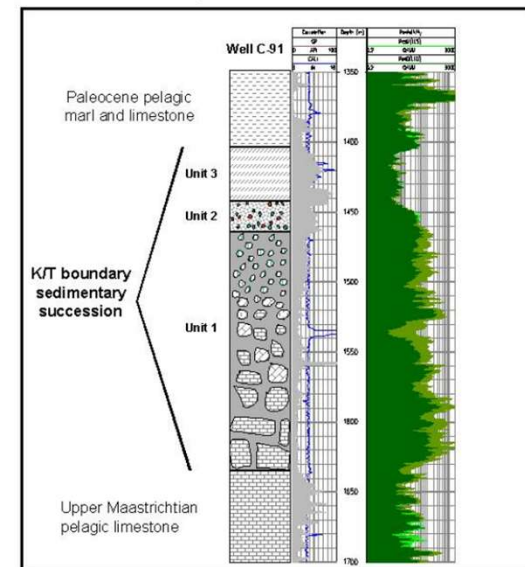
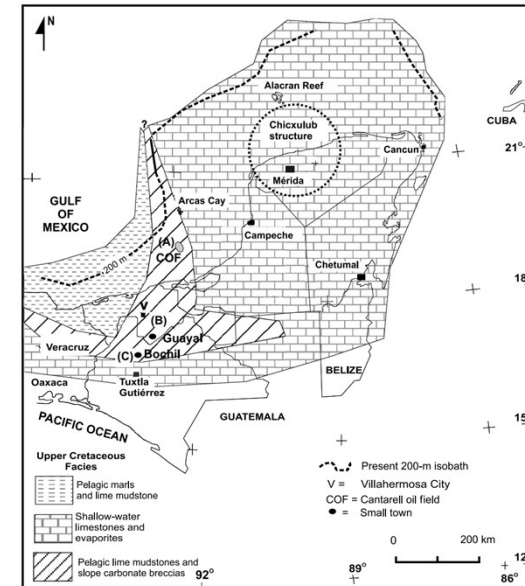


RADARSAT-1 Image showing the Cantarell Oil Seep



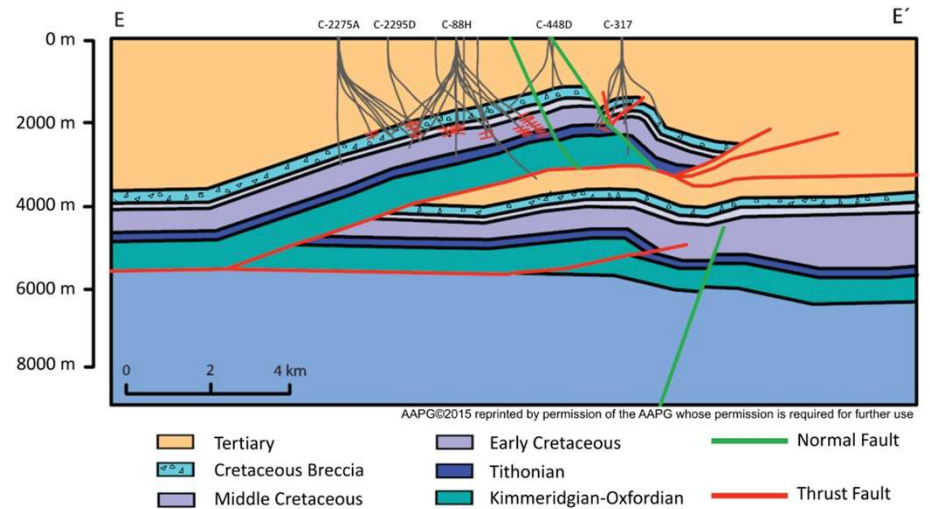
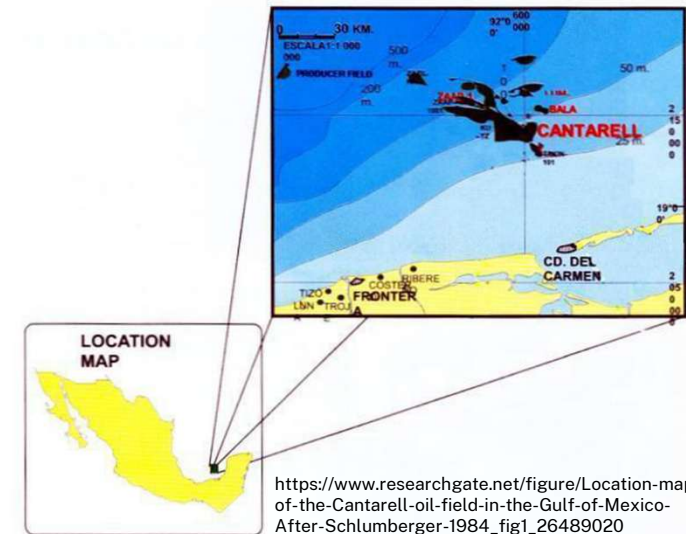
Cantarell Field, Bay of Campeche

- The Cantarell main reservoir consists of carbonate breccia of Late Cretaceous age
- Whilst indications of sub-aerial exposure are recognised by karsted features the breccia is widely attributed to a shelf failure (mass transport) associated with the Chicxulub Crater asteroid impact at the KT boundary



A Super Giant Field

- The oil field, categorized as a super giant had original oil in place of 35 billion barrels with estimated recoverable volume of 17 billion barrels
- In addition to fracturing induced by meteorite impact structural permeability was further enhanced by late-stage Miocene compression
- There are four fields that comprise the Cantarell complex – Akal, Nohoch, Chac and Kutz
- At it's peak Cantarell was the second-highest-producing field (2.14 MMbbl/d in 2004) in the world behind the Ghawar Field



<https://geoexpro.com/vast-hydrocarbon-potential-mexicos-offshore-ronda-uno/>



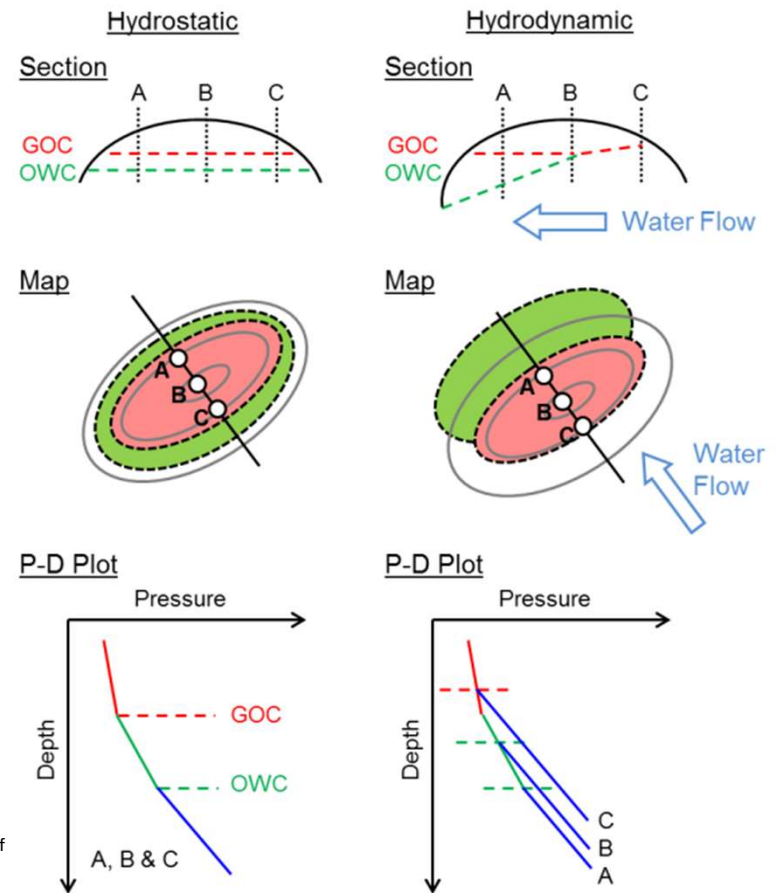
Play Example 5 – Hydrodynamic Traps

- In our pursuit of the prize, we often neglect the water and assume passive hydrology
- Aquifers are rarely passive responding to the same physics that drive hydrocarbon accumulation
- Water-flow can be strong enough to tilt oil-water contacts and perturb migration directions
- A common hydrocarbon gradient underlain by variable water gradients point to the potential for basin hydrodynamics to impact the hydrocarbon system
- Compartmentalisation can produce similar outcomes, so hydrodynamics can be a non-unique interpretation
- Gas was generally assumed to be too buoyant to be impacted by hydrodynamics



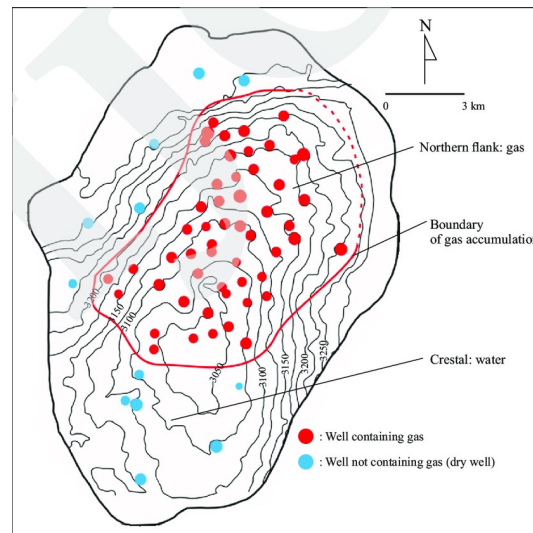
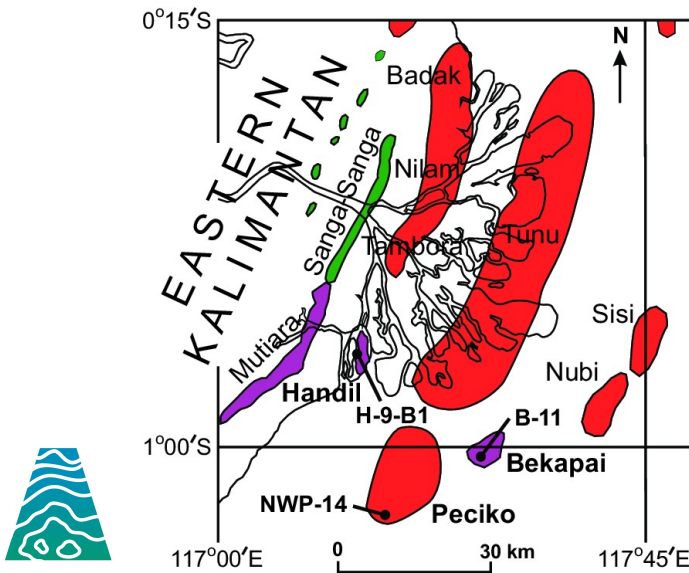
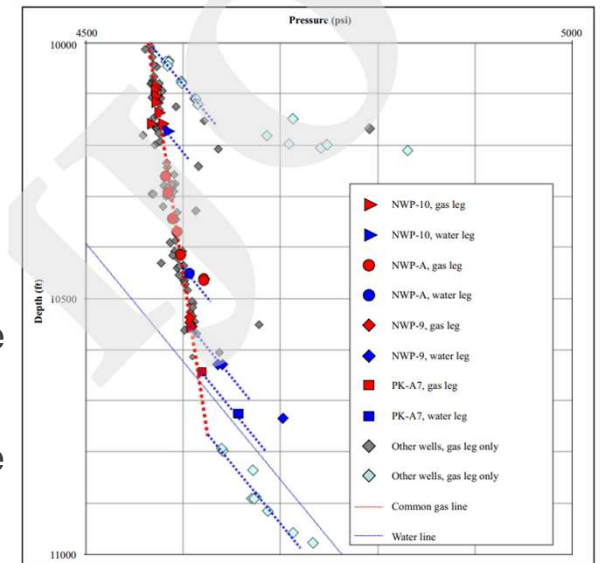
https://www.searchanddiscovery.com/documents/2014/41314green/ndx_green.pdf

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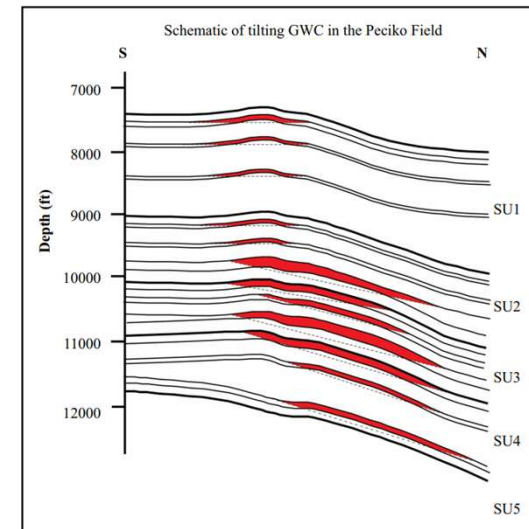


Analogue Field 5 – Peciko Gas Field

- Peciko-1 in the Mahakam Delta drilled on crest of a deep-seated structure in 1982 but tested only marginal gas pay
- Took another 9 years to recognise that the gas had been swept from the crest by hydrodynamic flow in the aquifer
- Field full potential (6+TCF) defined by drilling the hydrodynamic closure rather than the structural closure (i.e. drill down-dip from water)



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<https://www.researchgate.net/publication/323661480>

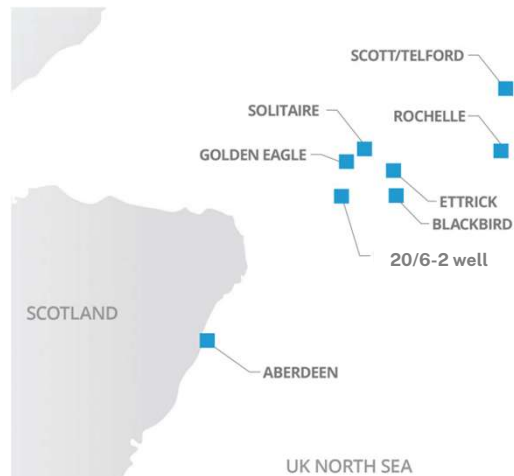
Play Example 6 – Re-discovery

- Re-discovery refers to fields where the original well(s) were incorrectly interpreted often resulting in years or decades being lost before the true value of the discovery is revealed
- Mostly these fields delivers benefit to a different company than the one that first drilled the discovery
- Critical to pay full attention to all discoveries not just the ones that yield commercial fields



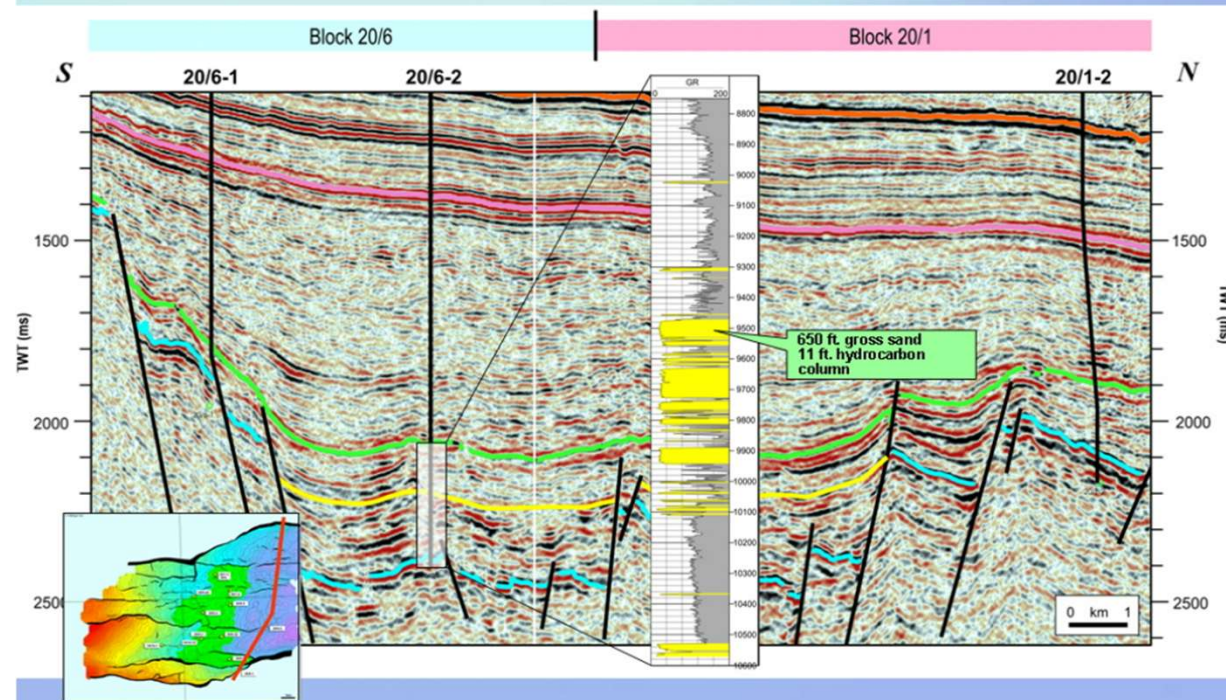
Exploring with the Wrong Mindset

- The 20/6-2 well was drilled in 1986 to test a small 4-way closure presumably as a tie-back to the nearby Ettrick Field
- The well penetrated a 200m thick gross reservoir interval, but only the top 3m was oil-bearing



Map modified from CNOOC Petroleum Europe Ltd Environmental Statement 2019

North – South Line Through 20/6-2



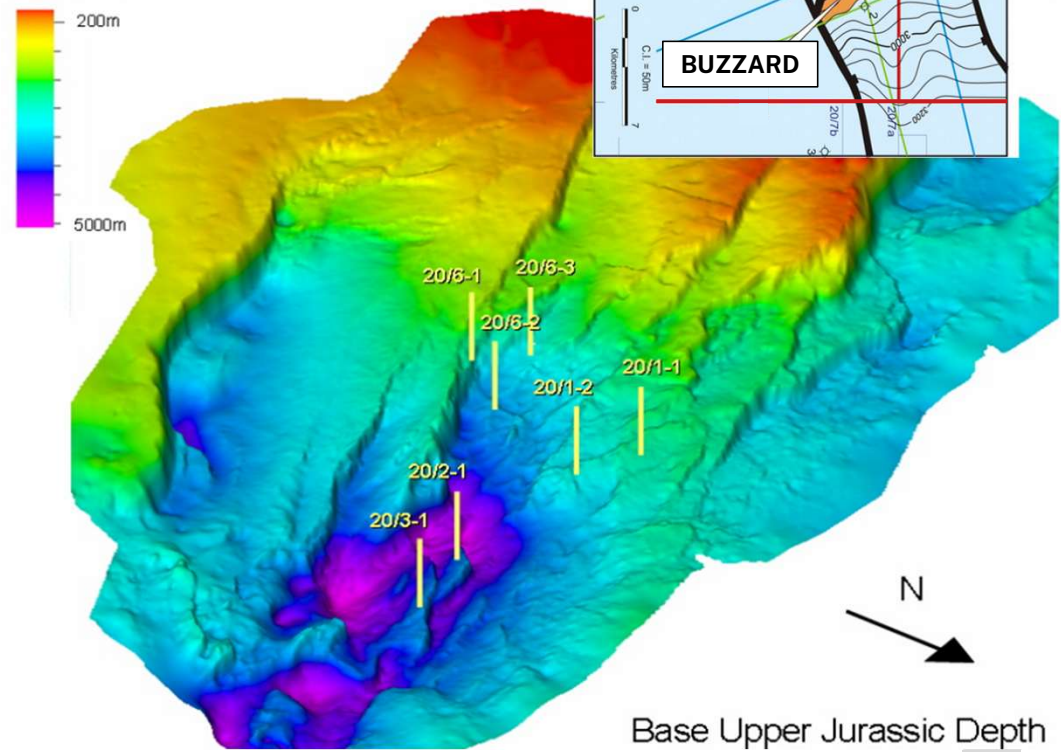
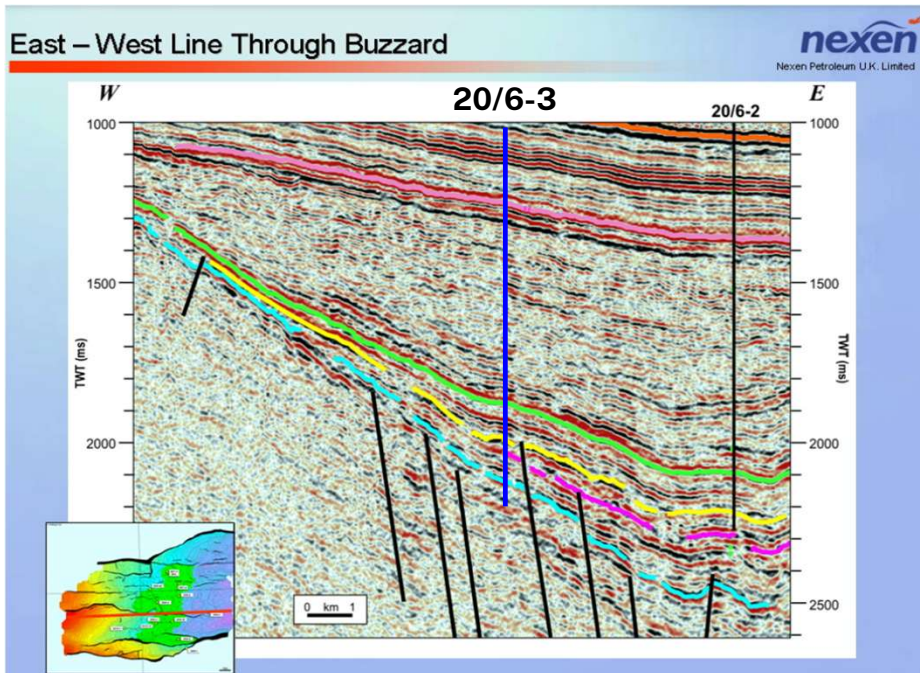
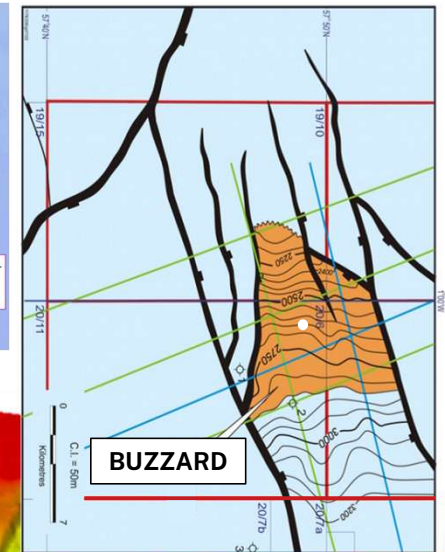
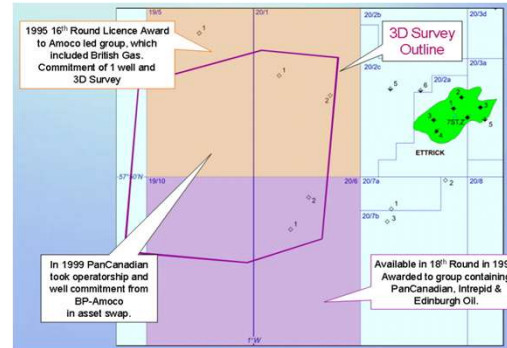
https://www.searchanddiscovery.com/documents/2005/av/robbins/ndx_robbins.pdf

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Analogue Field 6: Buzzard

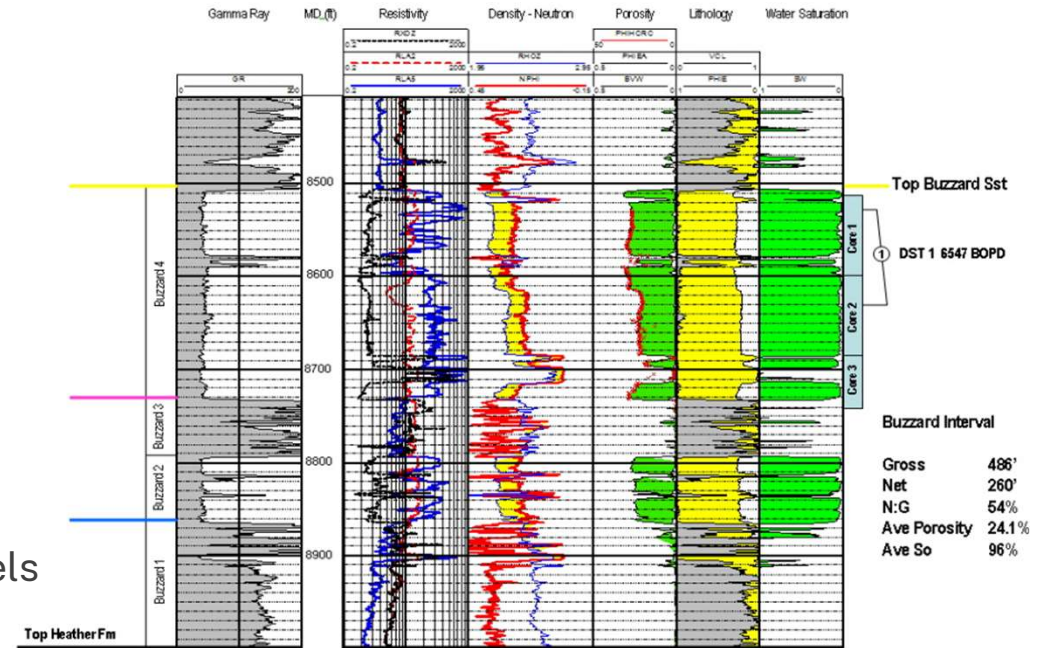
Exploring with Purpose (aka Going for Broke)

- Pan Canadian assumed operatorship in 1999 from BP-Amoco
- 20/6-3 well drilled up-dip from the previous discovery to test the stratigraphic trapping component

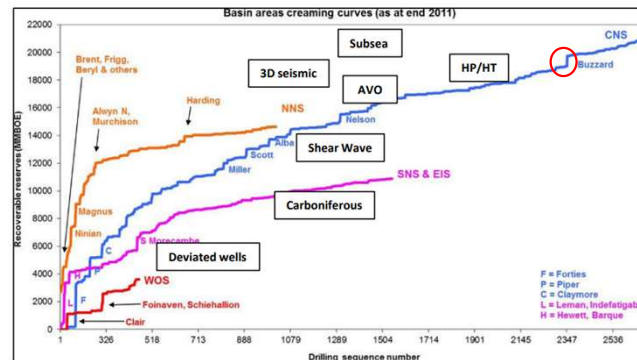


Winners are Grinners

- The Buzzard discovery well defined a 150m oil column with excellent reservoir properties
- Tested at constrained rate of 6547 bbls/day of 32°API oil
- Mum and Dad were over the moon and a major creaming curve reset was made
- Buzzard has estimated STOIP of >1.4 Billion barrels

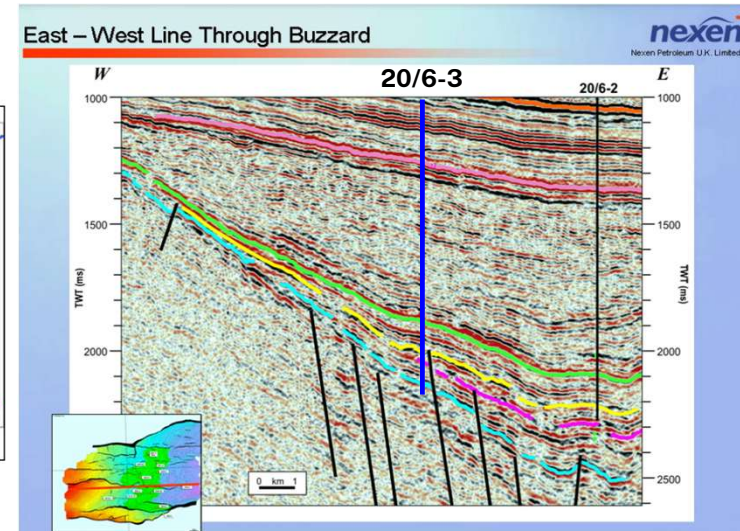


https://www.searchanddiscovery.com/documents/2005/av/robbins/ndx_robbins.pdf



Source: Lyell collection, J. A. Austin, S. J. C. Cannon and D. Ellis

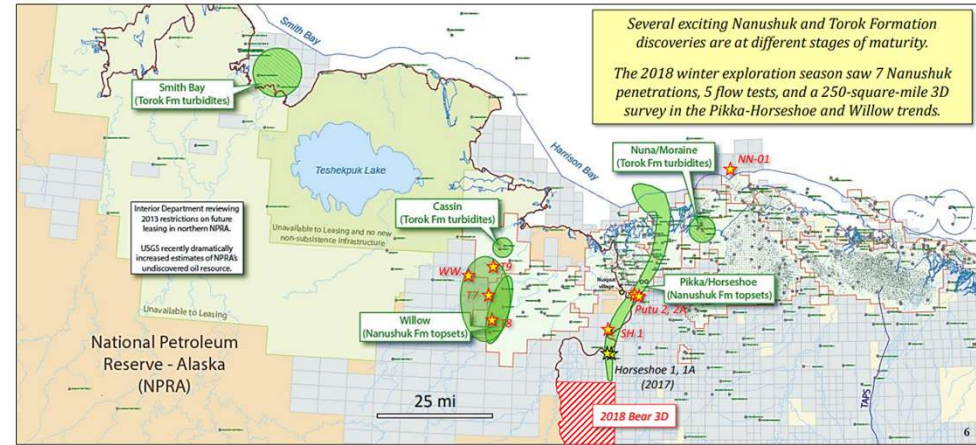
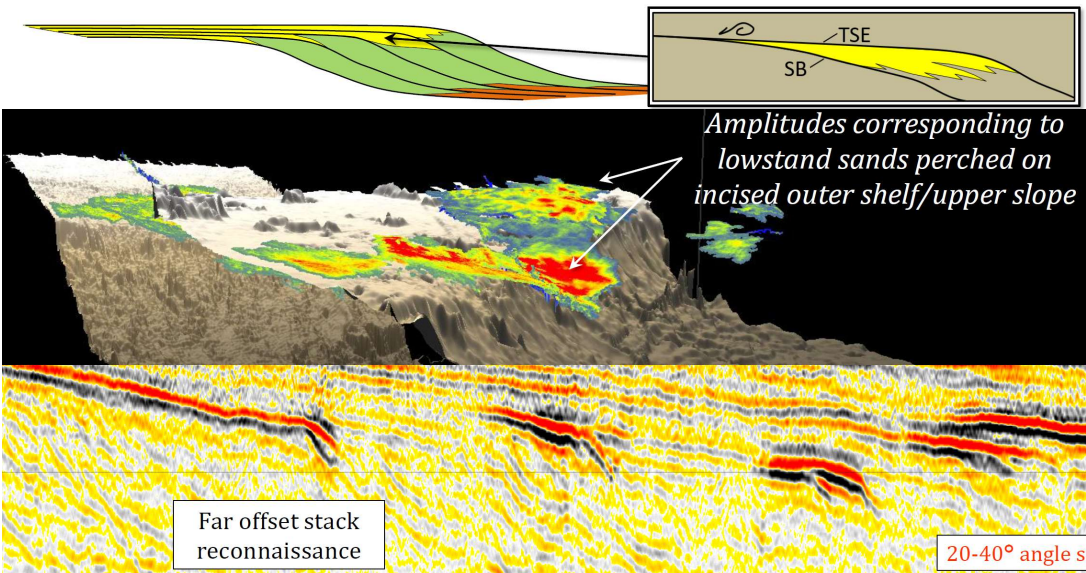
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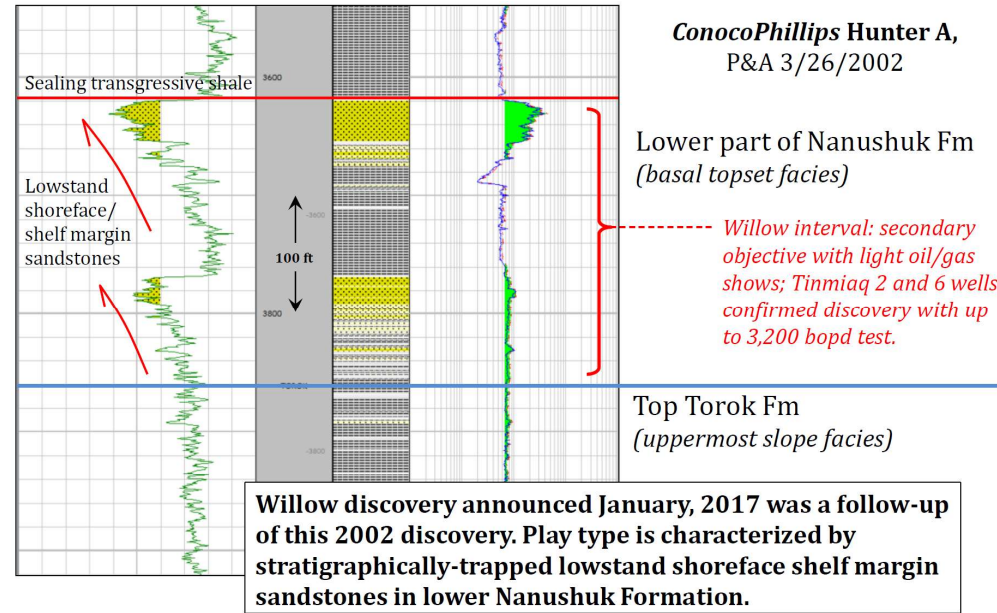
Analogue Field 7:

Re-discovery a key element on the North Slope, Alaska

- Amplitude supported LST sandstone wedges with oil stratigraphically trapped by sealing transgressive shales above
- Nanushuk progrades penetrated in >150 wells on the way down to deeper objectives (Torok Fm Turbidites)
- Initial sub-economic discovery 15 years earlier makes the fields good examples of “re-discovery”
- Key message – understand sub-economic discoveries



https://dog.dnr.alaska.gov/Documents/ResourceEvaluation/20180521_DiscovThinking_Decker.pdf



The Analogue Code

- A good analogue will help but they are never like for like and open to misuse so use with appropriate caution
- Stick to the ‘Analogue Code’

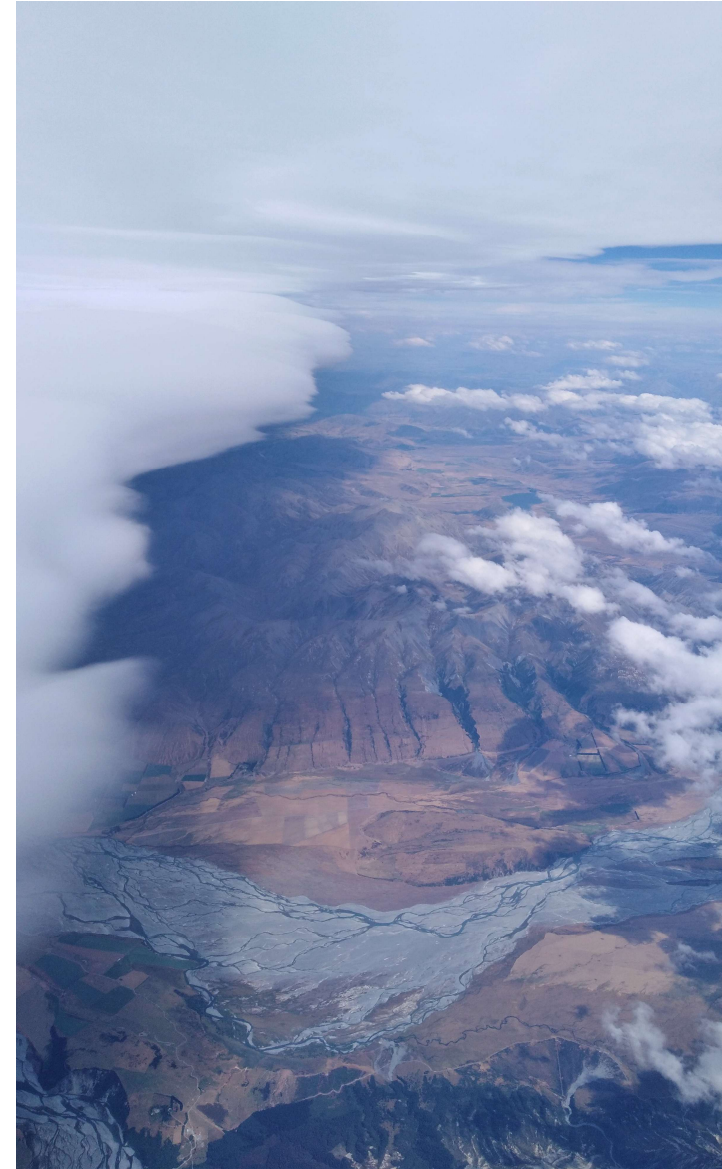
“They’re more guidelines than actual rules”

- The West African Jupiter Field analogue for example has been used regularly to sell prospects with only a passing resemblance to the real thing



Summary

- Geological analogues form a vital part of the geoscientist's armoury
- To benefit from accumulated collective experience and to avoid unnecessary failures a good inventory of analogues is vital
- Using a combination of modern, outcrop and sub-surface analogues is considered best practice with high and low-side outcomes covered
- Aside from providing data to calibrate assurance of existing opportunities geological analogues play a key role in inspiring the new ideas that will produce the discoveries of tomorrow
- Three key takeaway messages:
 - Ideas find hydrocarbons, technology is the enabler to achieve success
 - Rediscovery plays a major role in finding play-opening discoveries
 - Geological success looks painfully obvious in hindsight



Analogue Database Product

- We built this presentation quickly with examples drawn from the Geophor Field Analogue Database
- Efficient and cost effective access to analogue data can be challenging, particularly for small to mid-size operators
- Our Geophor analogue database provides access to the collective knowledge of more than 150 years of exploration and development
- Geophor is a low-cost but high-value offering to easily bring the power of analogues to your evaluation processes
- Contact Ascendience Geoscience to arrange a demo of the Geophor product



1500 Fields and Growing
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GLOBAL ANALOGUE OIL AND GAS FIELD DATABASE

- **Leverage Value from Industry Sunk Costs**
- **Constrain Exploration Inputs**
- **Benchmark Variables for Field Development Planning**
- **Improved Risk Assessment**
- **Reveal New Opportunities to Grow Portfolio**
- **Enhance Understanding of Geological Processes**
- **Cost-Effective Access to Critical Ideas and Data**

THE POWER OF ANALOGUES

Geological analogues offer data and ideas to narrow sub-surface uncertainty. They deliver answers to key questions, but they also challenge answers with new questions that reveal unseen opportunities.

Geophor contains oil and gas fields from around the world, across a diverse range of geological settings, providing a window on the collective learning of more than 150 years of exploration and development.

GEOPHOR PRODUCT DETAILS

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Any Questions?



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