



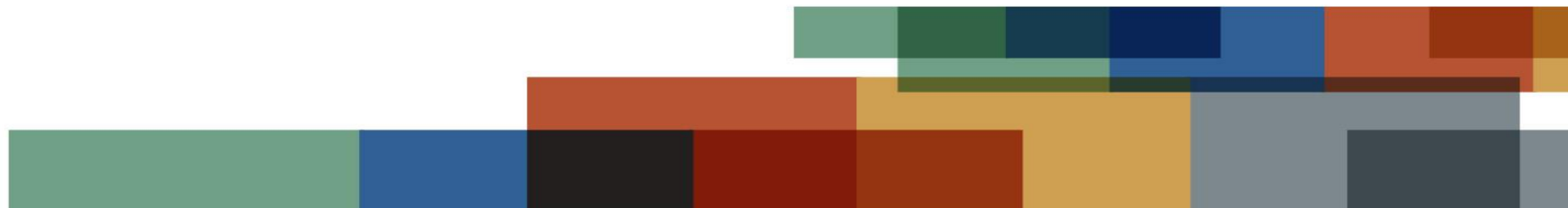
decisions with confidence

Asia-Pacific Unconventional Opportunities at \$60 Oil

Comparisons between North American and Asia-Pacific Unconventional Opportunities

June 2018

Ian Cockerill



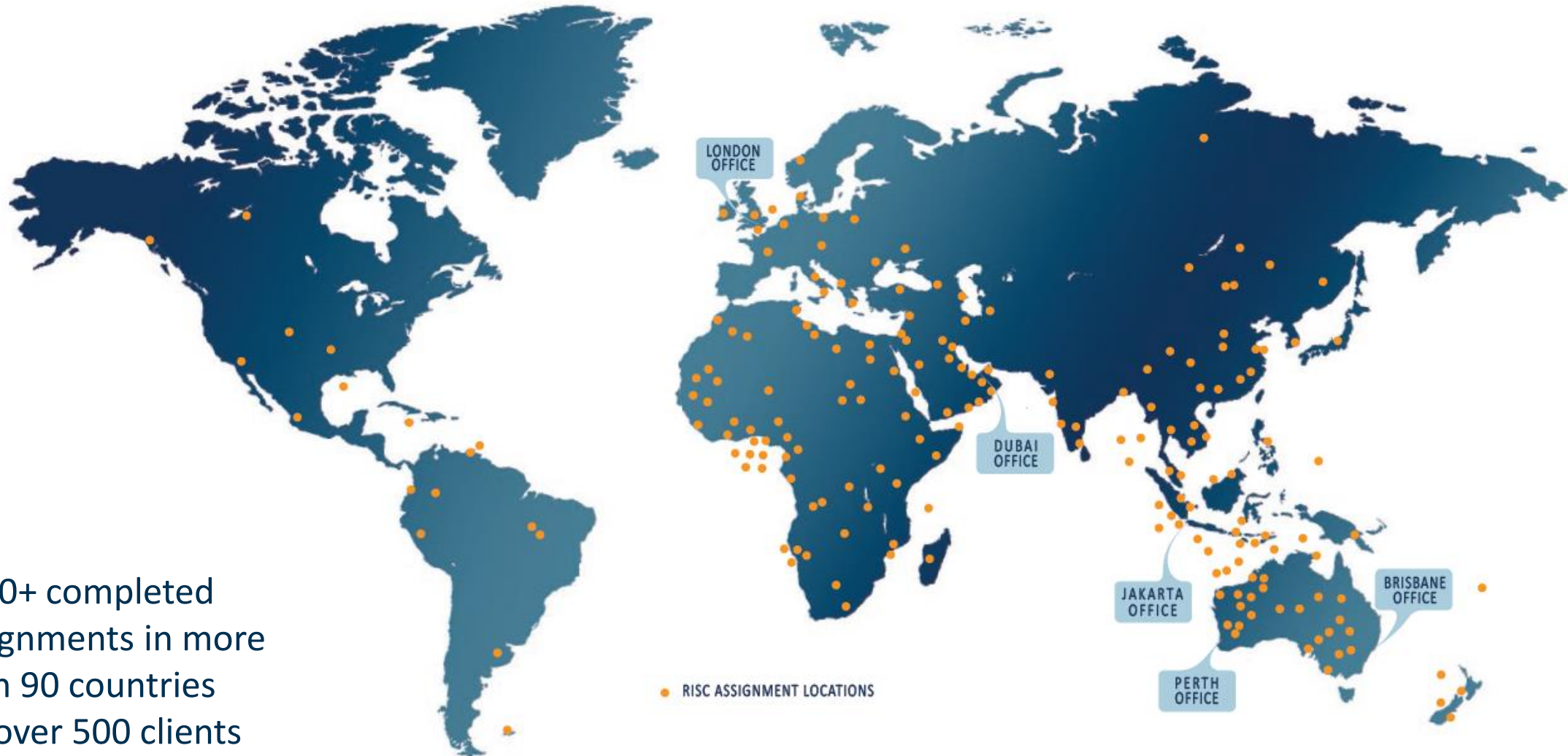
Presentation outline

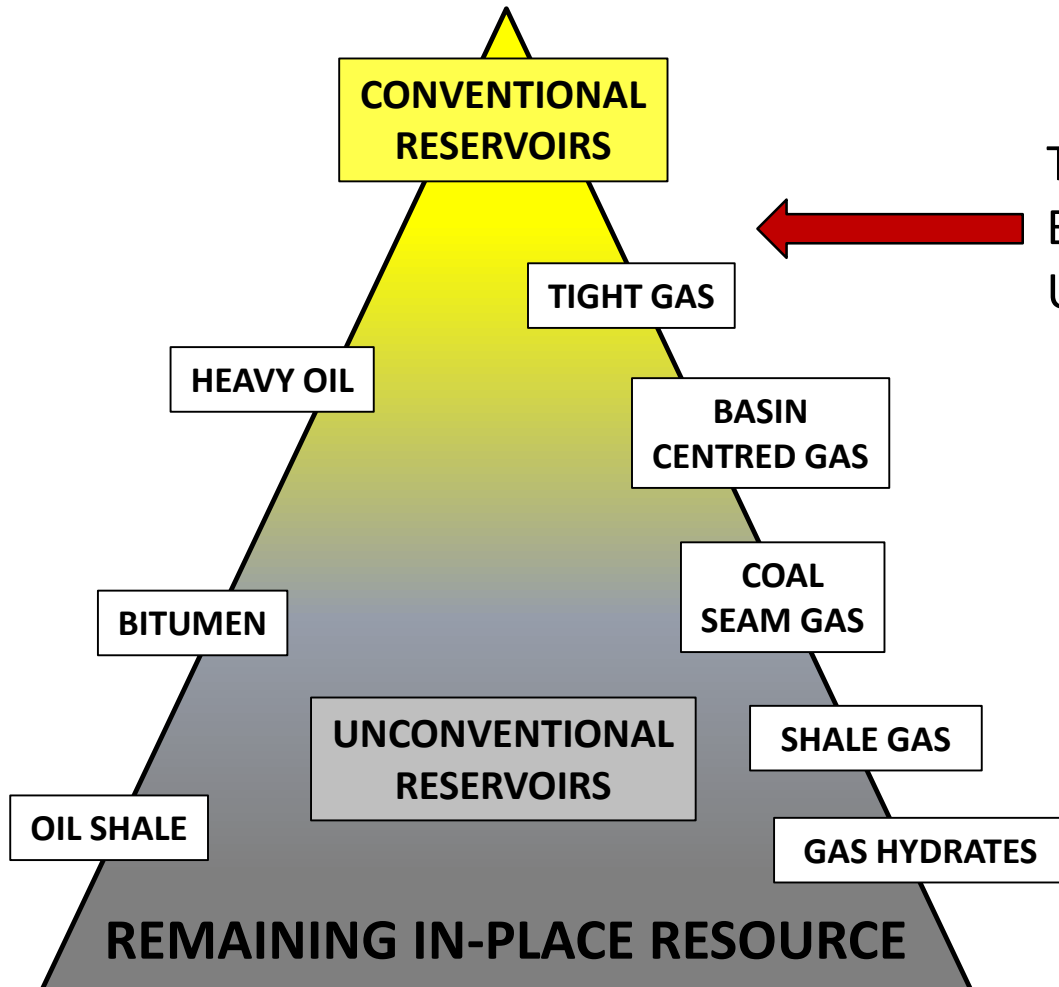


RISC's Global reach and experience



2000+ completed assignments in more than 90 countries for over 500 clients worldwide





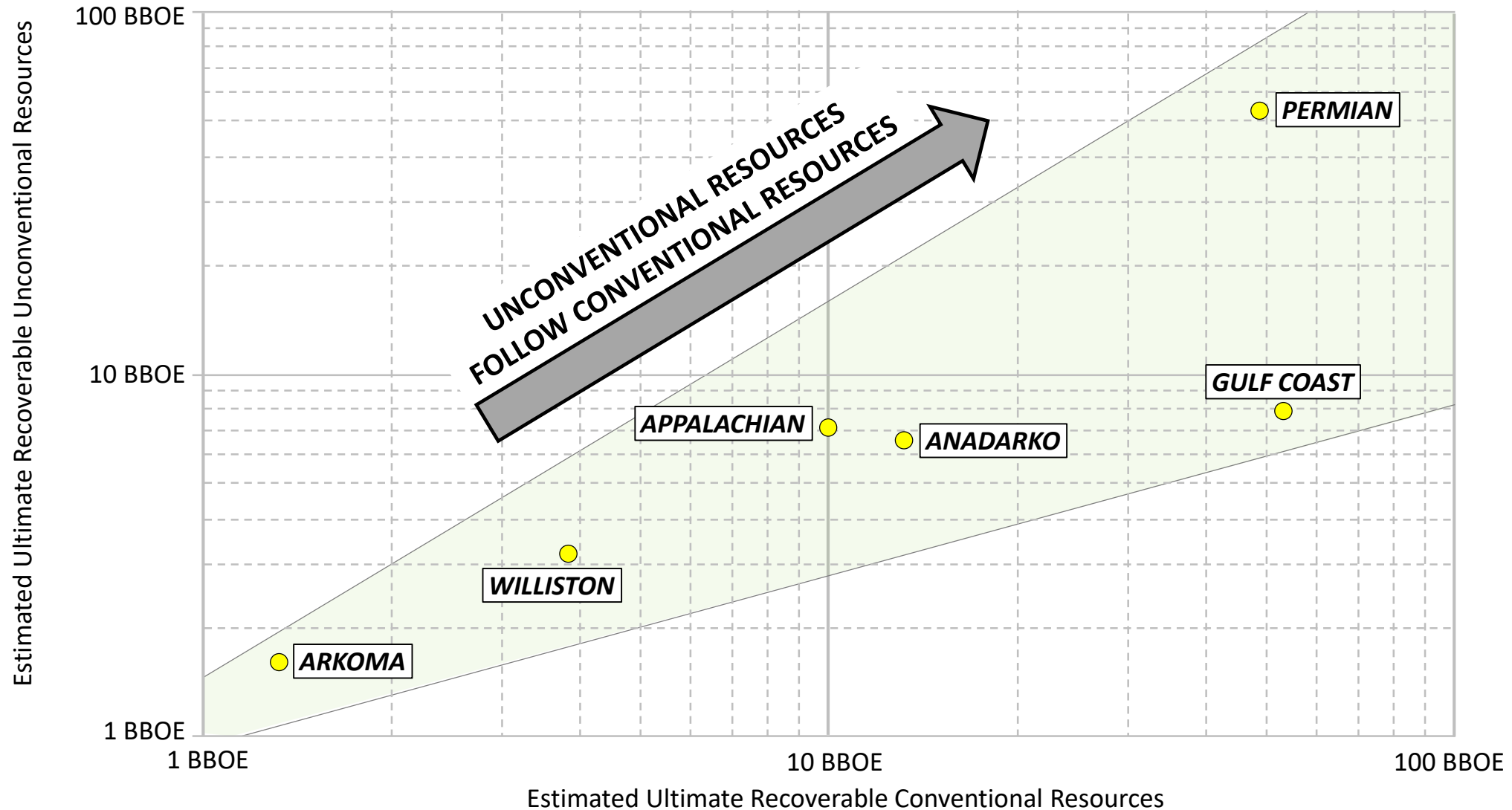
THERE ARE NO HARD LINES
BETWEEN CONVENTIONAL AND
UNCONVENTIONAL RESOURCES

UNCONVENTIONAL RESERVOIRS SHARE A LOT OF SIMILAR CHARACTERISTICS TO CONVENTIONAL RESERVOIRS

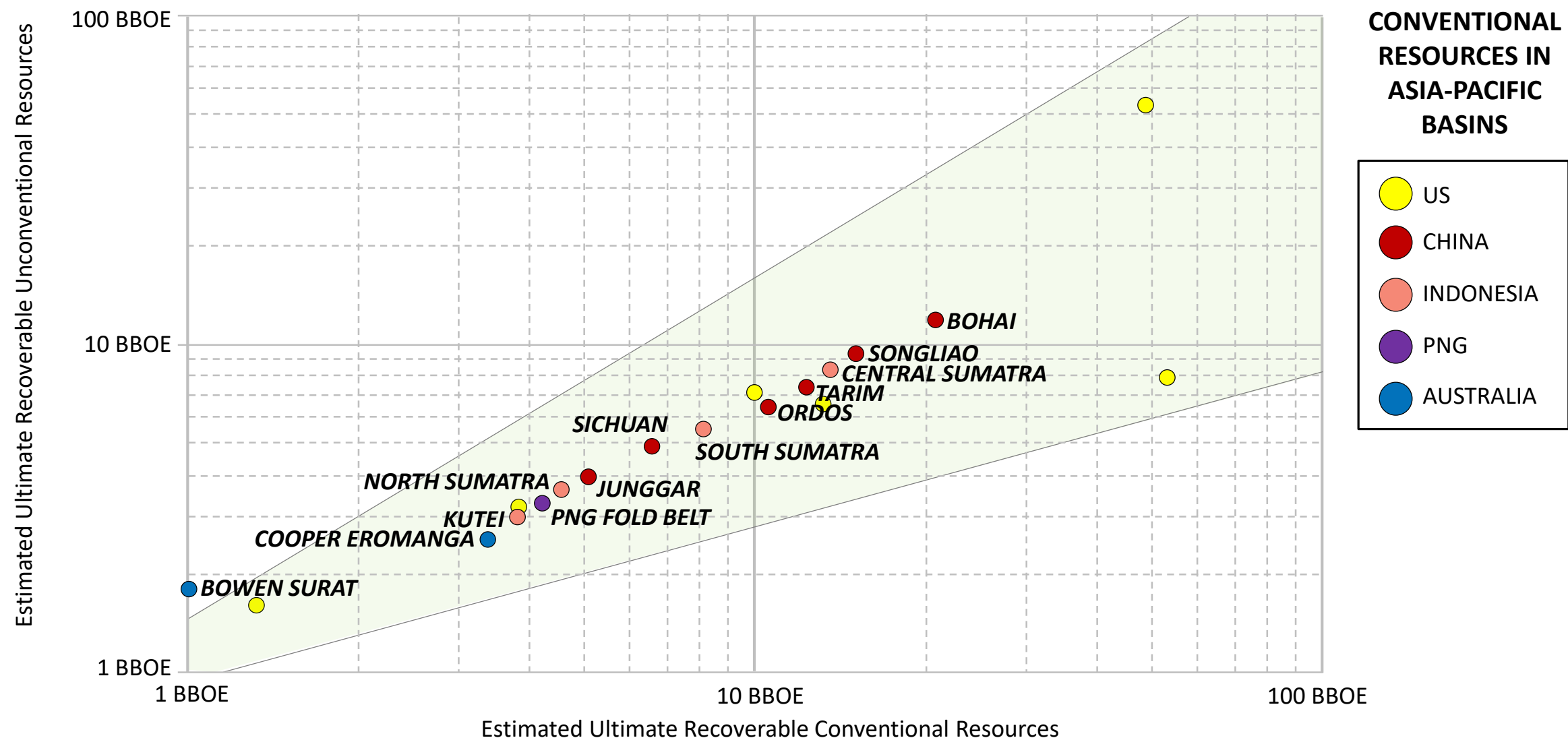
- Zones of higher Porosity / Permeability
- Zones of higher Resistivity
- Zones of higher Pressure
- Regional structures or structural highs

**ITS NOT JUST A GAME OF FINDING A SHALE AND
FRACKING THE BEJEEZUS OUT OF IT**

Unconventional potential resources correlation to conventional resources



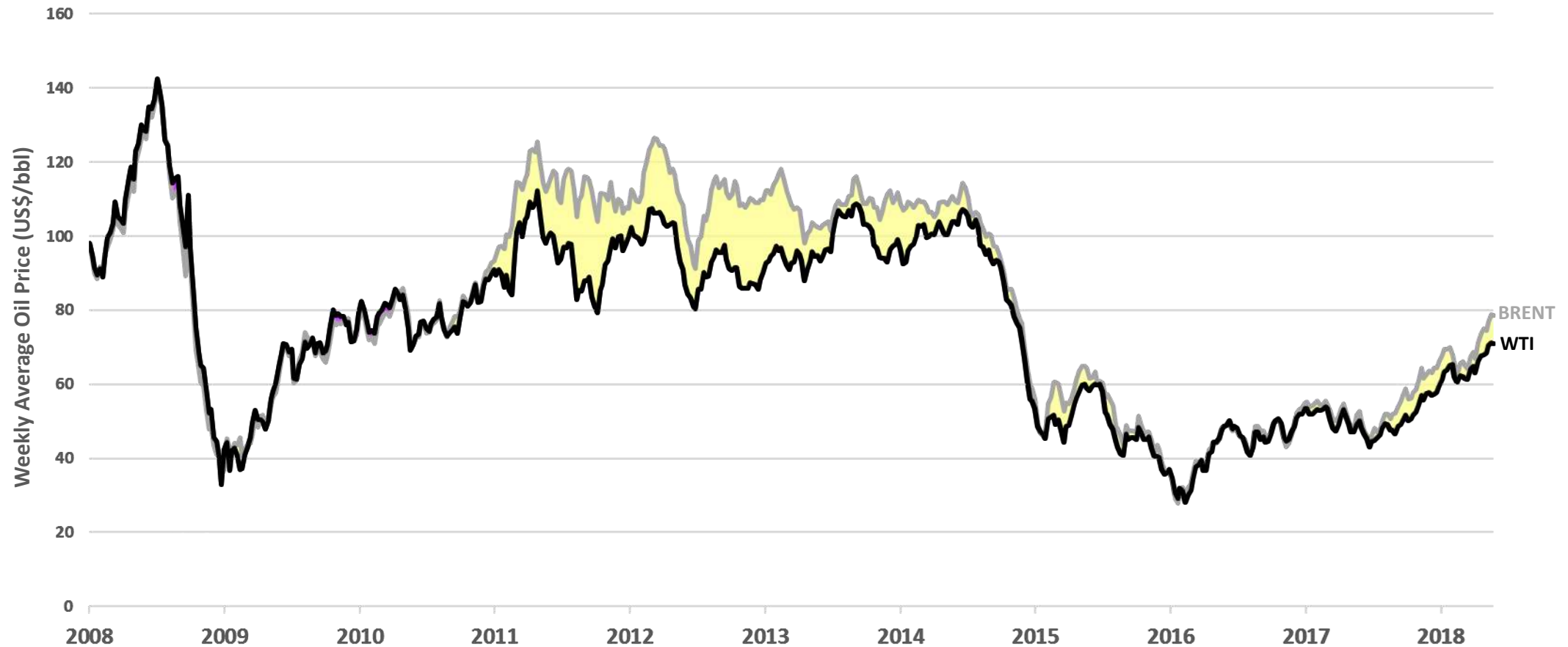
Unconventional potential resources correlation to conventional resources



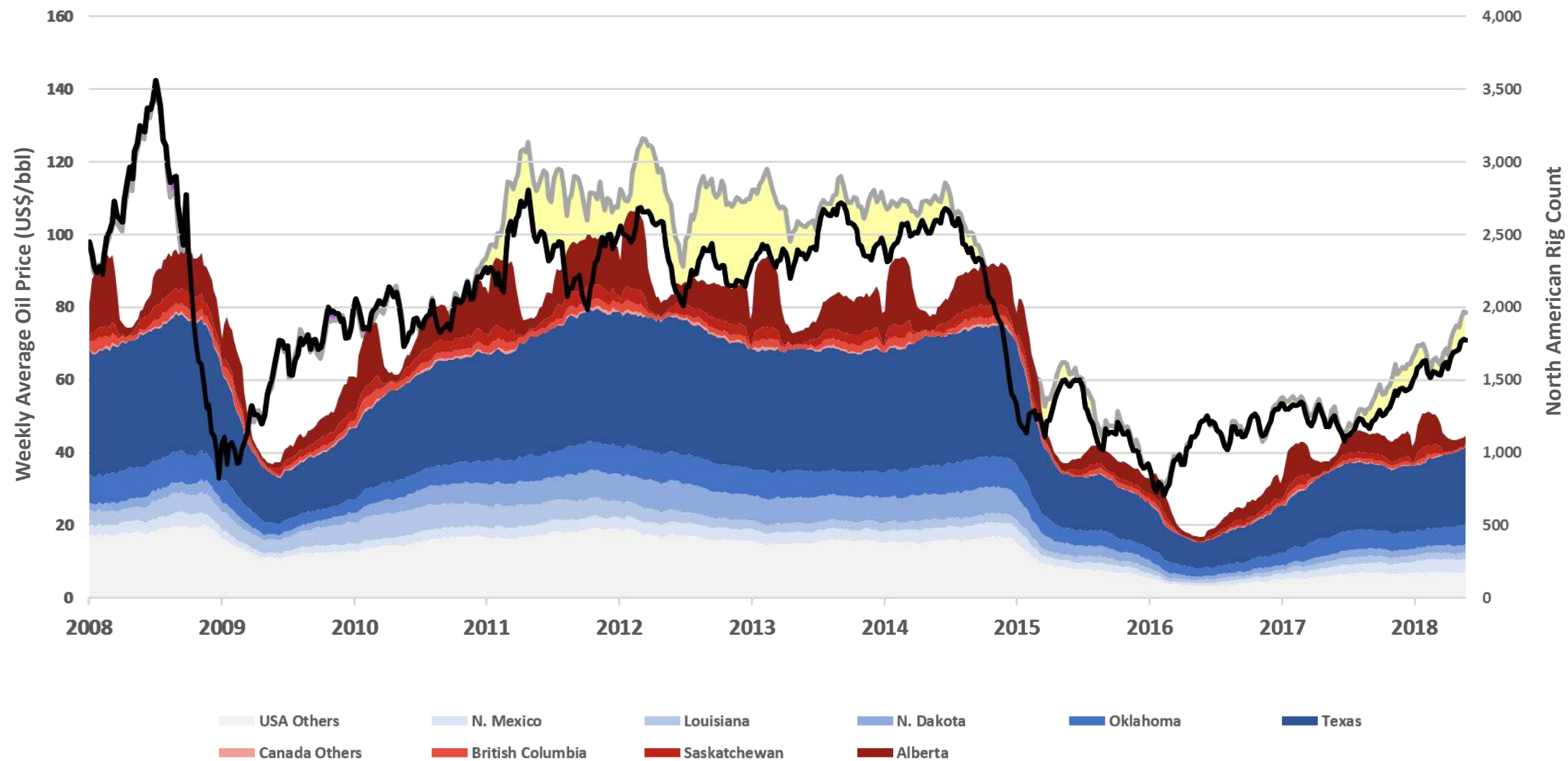
Oil price versus North American unconventional development



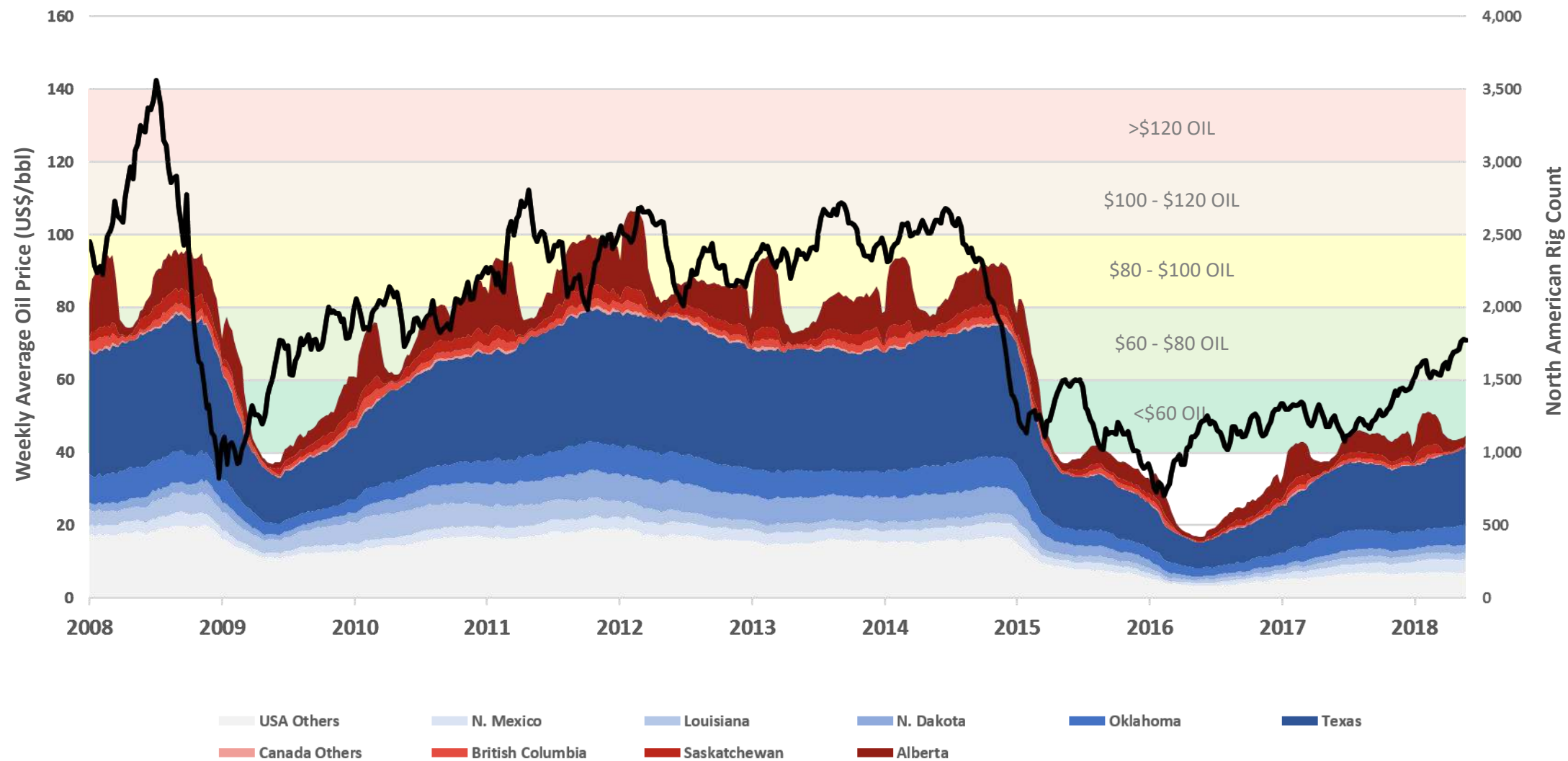
Oil price versus North American unconventional development



Oil price versus North American unconventional development



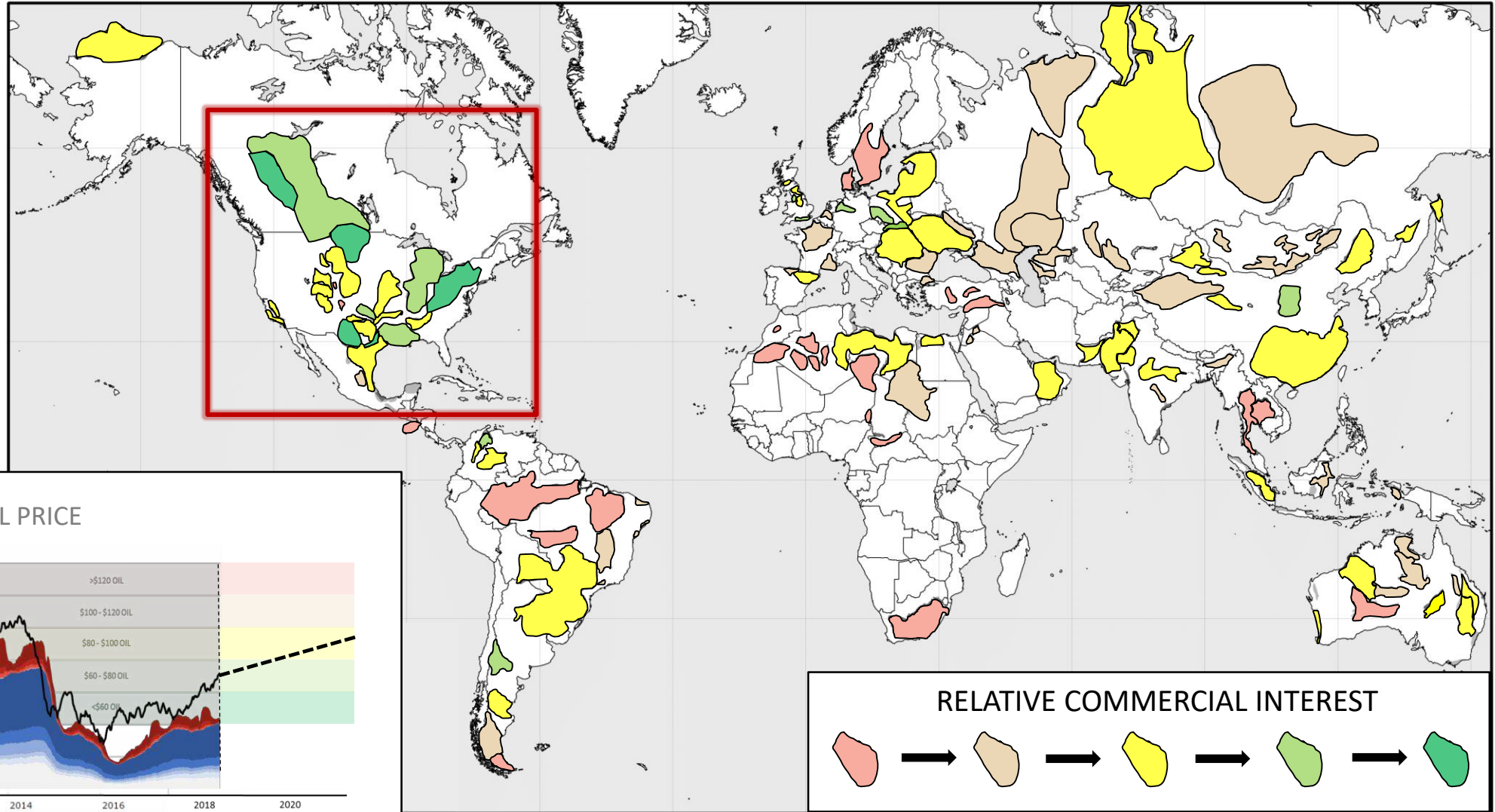
Oil price versus North American unconventional development



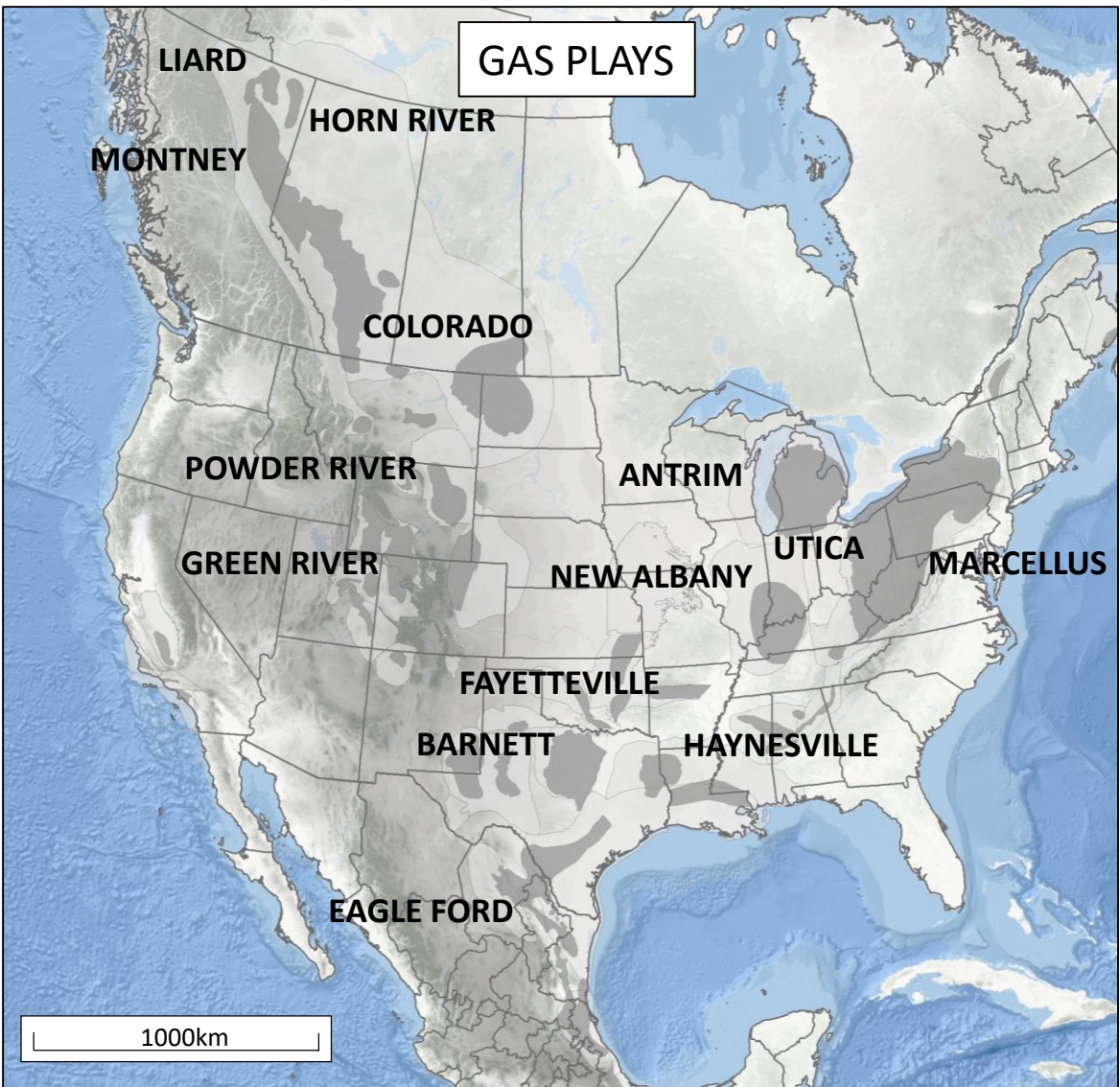
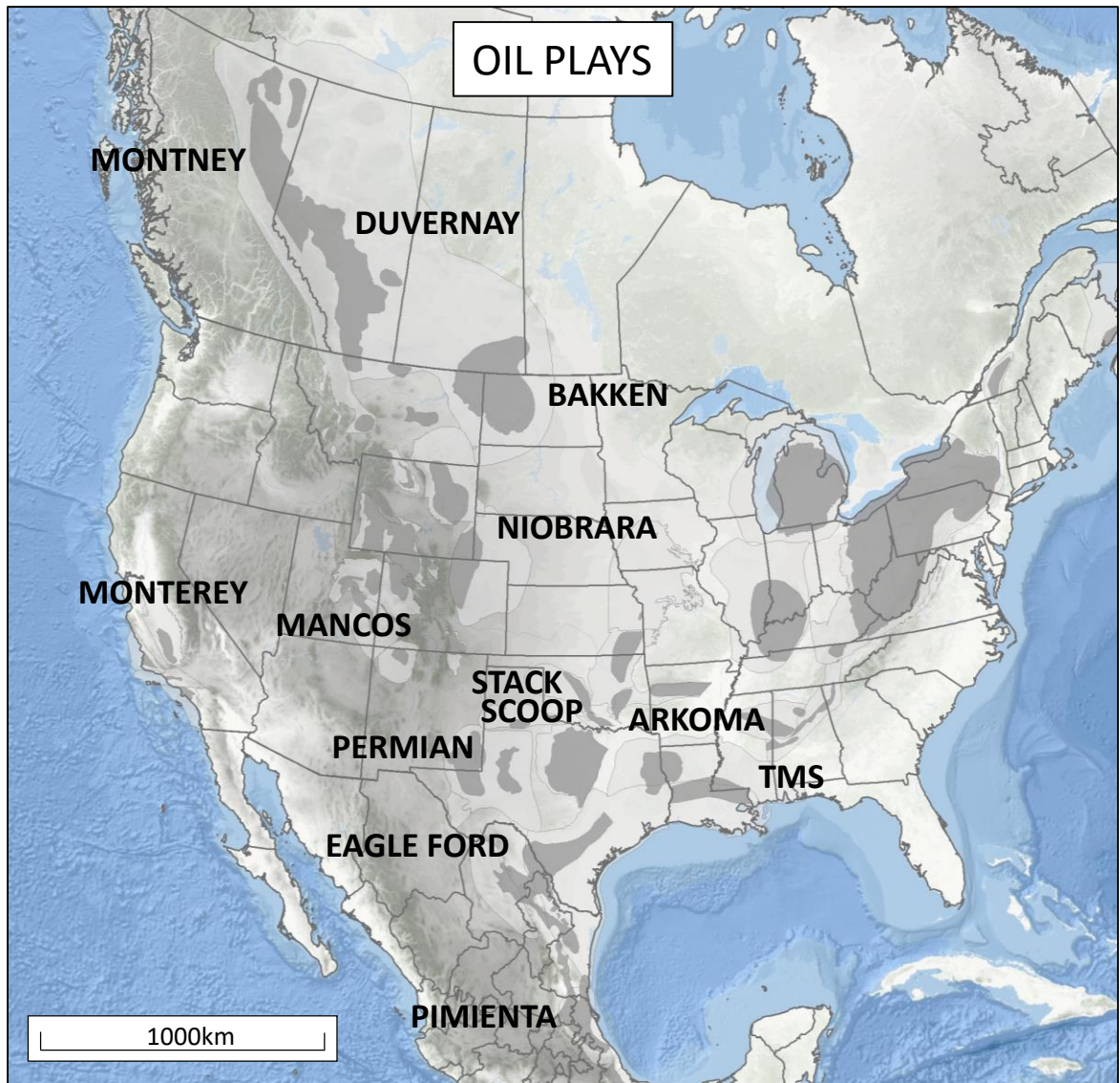
Global unconventional 'interest'

Technically Recoverable Shale Gas Resource (Tcf)

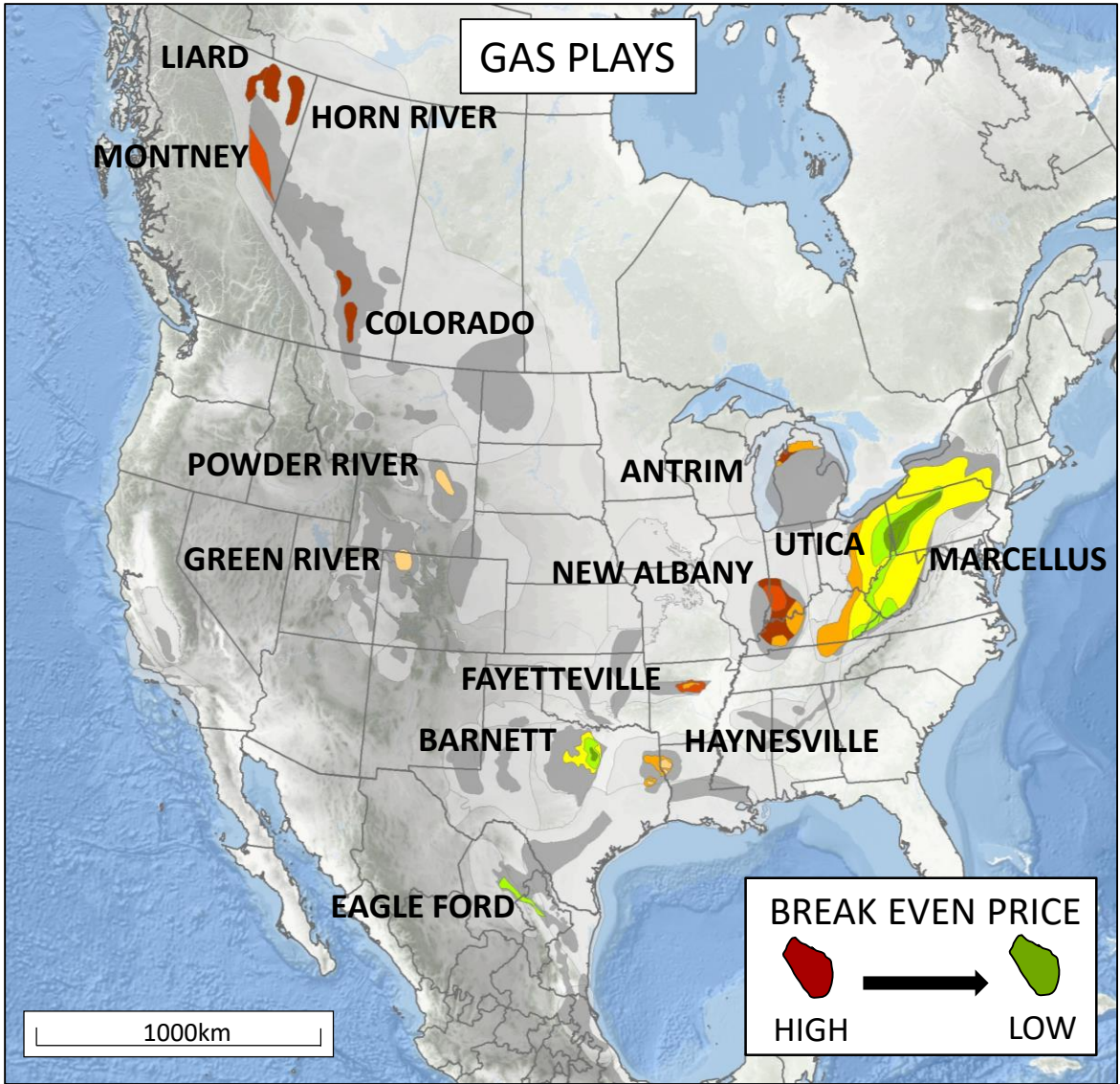
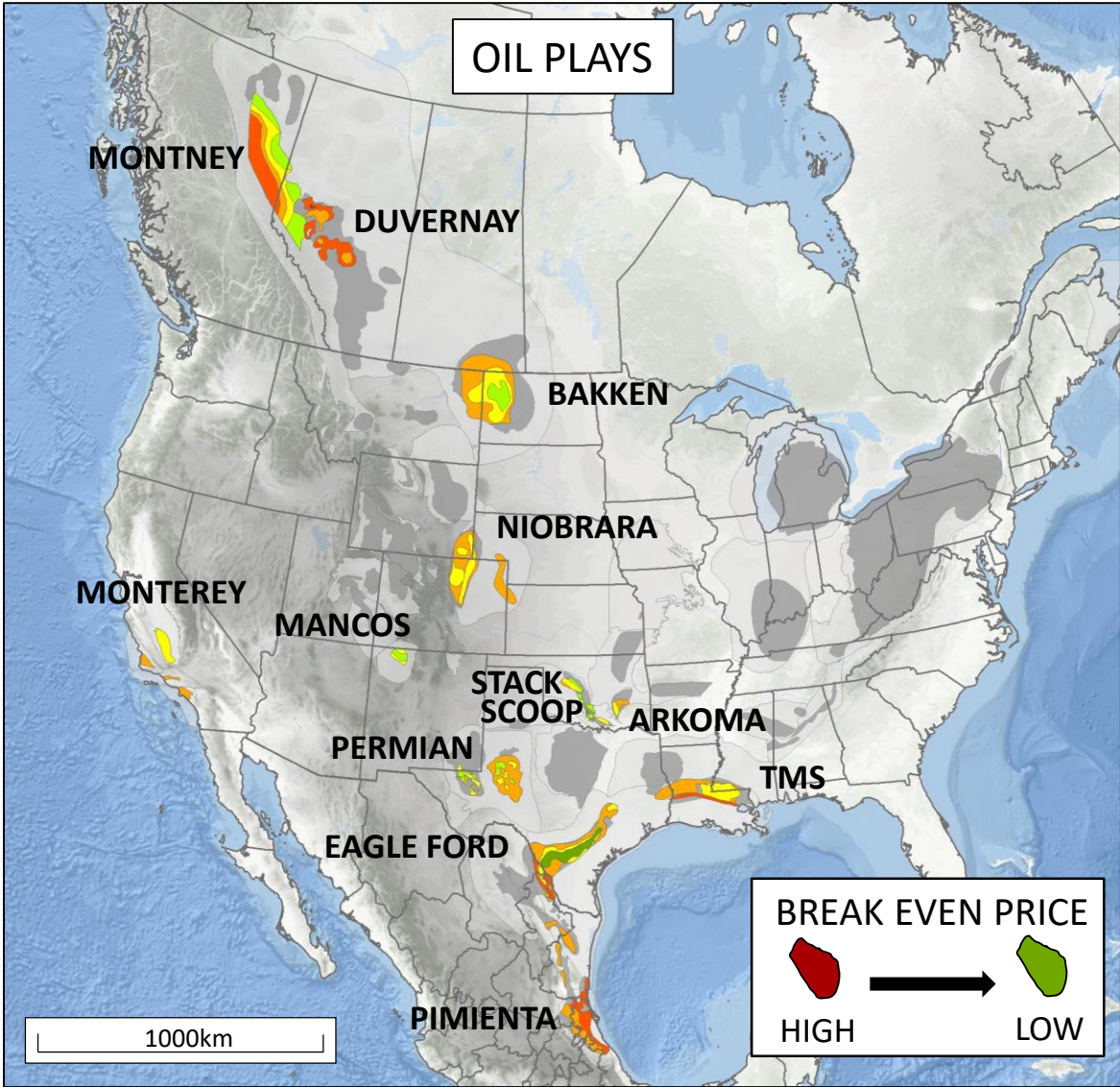
1	US	1,161
2	China	1,115
3	Argentina	802
4	Algeria	707
5	Canada	573
6	Mexico	545
7	Australia	437
8	South Africa	390
9	Russia	285
10	Brazil	245
	Others	1,535
Total		7,795



Leading North American unconventional plays

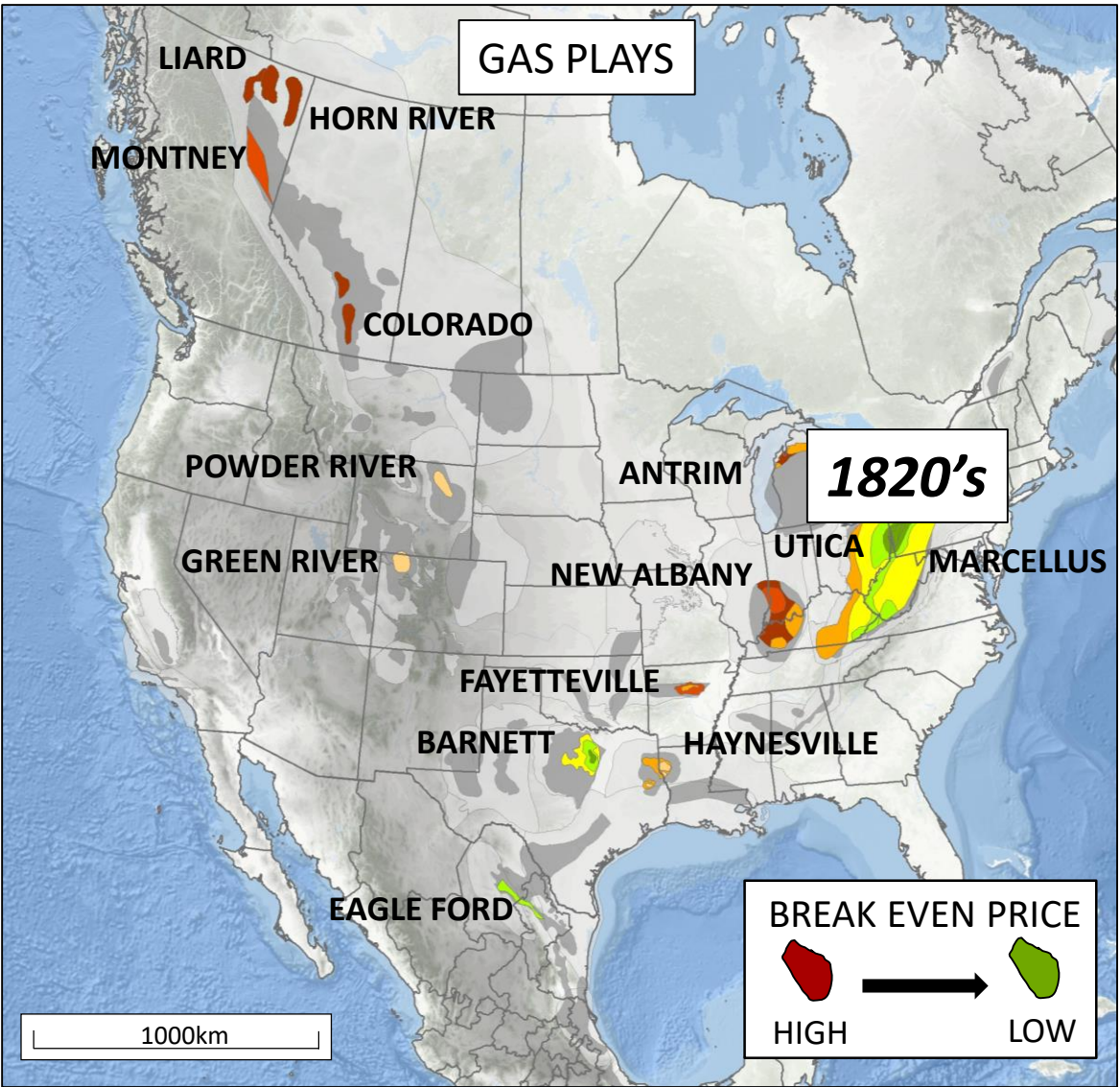
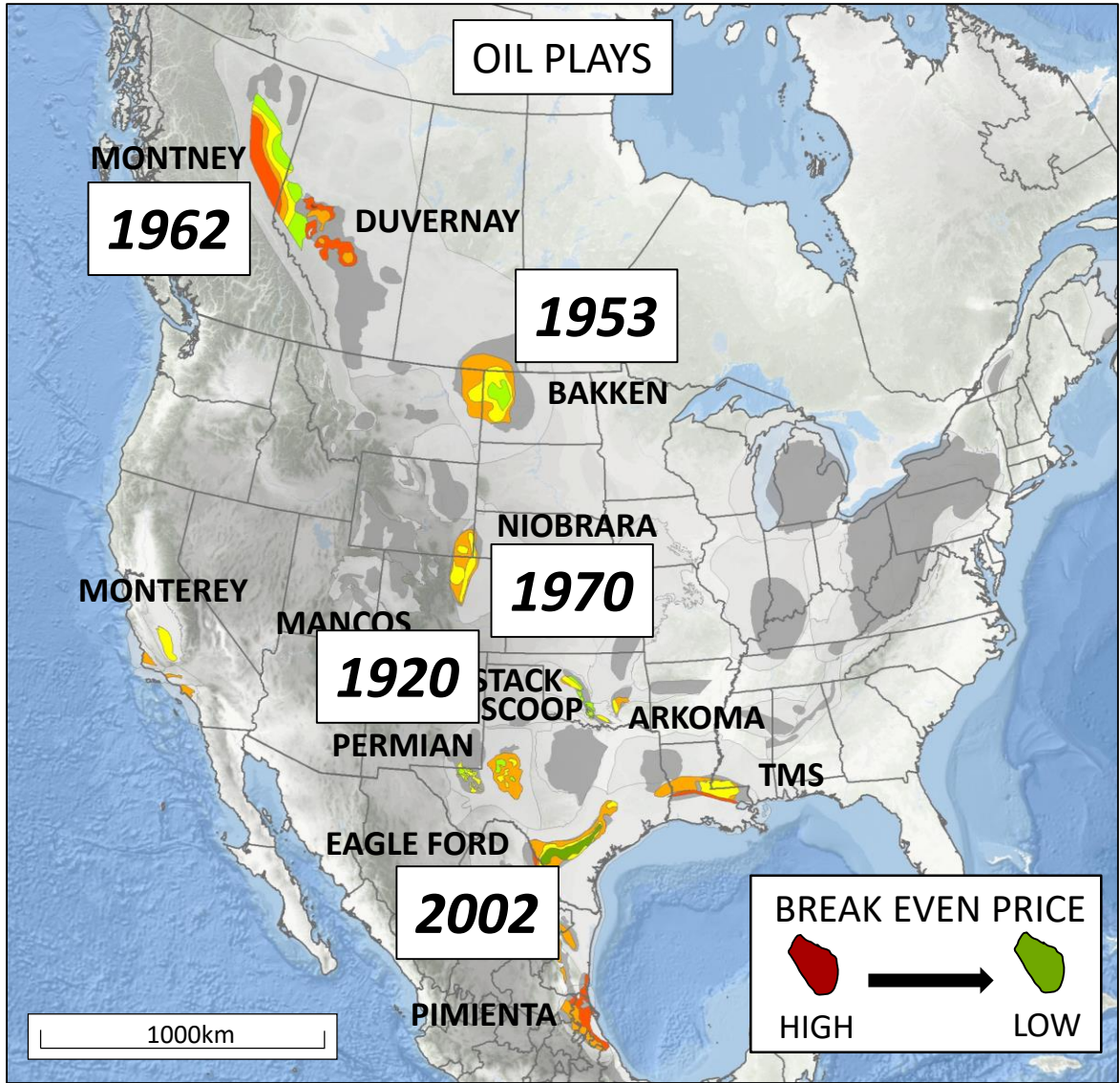


Leading North American unconventional plays



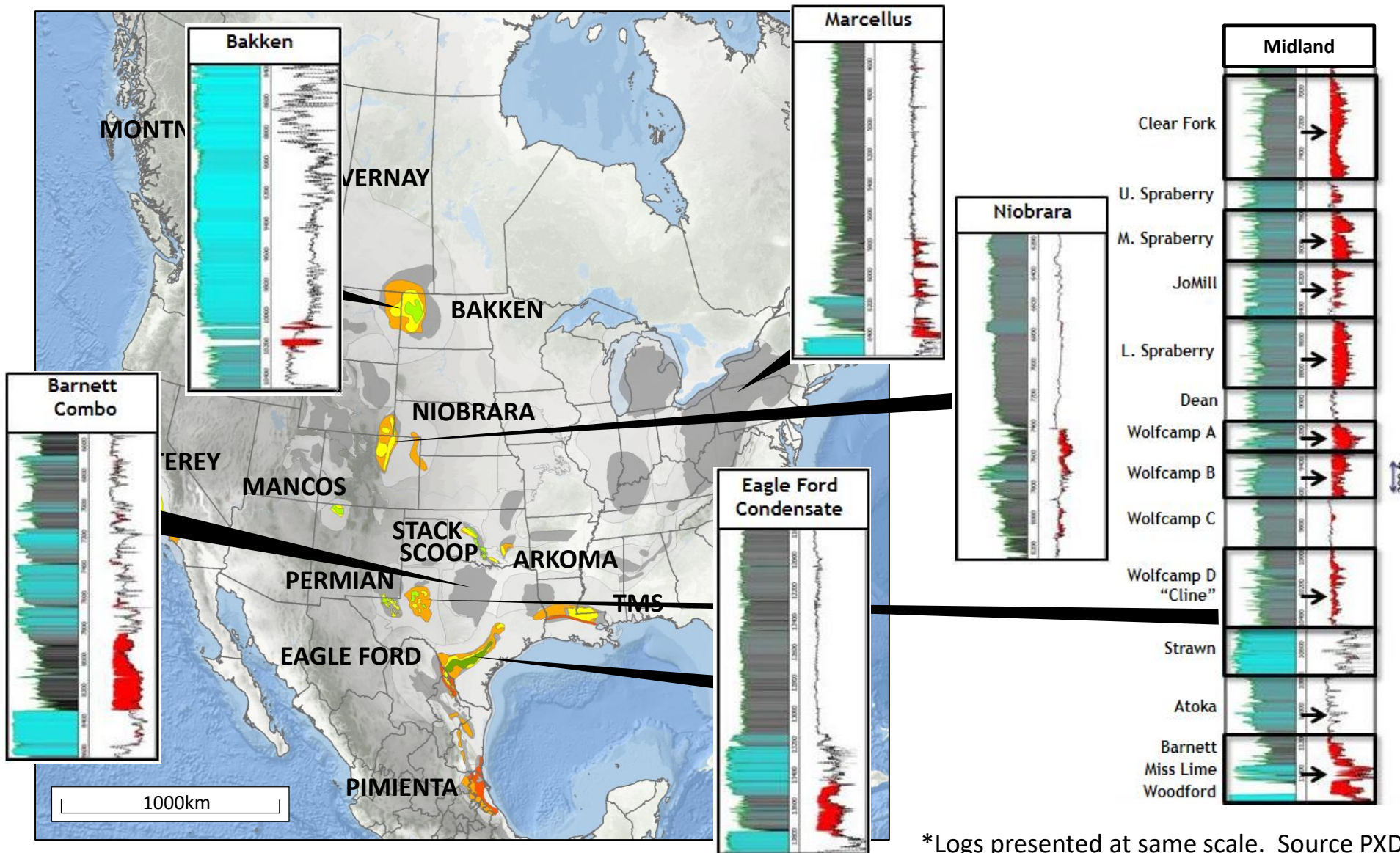
Source: Consensus view from public domain information

Leading North American unconventional plays – Year of first production



Source: Consensus view from public domain information

Major North American unconventional plays

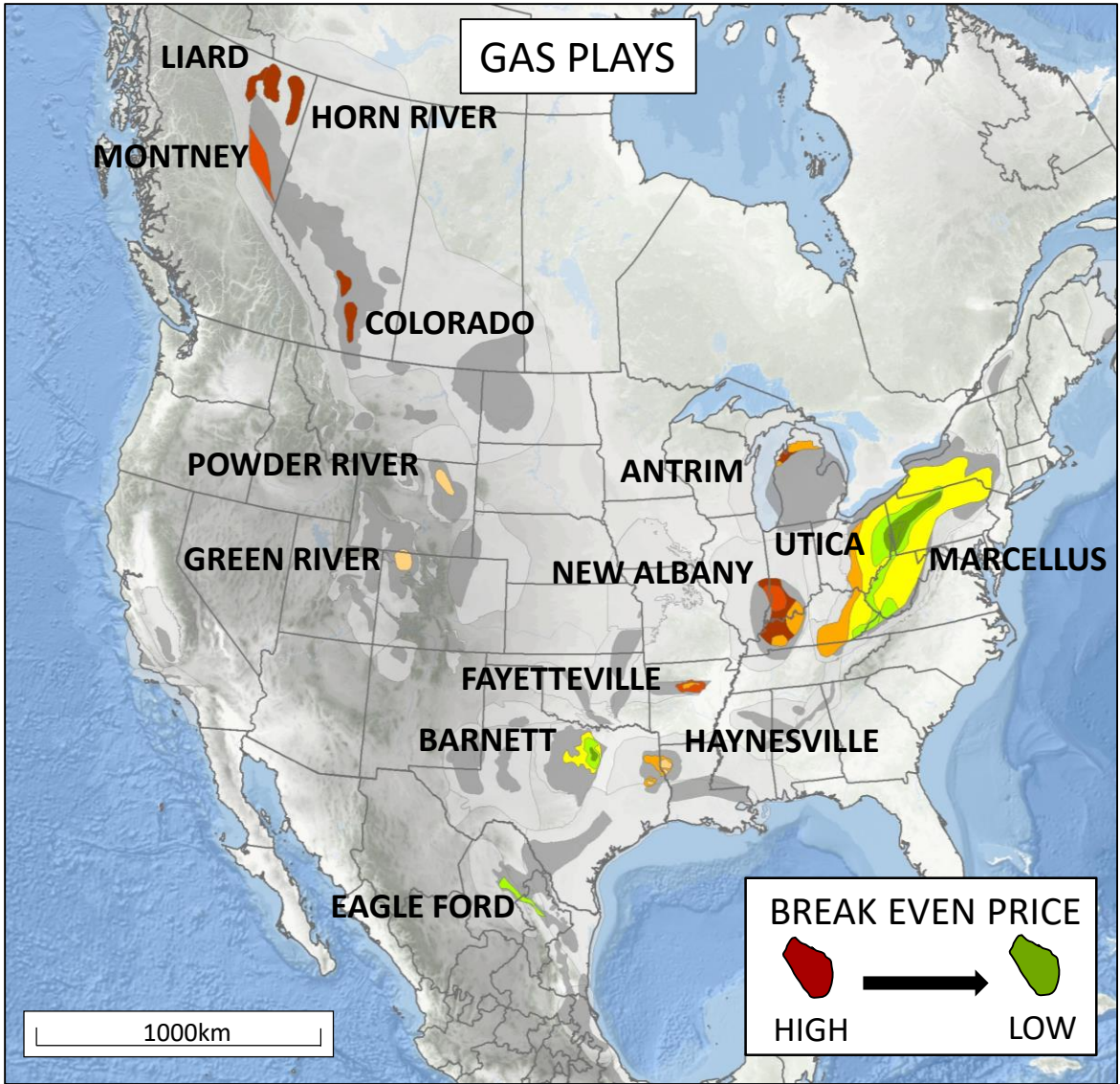
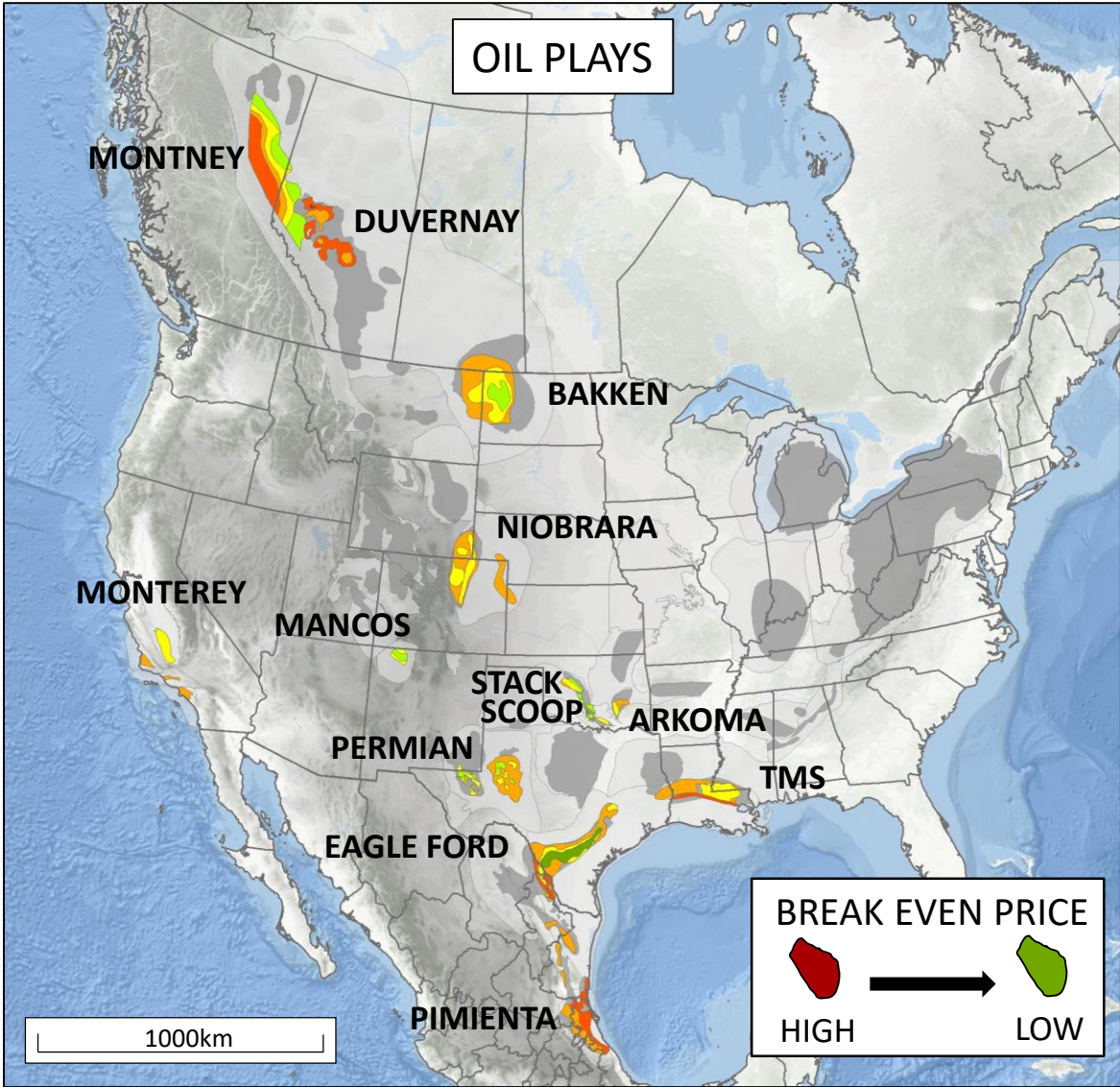


Some things to keep in mind

- Discrete zones of higher porosity /higher resistivity
- Plays are laterally heterogeneous
- Over-pressure. Rate more important than in-place
- Finding the balance in GOR. Rate versus product
- Areas of very mature conventional production – data / infrastructure / tolerant community stakeholders

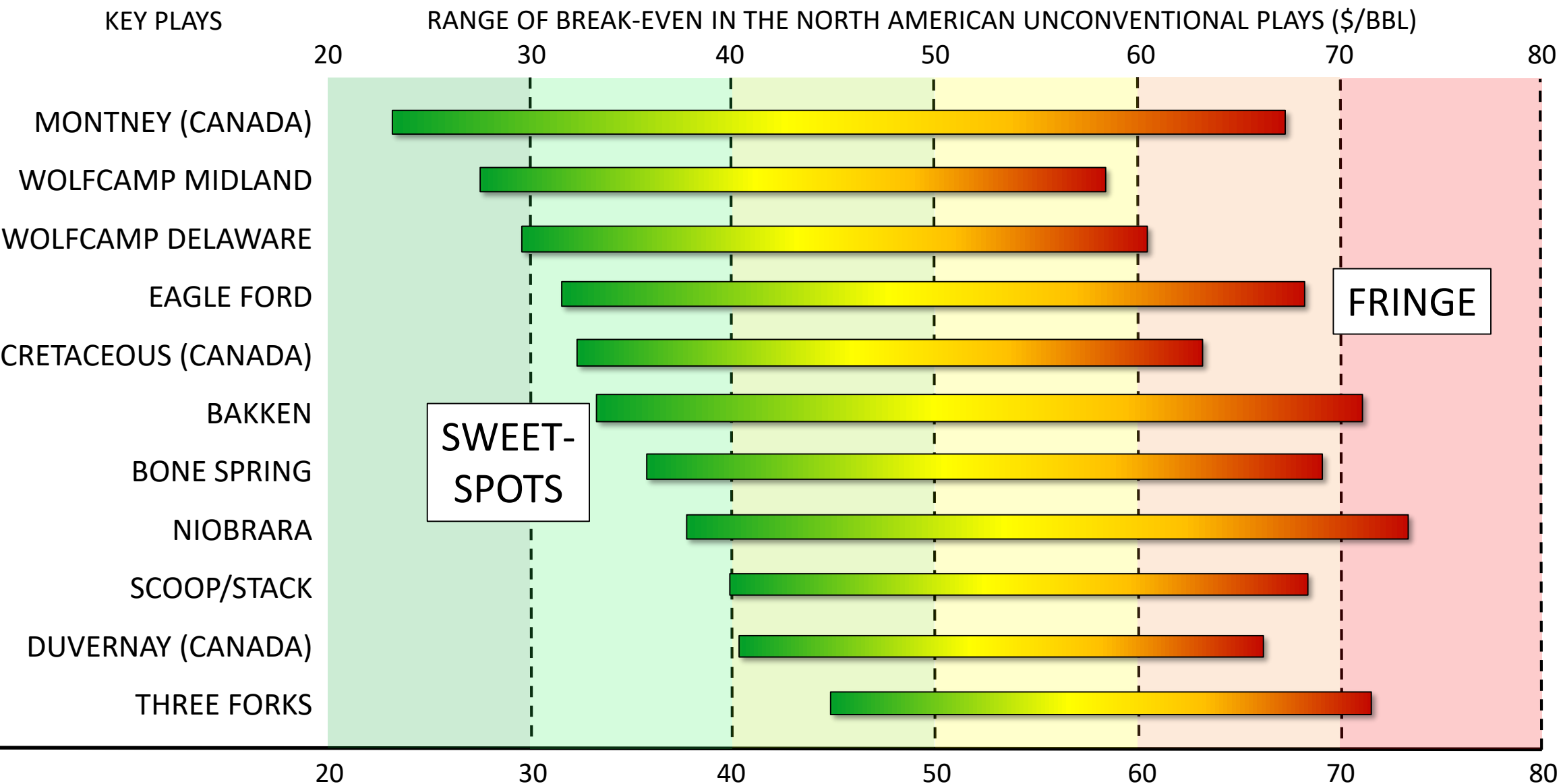
*Logs presented at same scale. Source PXD

Play heterogeneity



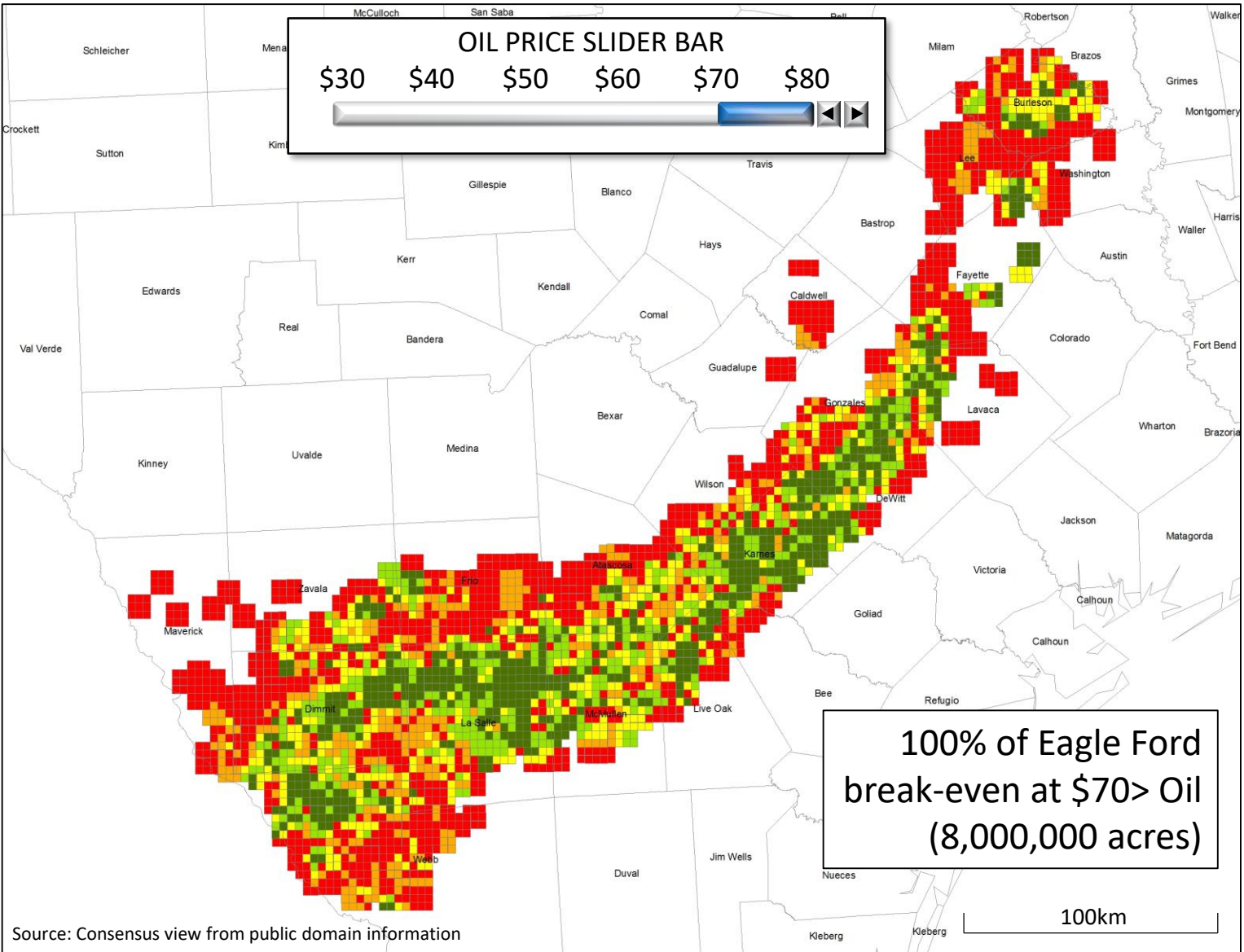
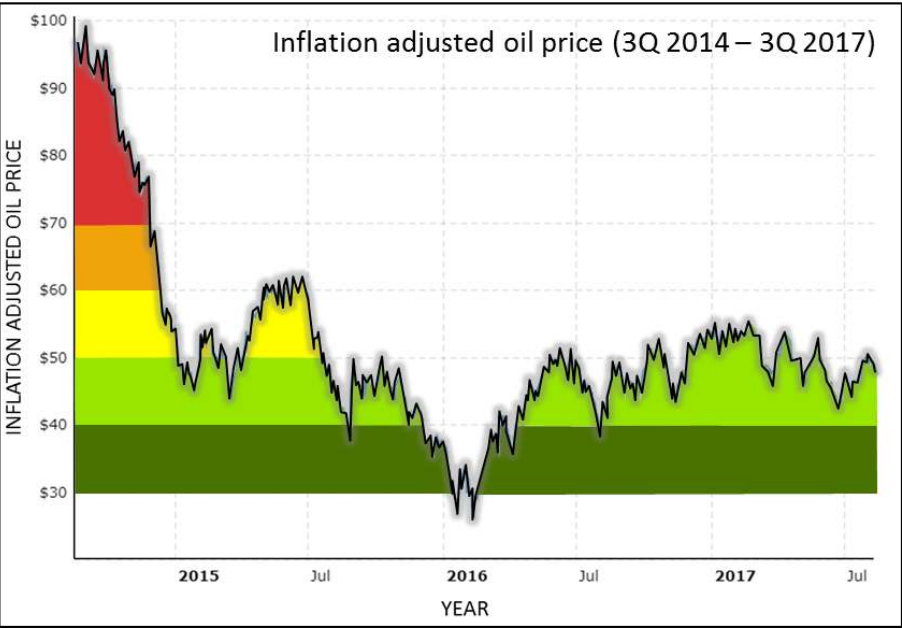
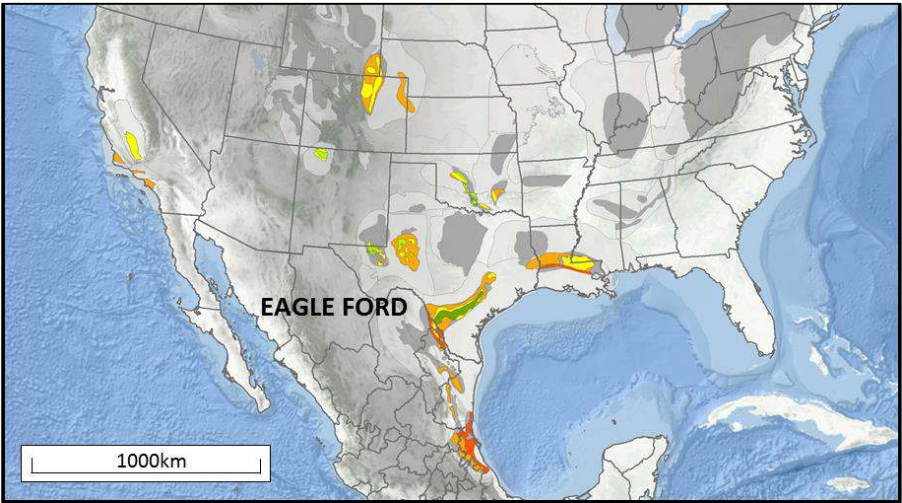
Source: Consensus view from public domain information

Break-even oil prices for new wells in North American plays

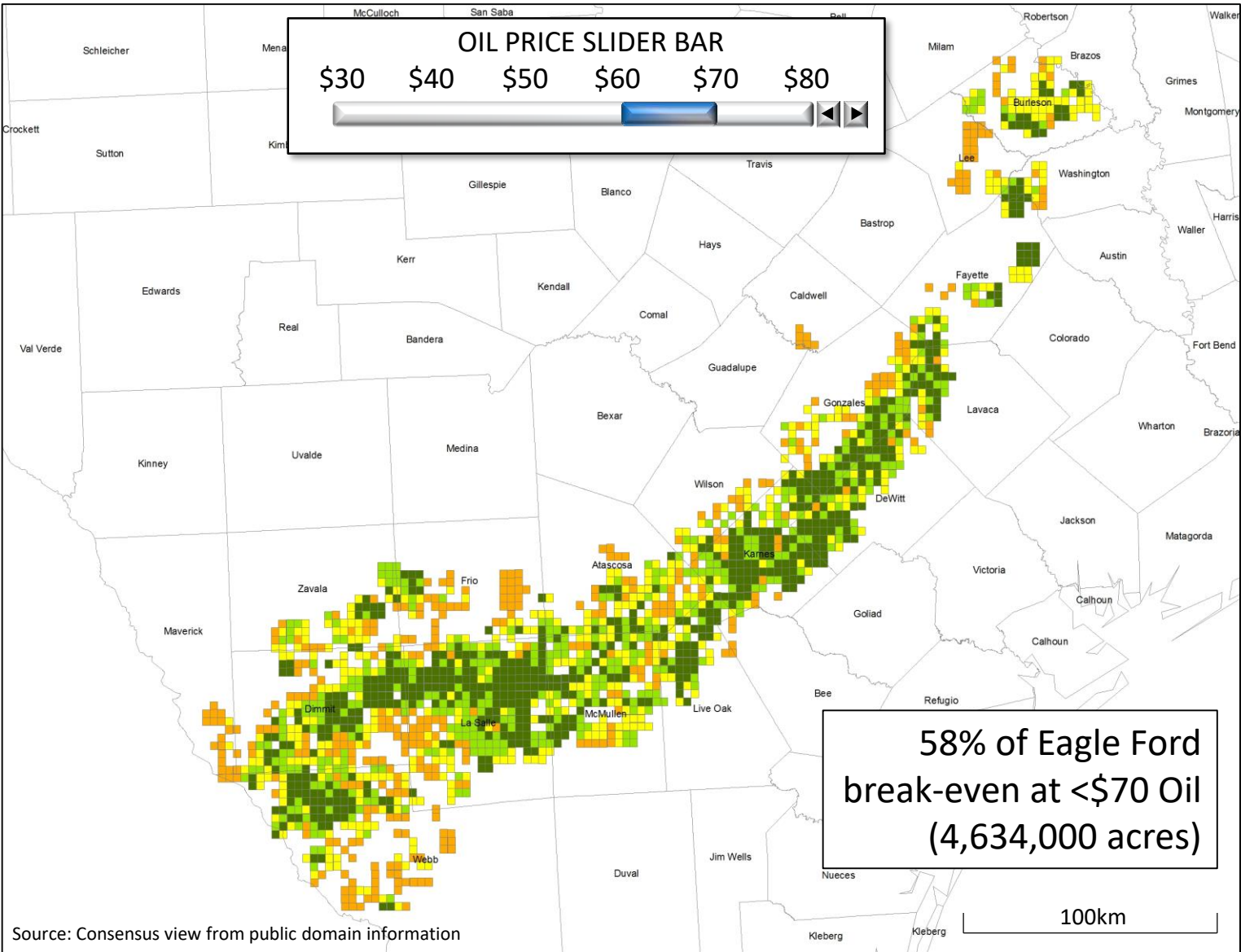
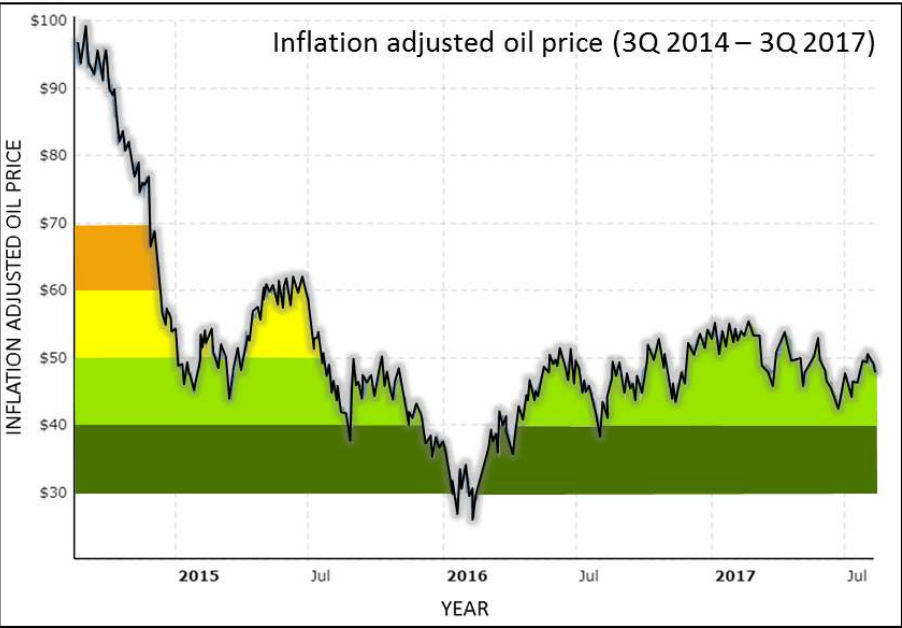
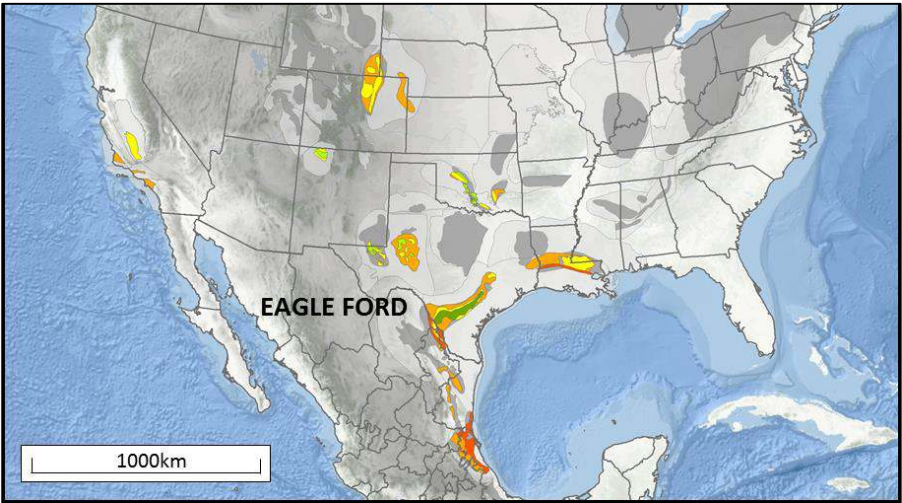


Source: Consensus view from public domain information

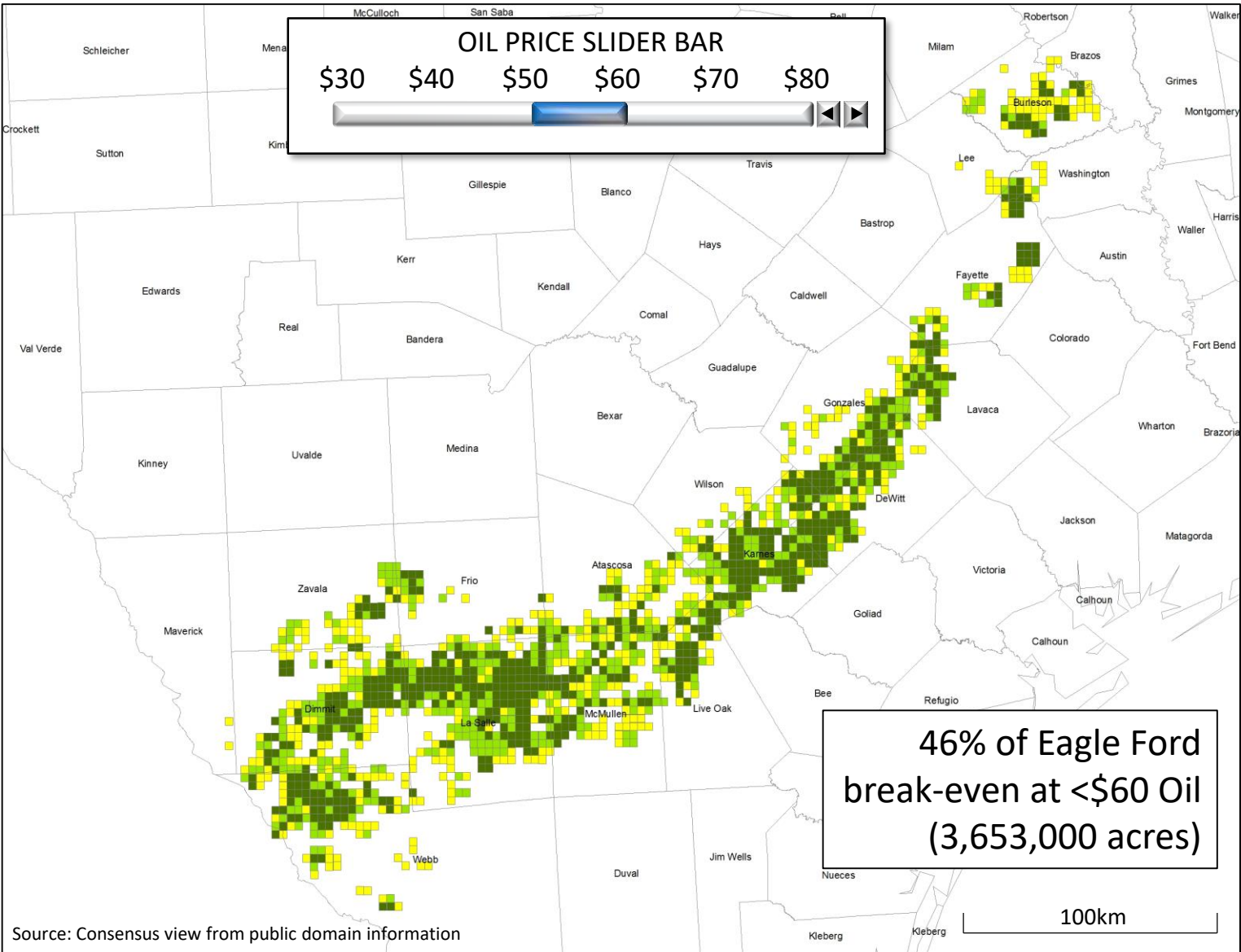
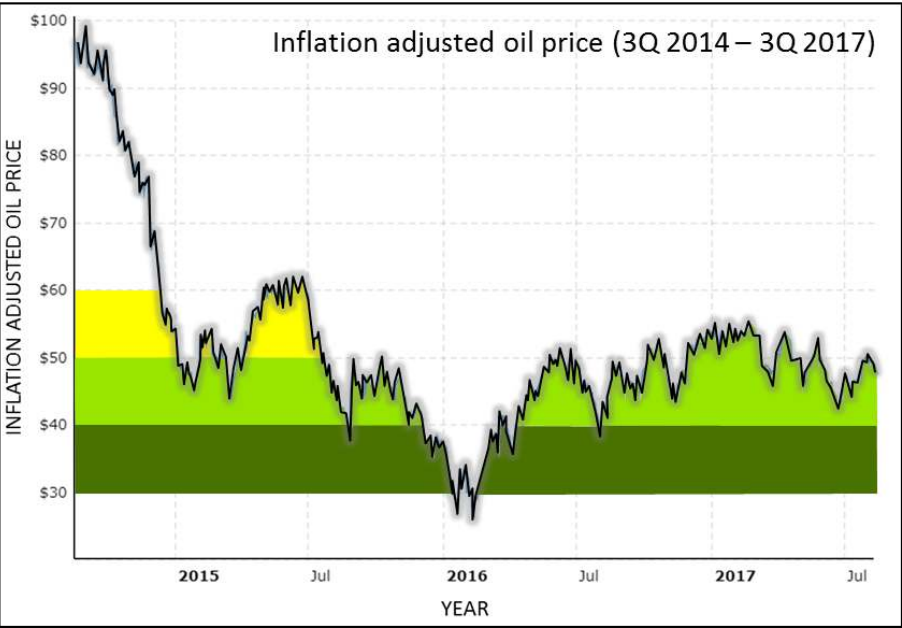
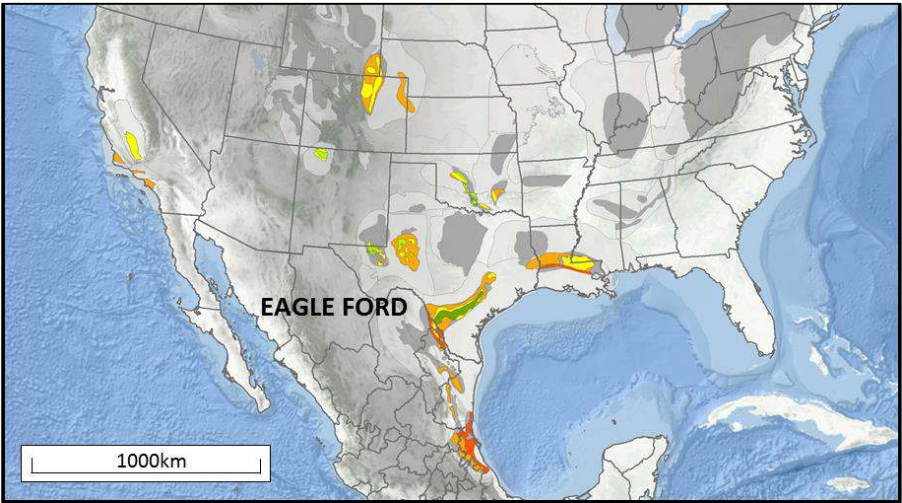
Breaking point in the Eagle Ford



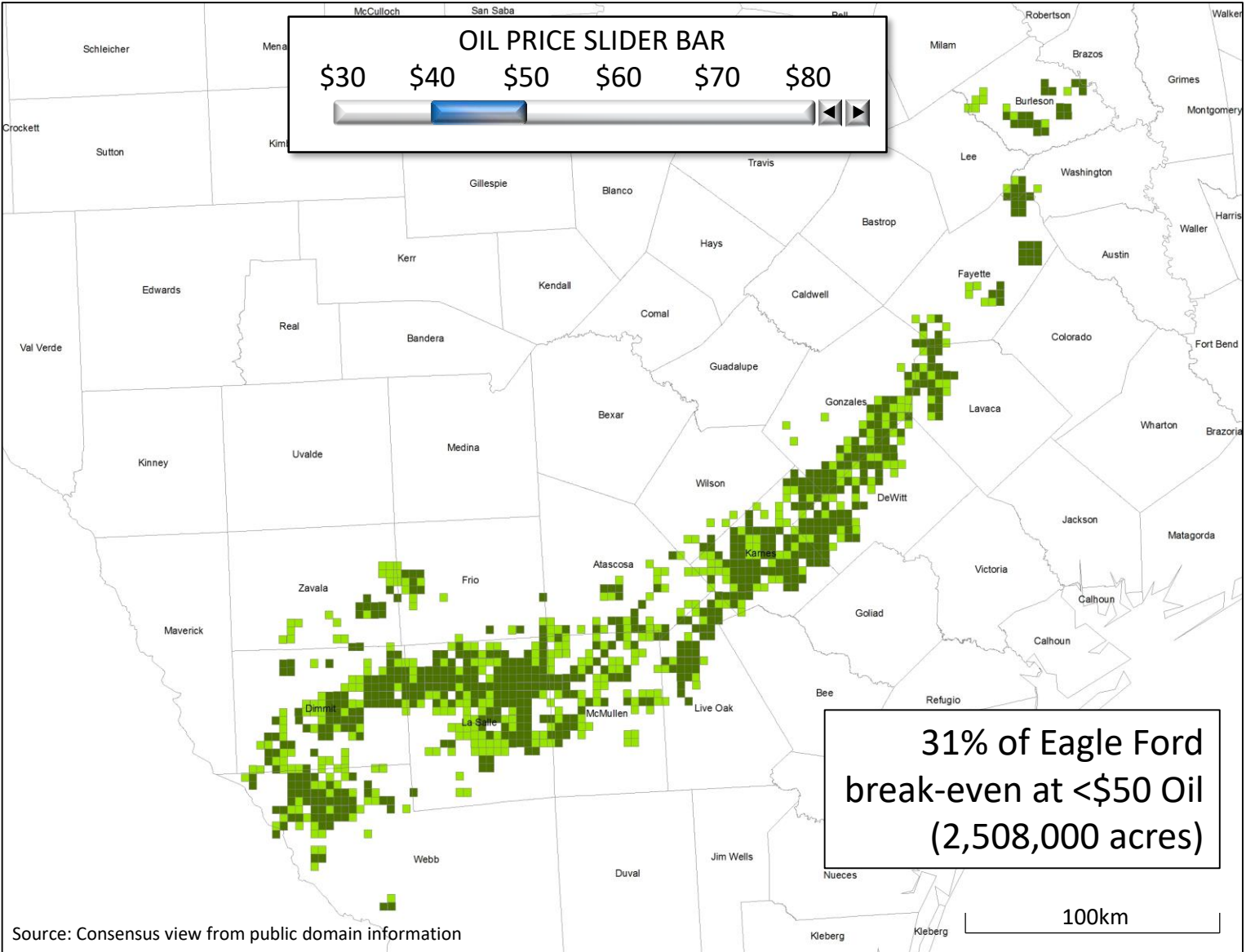
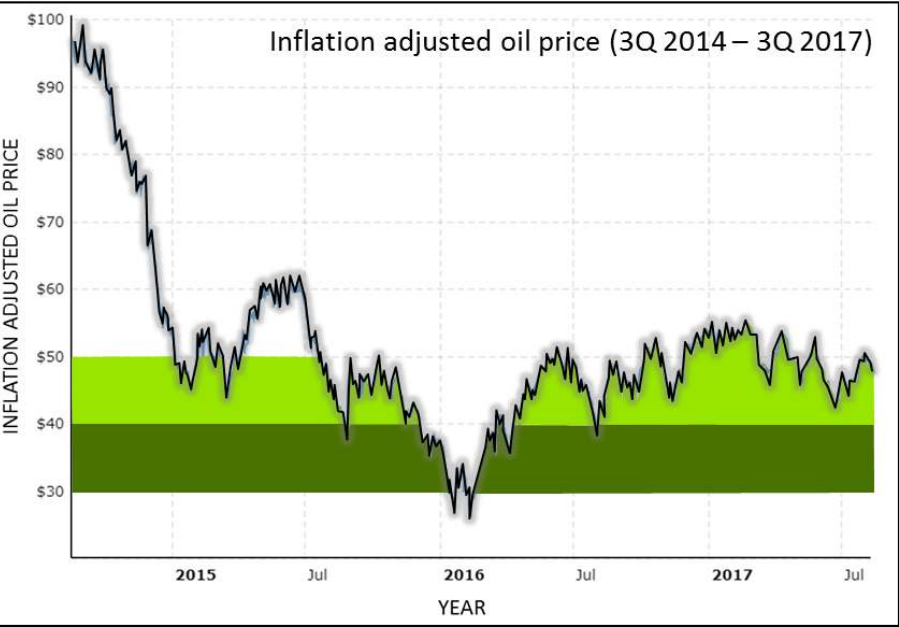
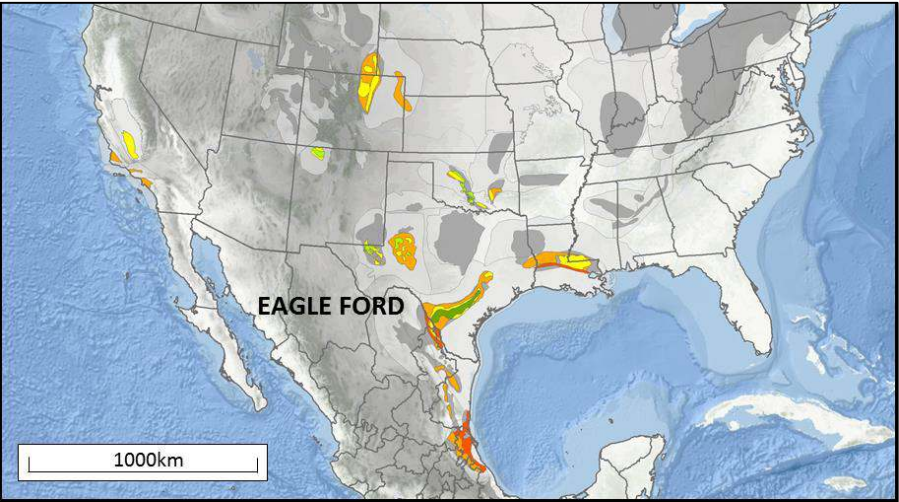
Breaking point in the Eagle Ford



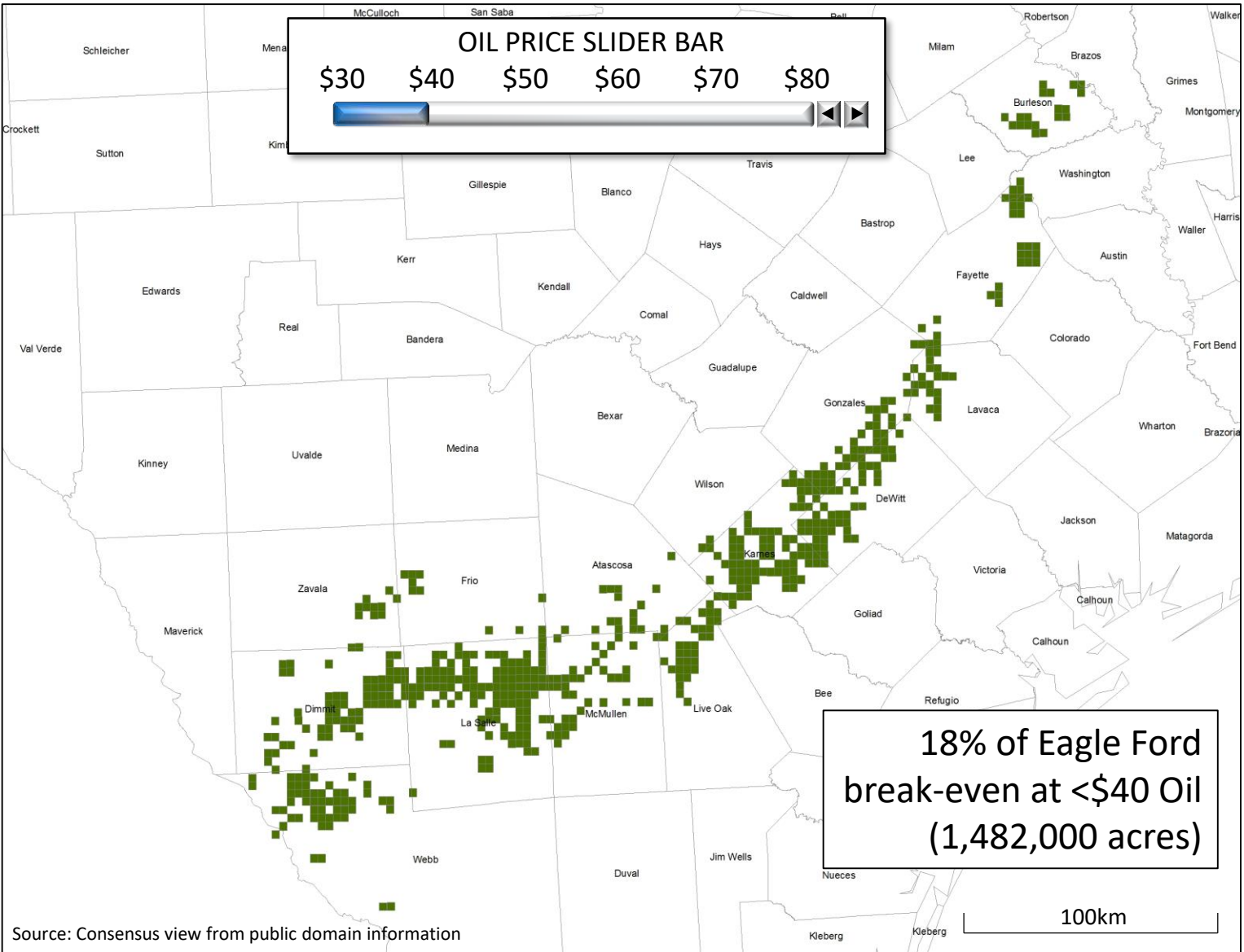
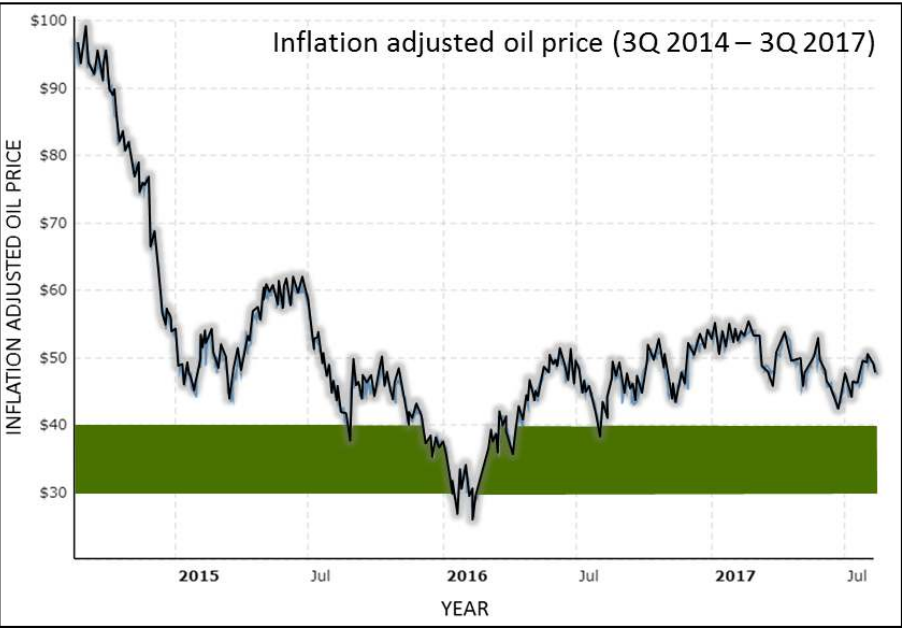
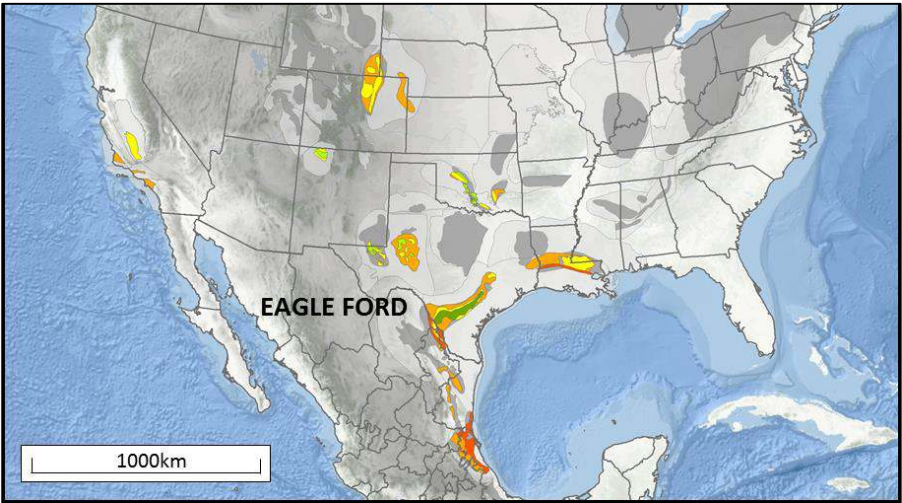
Breaking point in the Eagle Ford



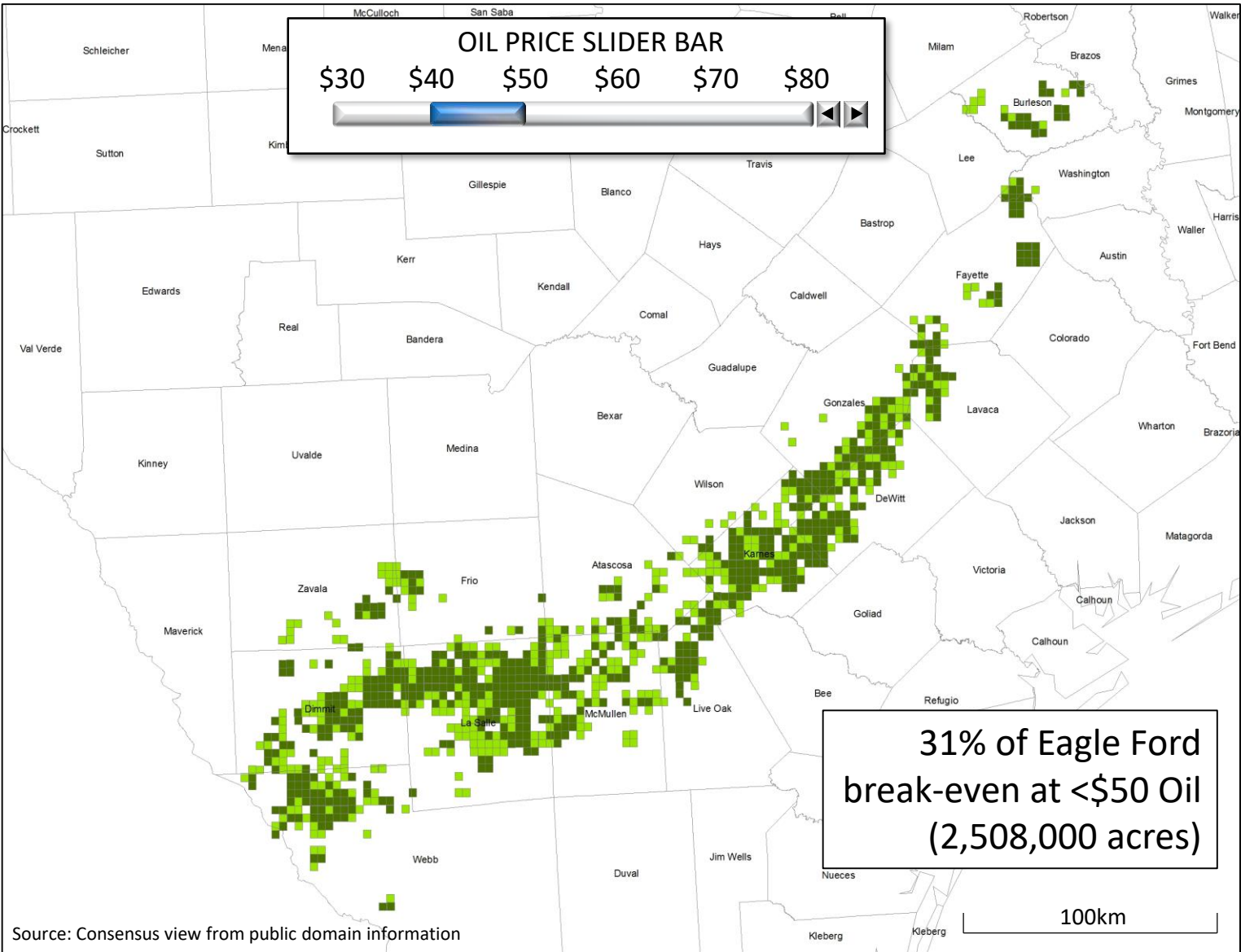
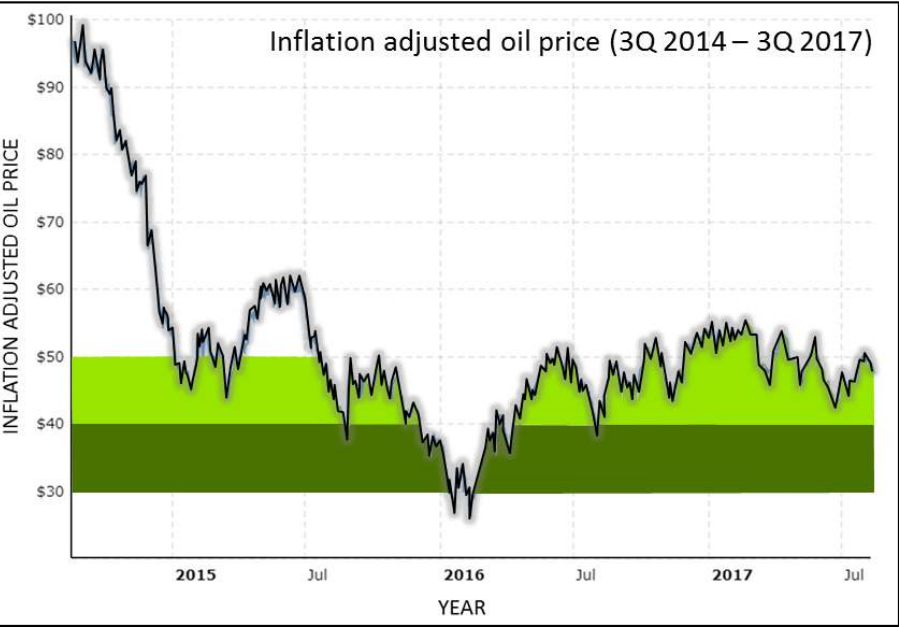
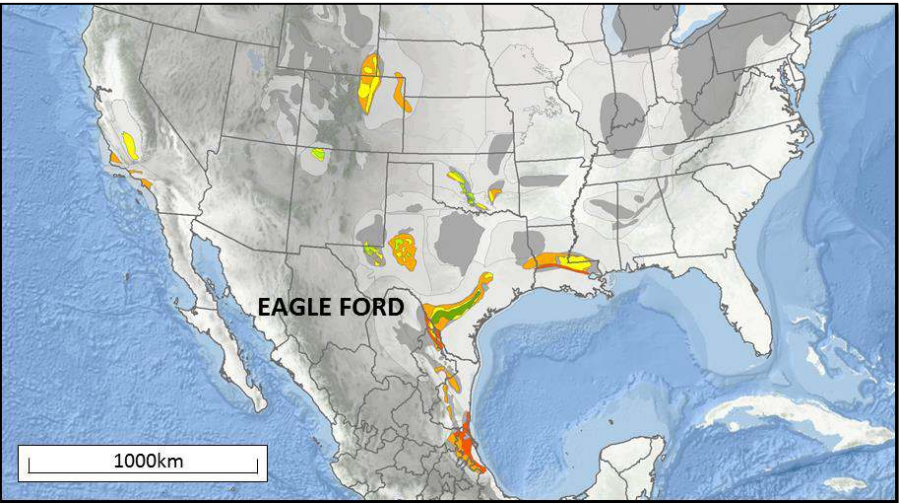
Breaking point in the Eagle Ford



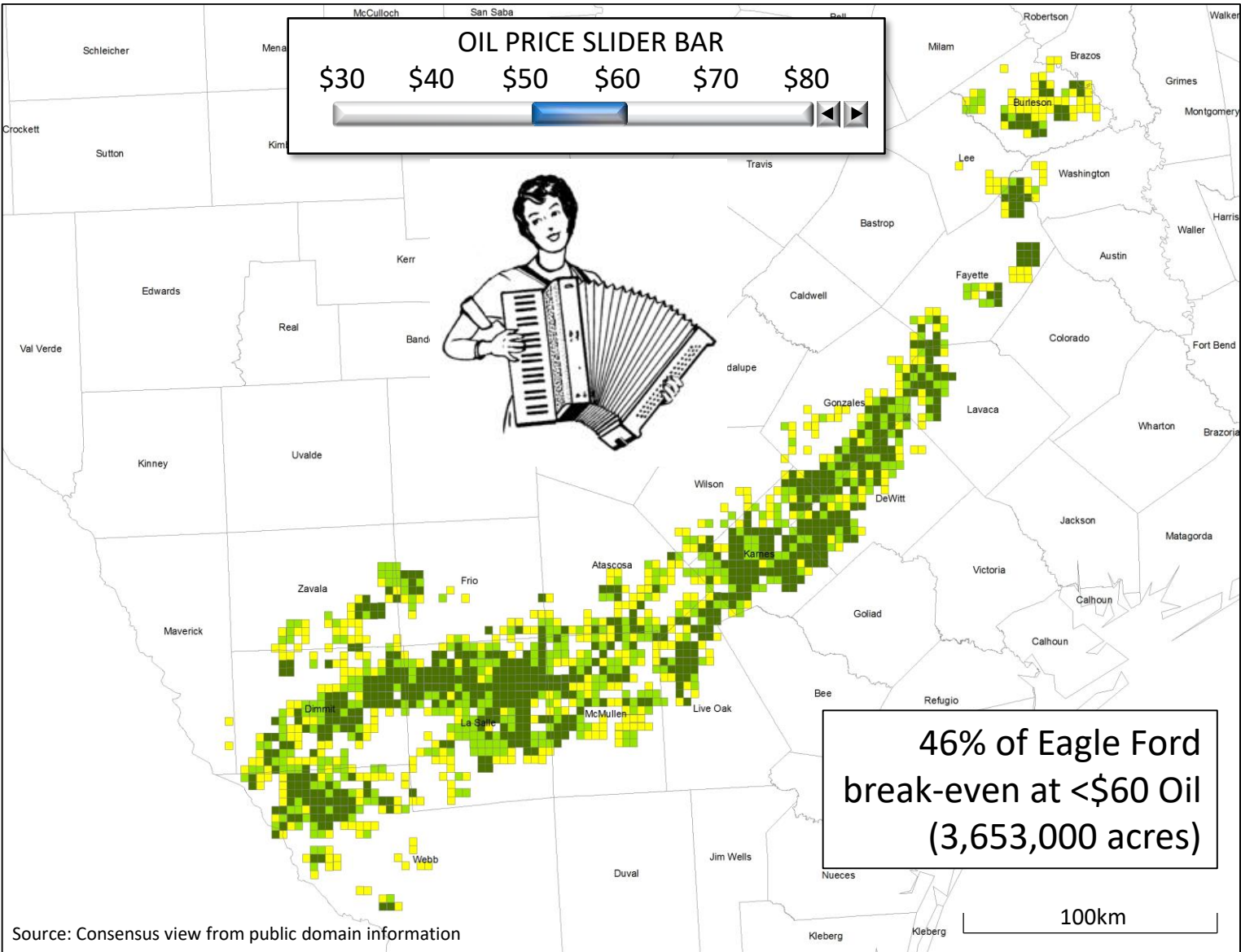
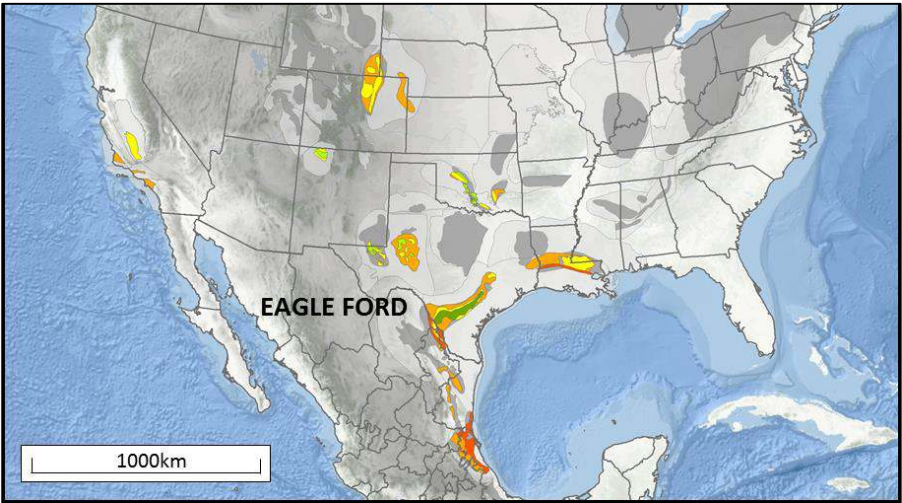
Breaking point in the Eagle Ford



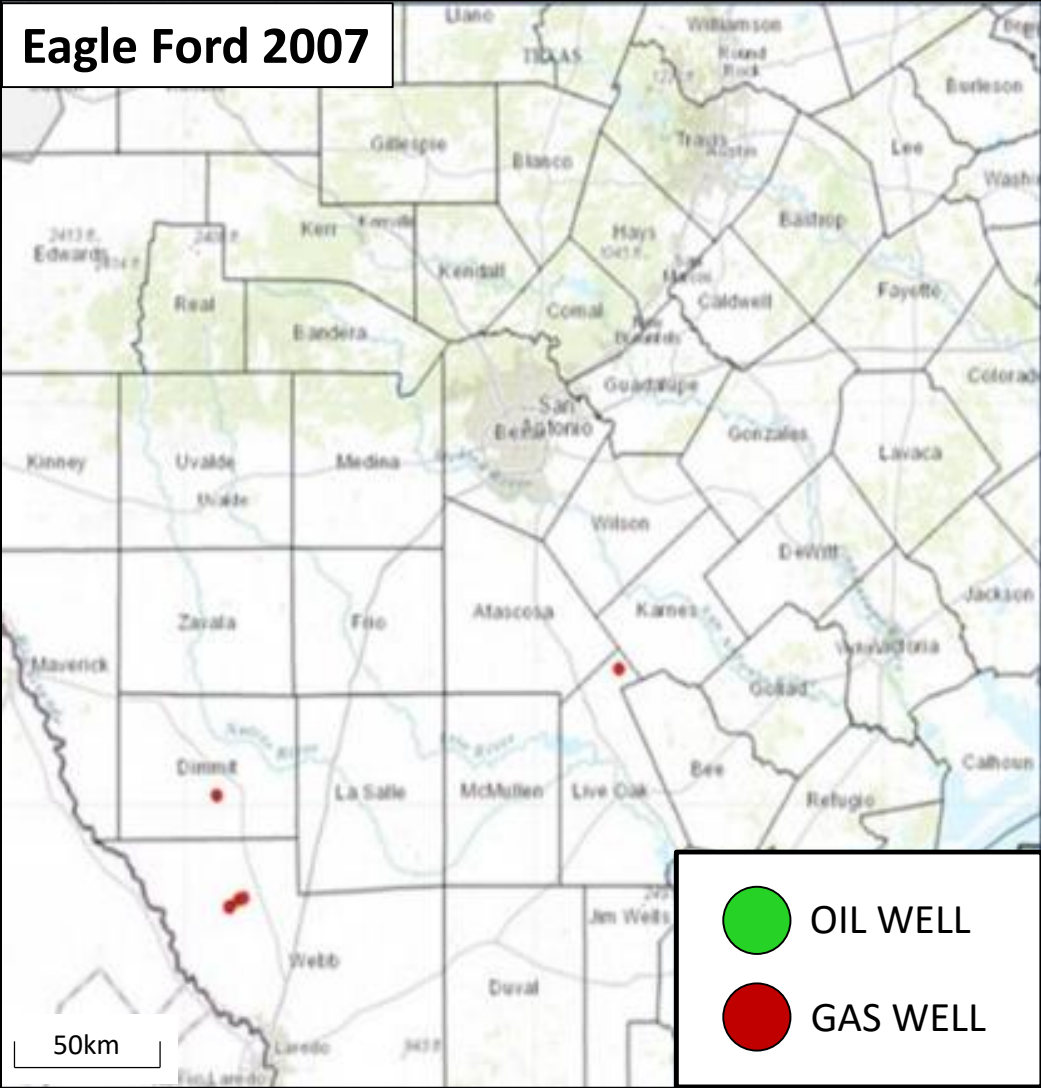
Breaking point in the Eagle Ford



Breaking point in the Eagle Ford



Growth of the Eagle Ford



Unconventional challenges outside of North America

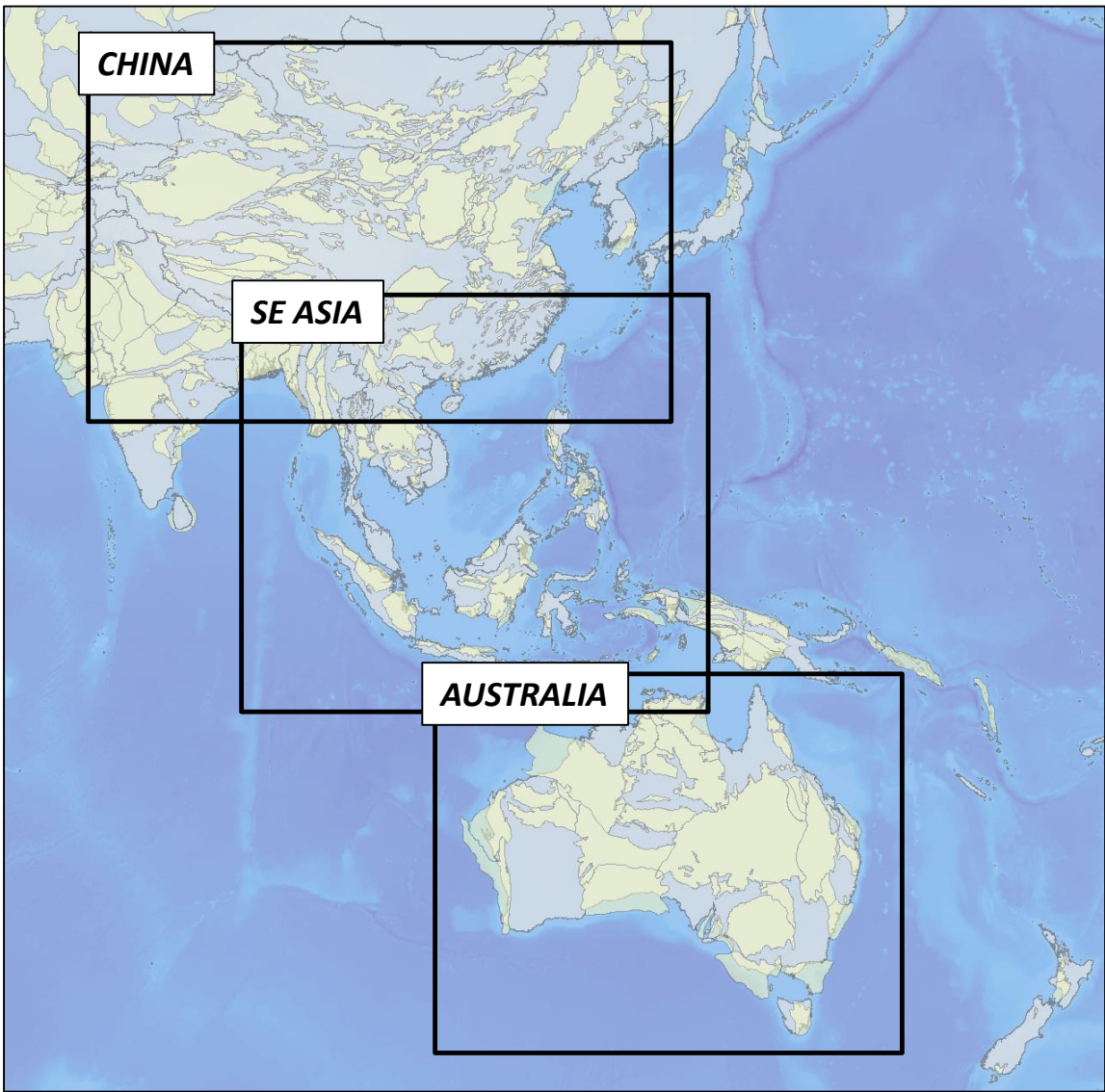


REGION	HIGHER COSTS	SERVICE SECTOR	REGULATORY FRAMEWORK	OPPOSITION	INFRA-STRUCTURE	SECURITY	WATER SCARCITY	GAS PRICE	ACCESS TO CAPITAL
Mexico									

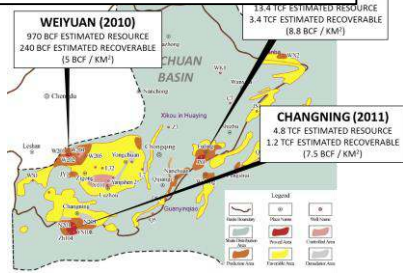
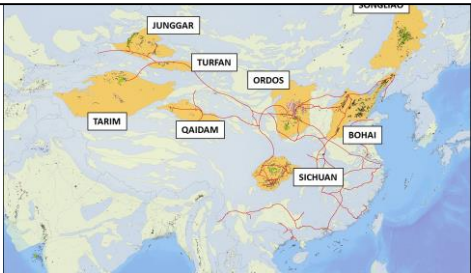
- Higher costs / Smaller service industry
- Poor regulatory framework
- Lack of infrastructure
- Lack of security
- Water shortages
- Low prices – Mexican gas prices are linked to those in the US. 4.5 BCF/D US Gas exported to Mexico*
- Contract sanctity (July 2018 presidential election, where energy nationalist Andrés Manuel López Obrador has been leading in early polls)

**US gas prices would be around \$2 without Mexico exports*

Asia-Pacific unconventional opportunities



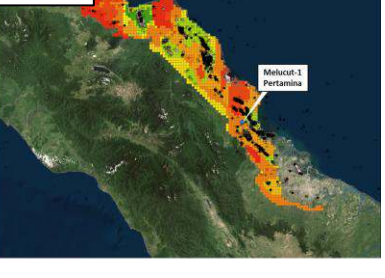
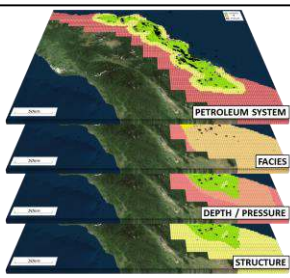
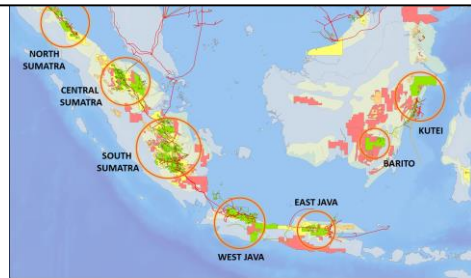
CHINA – STATE DRIVEN EFFORT WITH MIXED RESULTS



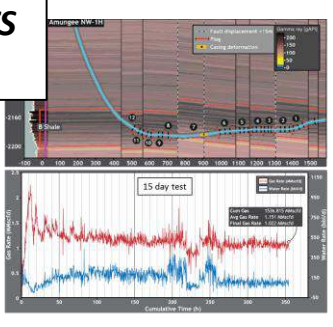
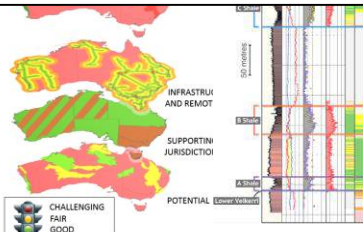
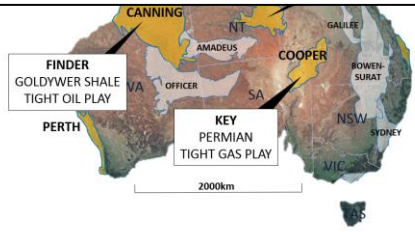
US equity bids \$530M bid for SinoGas



SE ASIA – CHALLENGES IN INFRASTRUCTURE/LOGISTICS



AUSTRALIA – SIGNIFICANT EFFORT WITH POOR RESULTS (OUTSIDE OF CBM) AND CHALLENGING SOCIAL ISSUES



China – Sichuan Basin

Breakthrough and prospect of shale gas exploration and development in China^{*}

Dong Dazhong^{a,b,*}, Wang Yuman^a, Li Xinjing^a, Zou Caineng^a, Guan Quanzhong^a, Zhang Chenchen^a, Huang Jiliang^a, Wang Shufang^a, Wang Hongyan^{b,c}, Liu Honglin^a, Bai Wenhua^a, Liang Feng^a, Lin Wen^a, Zhao Qun^a, Liu Dexun^a, Qiu Zhen^a

^a PetroChina Research Institute of Petroleum Exploration and Development, Beijing 100083, China
^b National Energy Shale Gas R & D (Experimental) Centre, Langfang, Hebei 065007, China
^c Langfang Branch of PetroChina Research Institute of Petroleum Exploration and Development, Langfang, Hebei 065007, China

Received 3 November 2015; accepted 1 February 2016
Available online 3 August 2016

WEIYUAN (2010)

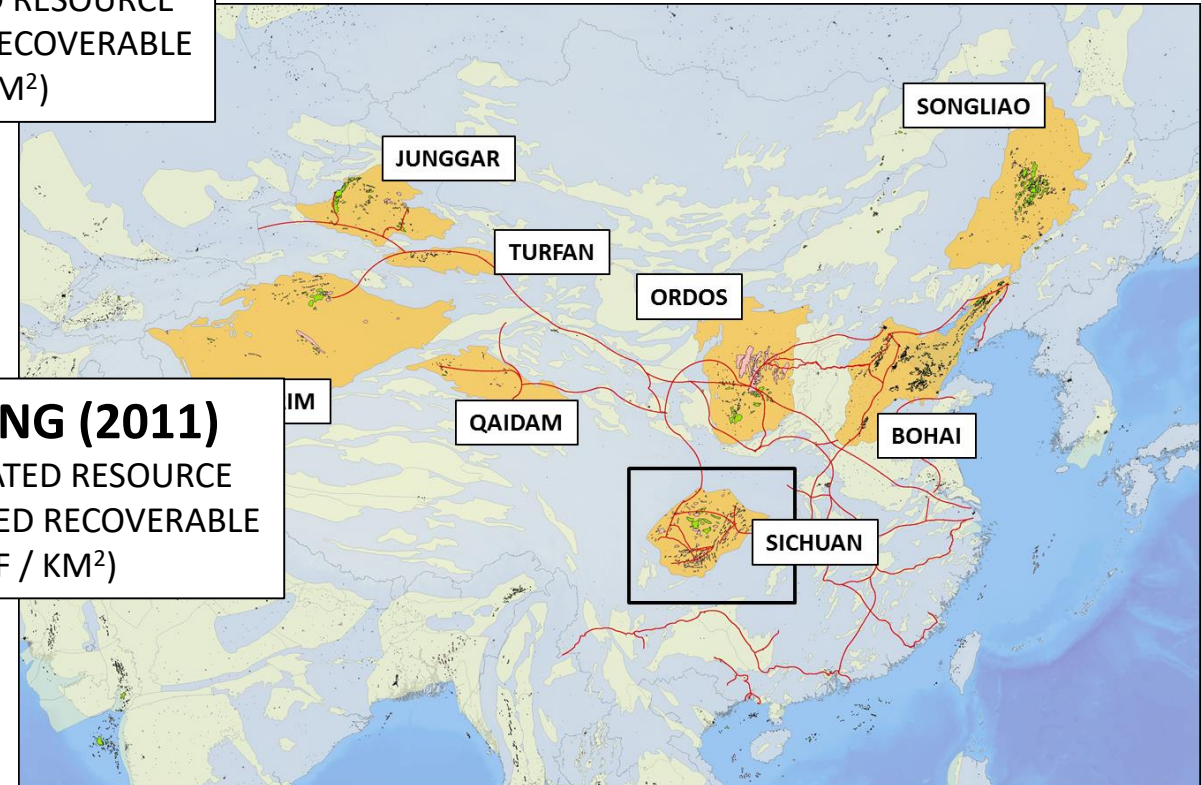
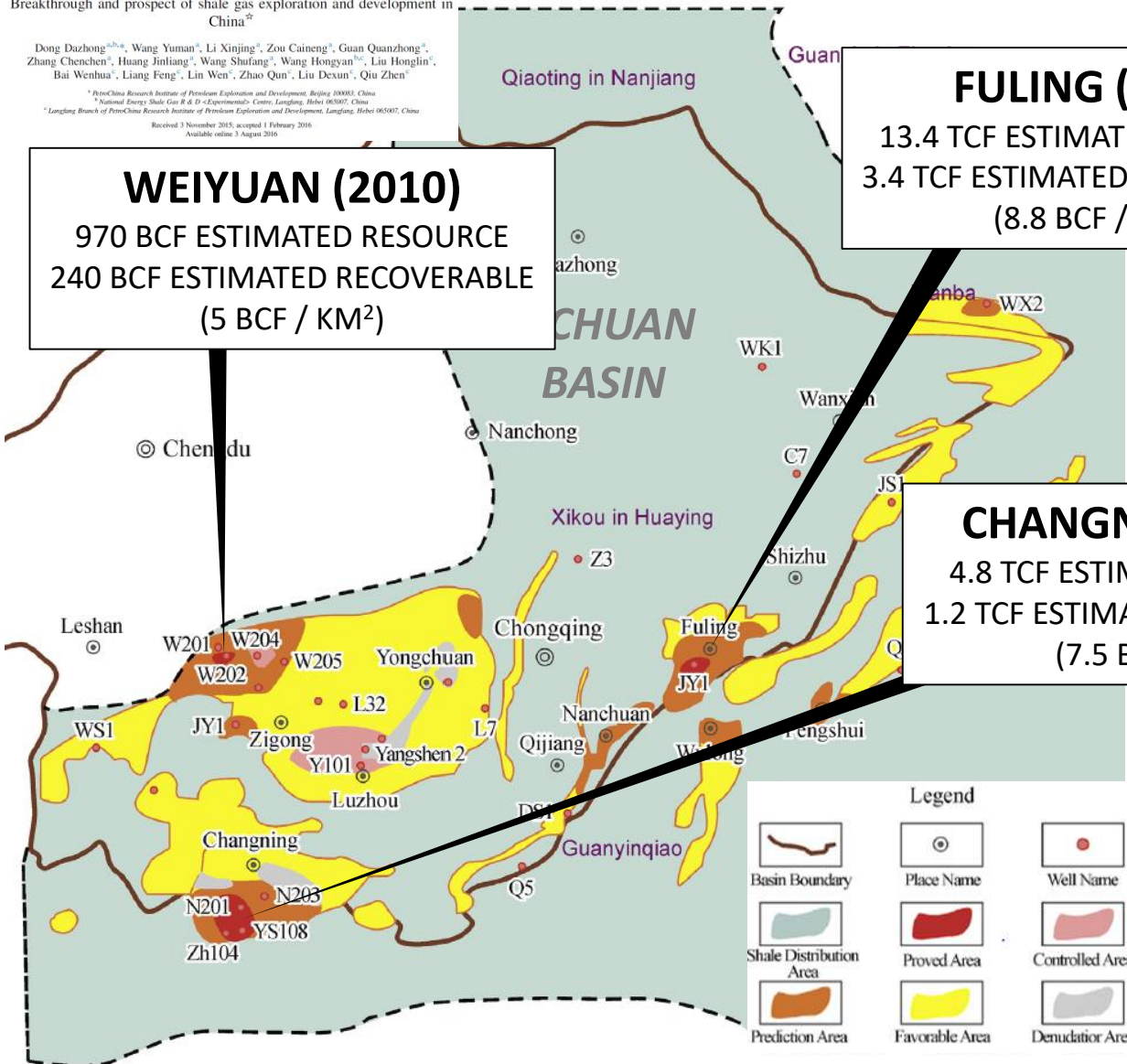
970 BCF ESTIMATED RESOURCE
240 BCF ESTIMATED RECOVERABLE
(5 BCF / KM²)

FULING (2012)

13.4 TCF ESTIMATED RESOURCE
3.4 TCF ESTIMATED RECOVERABLE
(8.8 BCF / KM²)

CHANGNING (2011)

4.8 TCF ESTIMATED RESOURCE
1.2 TCF ESTIMATED RECOVERABLE
(7.5 BCF / KM²)



Wells in the Wufeng-Longmaxi Formation yielding up to 19 MMSCF/D (98% Methane)

US equity lobs \$530M bid for SinoGas

US EQUITY firm Lone Start Capital has made a takeover bid for Sino Gas & Energy for 25 cents per share, valuing the company at close to \$530 million – an offer the board unanimously recommended to shareholders this morning.

Helen Clark | 31 May 2018 | 11:58 | News



Sino's Linxing development

Sino calls it "an attractive premium over recent trading prices" in the absence of a superior offer given it offers a 19% premium over Wednesday's closing price and 32% over the volume weighted average price of the last 30 days and a 47% premium over the past six months.

At the time of writing Sino's price had shot up over 15% and was hovering at just over 24c, indicating the market had more confidence than some of the private investors in a phone conference this morning, who said they would not be accepting it.

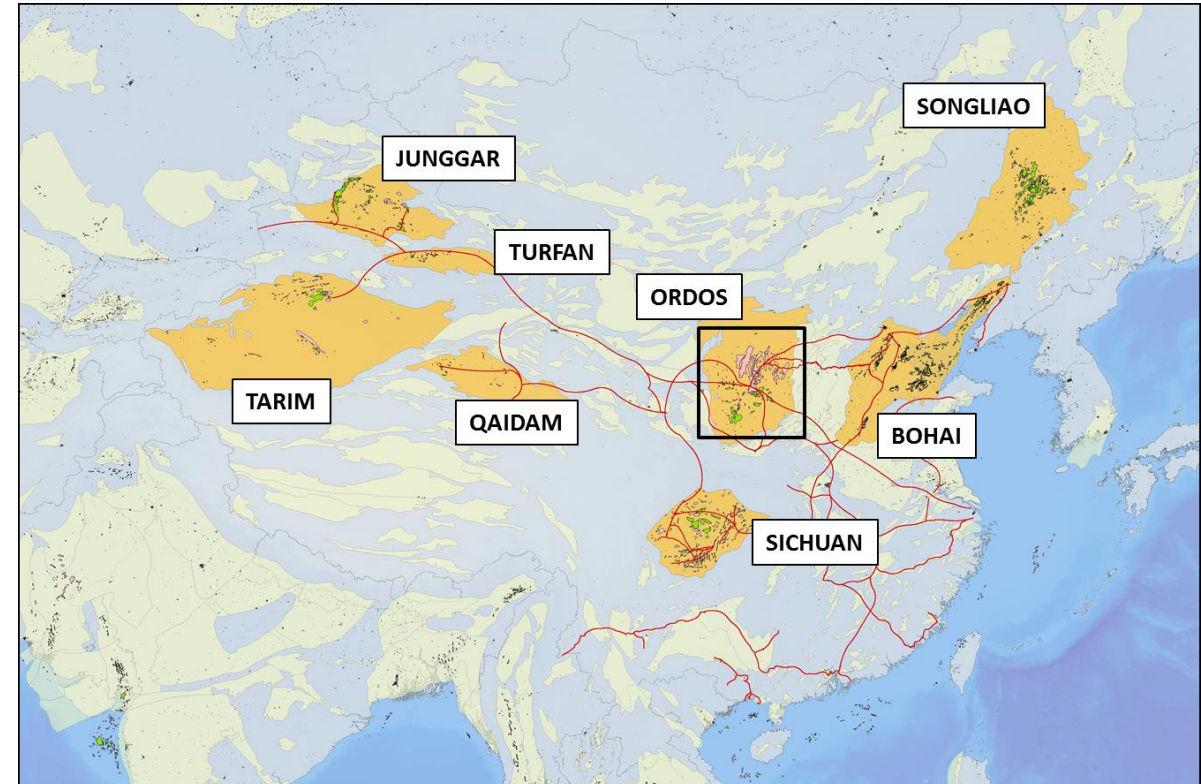
Related Content

[US equity lobs \\$530M bid for SinoGas](#)

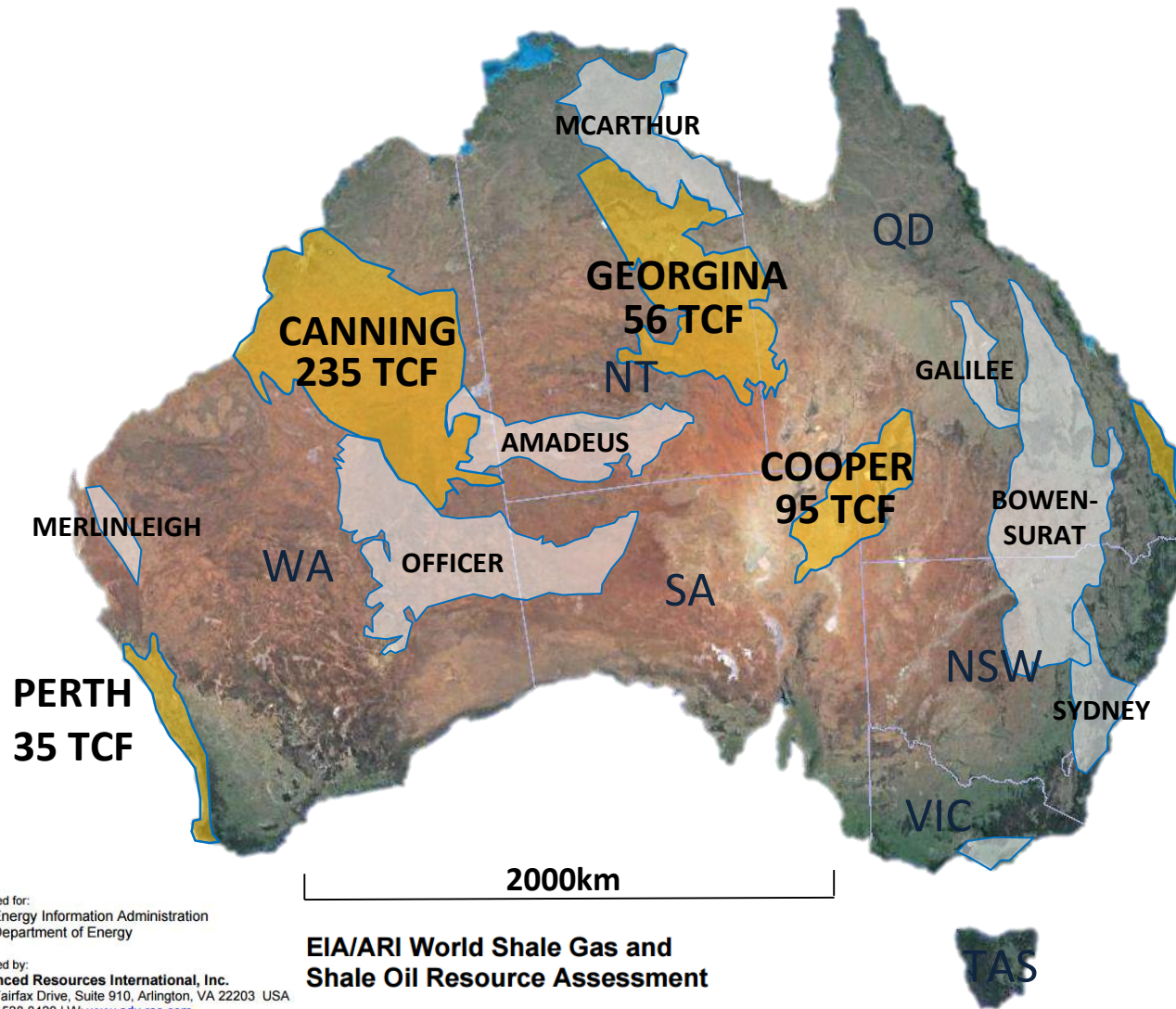
[US equity farms into Key's Marengo prospect](#)

[Chinese bid for AWE](#)

Topics (Select for more information):



Australian unconventional potential



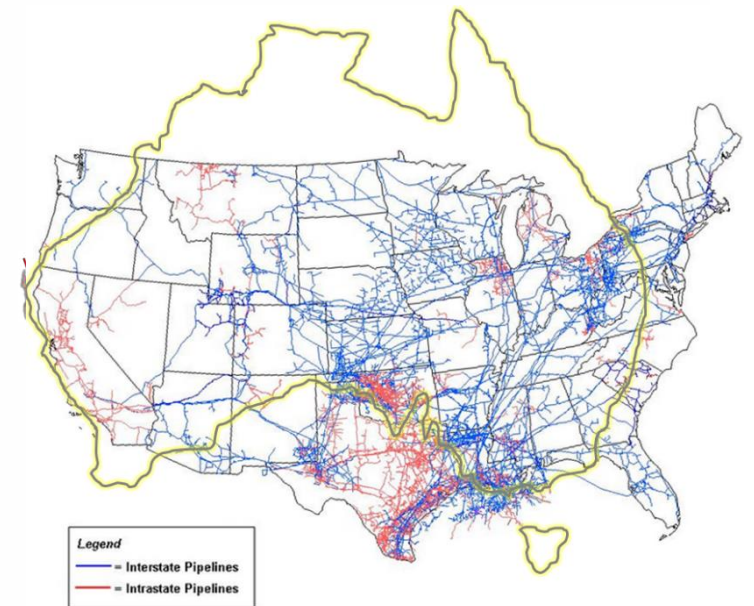
Prepared for:
U.S. Energy Information Administration
U.S. Department of Energy

Prepared by:
Advanced Resources International, Inc.
4501 Fairfax Drive, Suite 910, Arlington, VA 22203 USA
P: 703.528.8420 | W: www.adv-res.com

EIA/ARI World Shale Gas and Shale Oil Resource Assessment

*Technically Recoverable Shale Gas and Shale Oil Resources:
An Assessment of 137 Shale Formations in 41 Countries
Outside the United States*

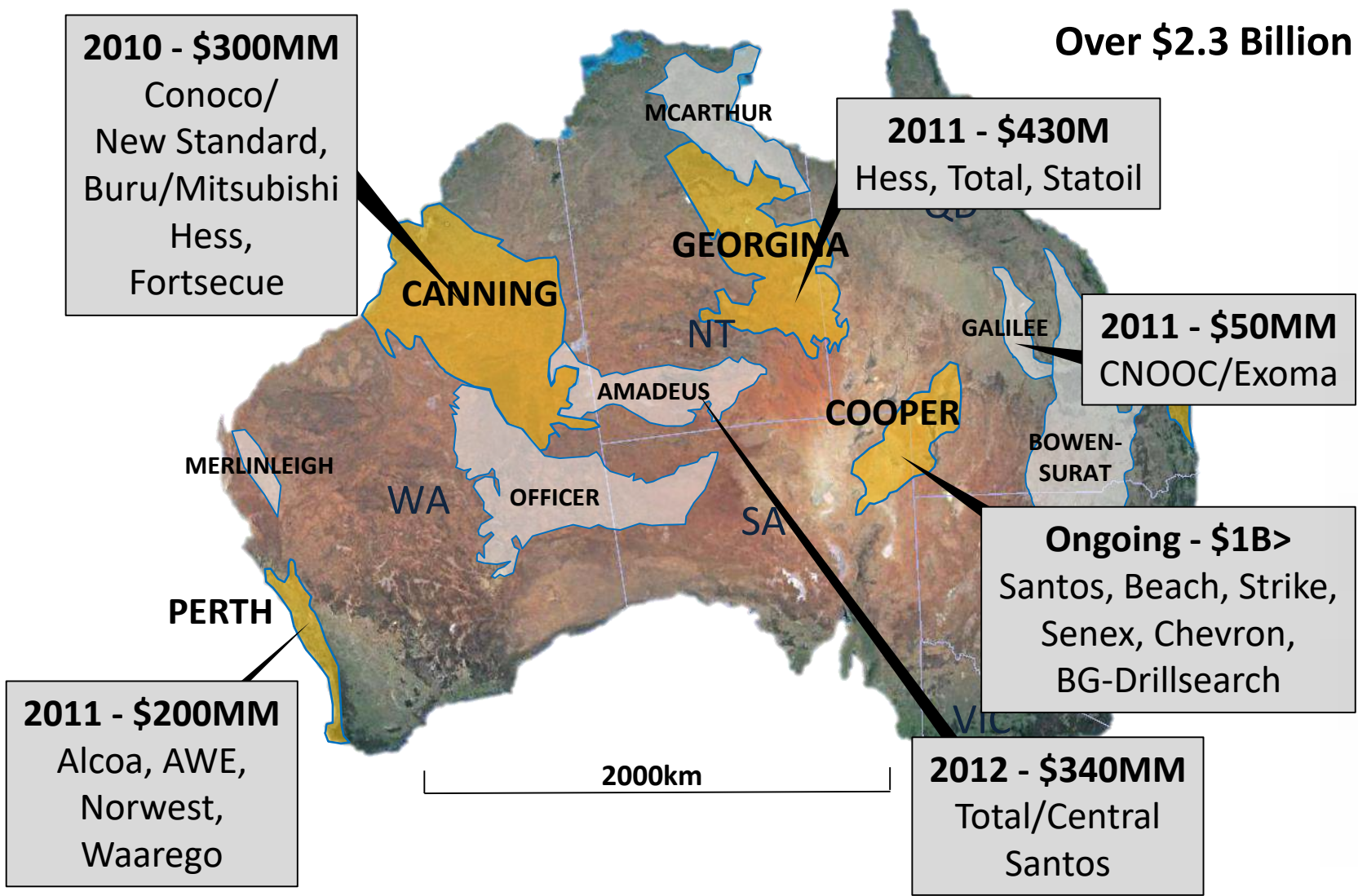
INFRASTRUCTURE CHALLENGES



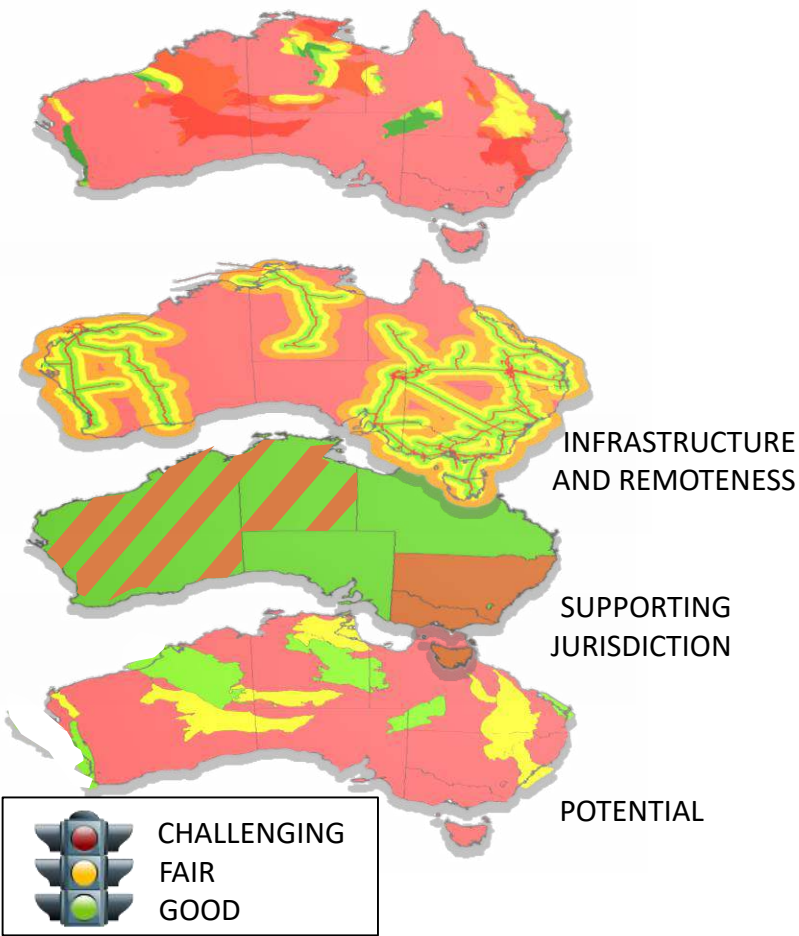
Historic Australian unconventional investment



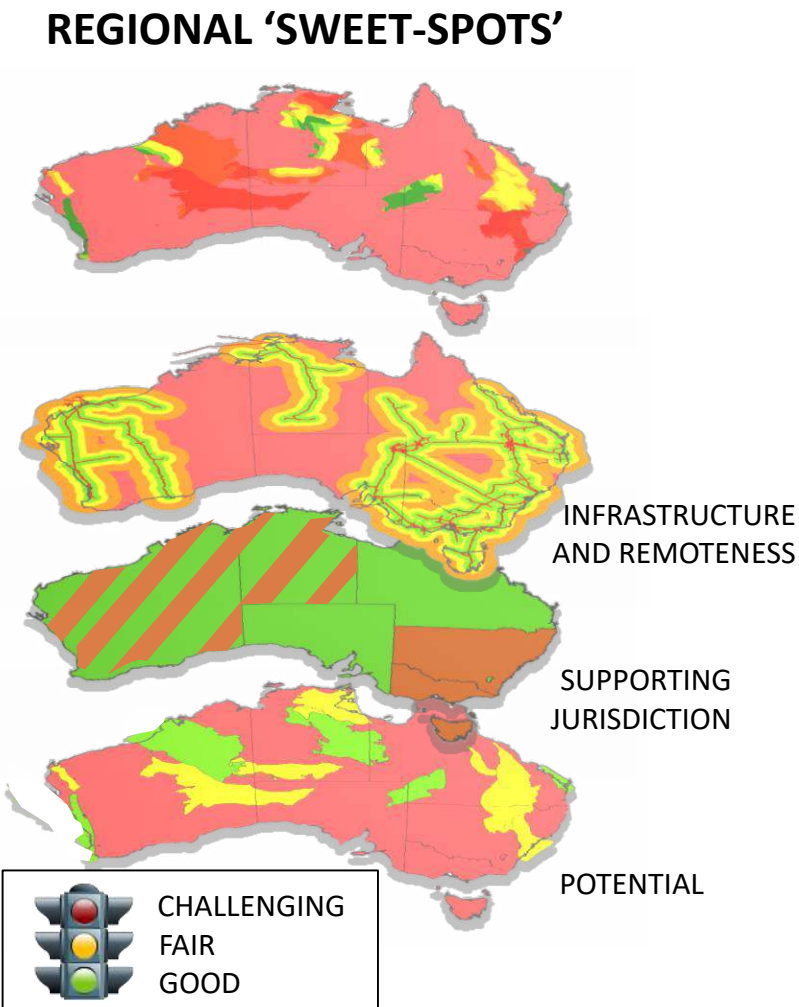
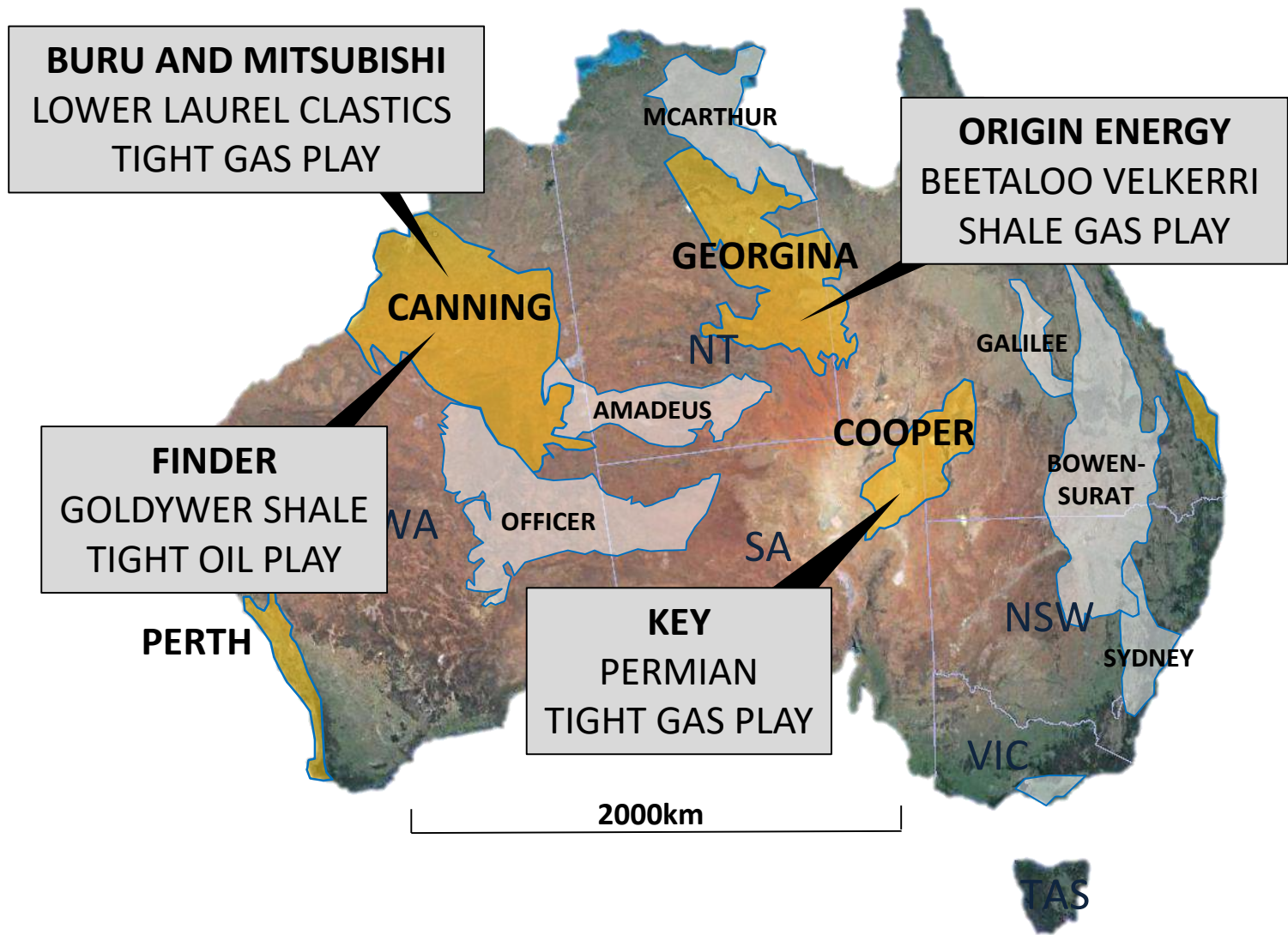
Over \$2.3 Billion spent on Australian unconventional



REGIONAL 'SWEET-SPOTS'



Ongoing Australian unconventional interest



Beetaloo Basin - Proterozoic Middle Velkerri tight gas prospect



Origin sitting on shale gas bonanza

MATT CHAMBERS
ENERGY

Off the outback Stuart Highway in the frack-free Northern Territory, it is looking increasingly likely that Origin Energy has discovered a world-class shale gas resource, comparable to those in the US, just east of Daly Waters.

And while it would take at least five years to develop, even if an NT fracking moratorium is eased, it could play a big part in balancing east coast gas supplies that are expected to struggle to meet demand over the next 20 years after the construction of export plants at Gladstone.

Known as the Beetaloo joint venture, Origin Energy estimates it has 6.6 trillion cubic feet (tcf) of contingent gas resources over 2000 square kilometres of ground. This follows the hydraulic fracturing, or fracking, and testing of Australia's most suc-

cessful shale well to date — the Amungee horizontal well. It was fracked just before the NT's Labor government took power in September and, at least temporarily, banned the practice.

That is a lot of gas in itself. But the shale play that was tested, known as the Velkerri formation and holding the world's oldest gas source rocks, extends over 17,000sq km on Origin's ground.

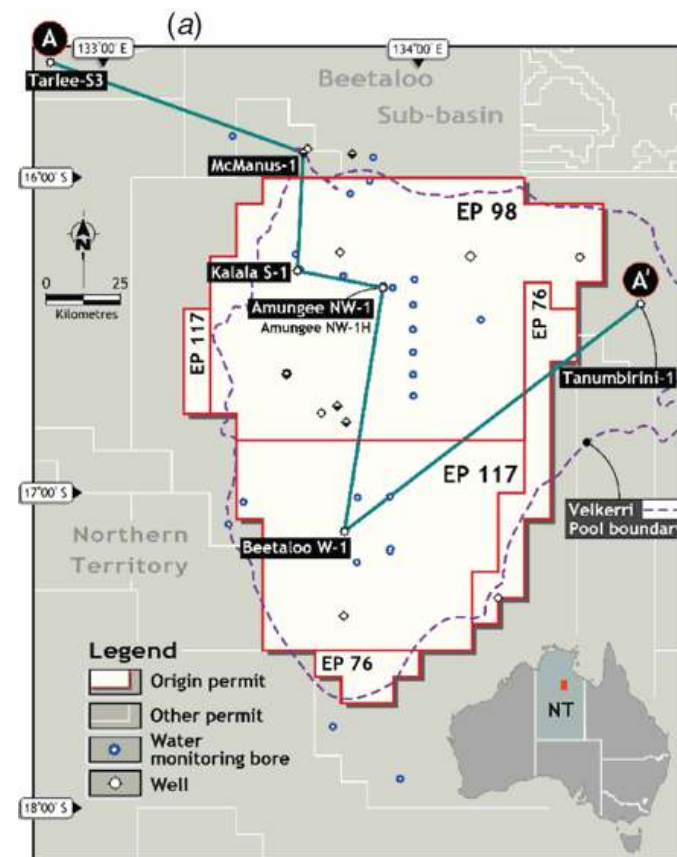
This means the resources could be expanded to eight times its current size, or about 50 trillion cubic feet of gas.

And it gets better. Slightly shallower than the 2.4km deep, 1.4 billion year-old Velkerri, sits another, younger play, known as the Kyalla formation, at just 1.2 billion years old. It has not been horizontally drilled — the technique that made fracking shale in the US commercially viable — but recent testing of samples have given the surprise indication the liquids-shale has properties that can be fracked.

So Beetaloo could have some valuable liquids and "stacked" plays, which is the property that has made the Permian basin in West Texas the hottest ticket in US onshore oil of late, to the extent that extra expected production is weighing down oil prices.

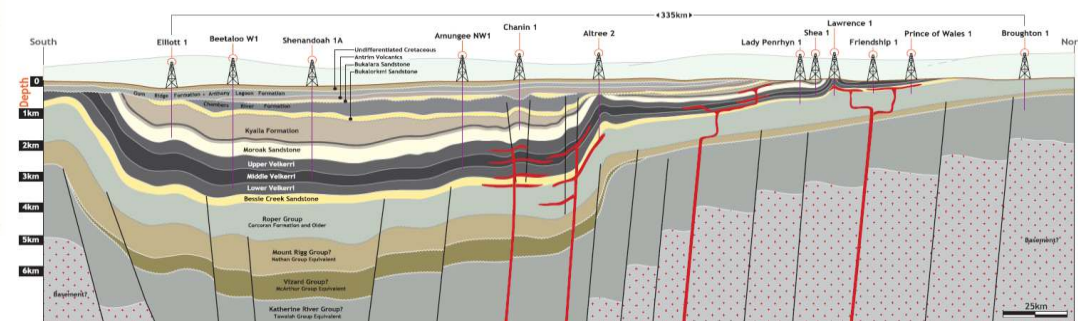
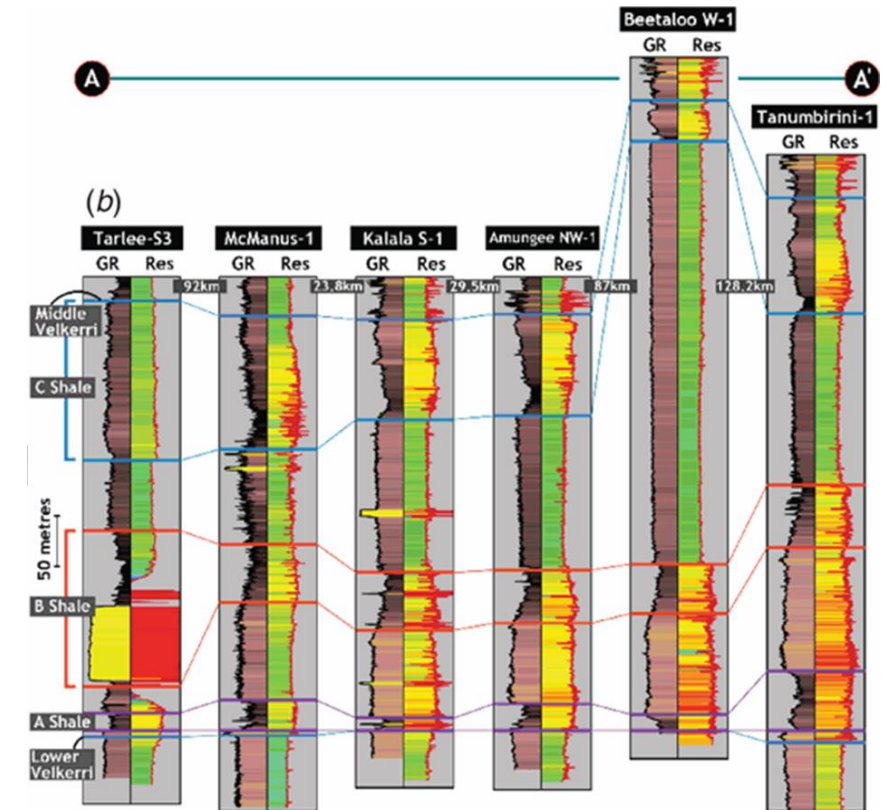


The Australian
20 July, p17

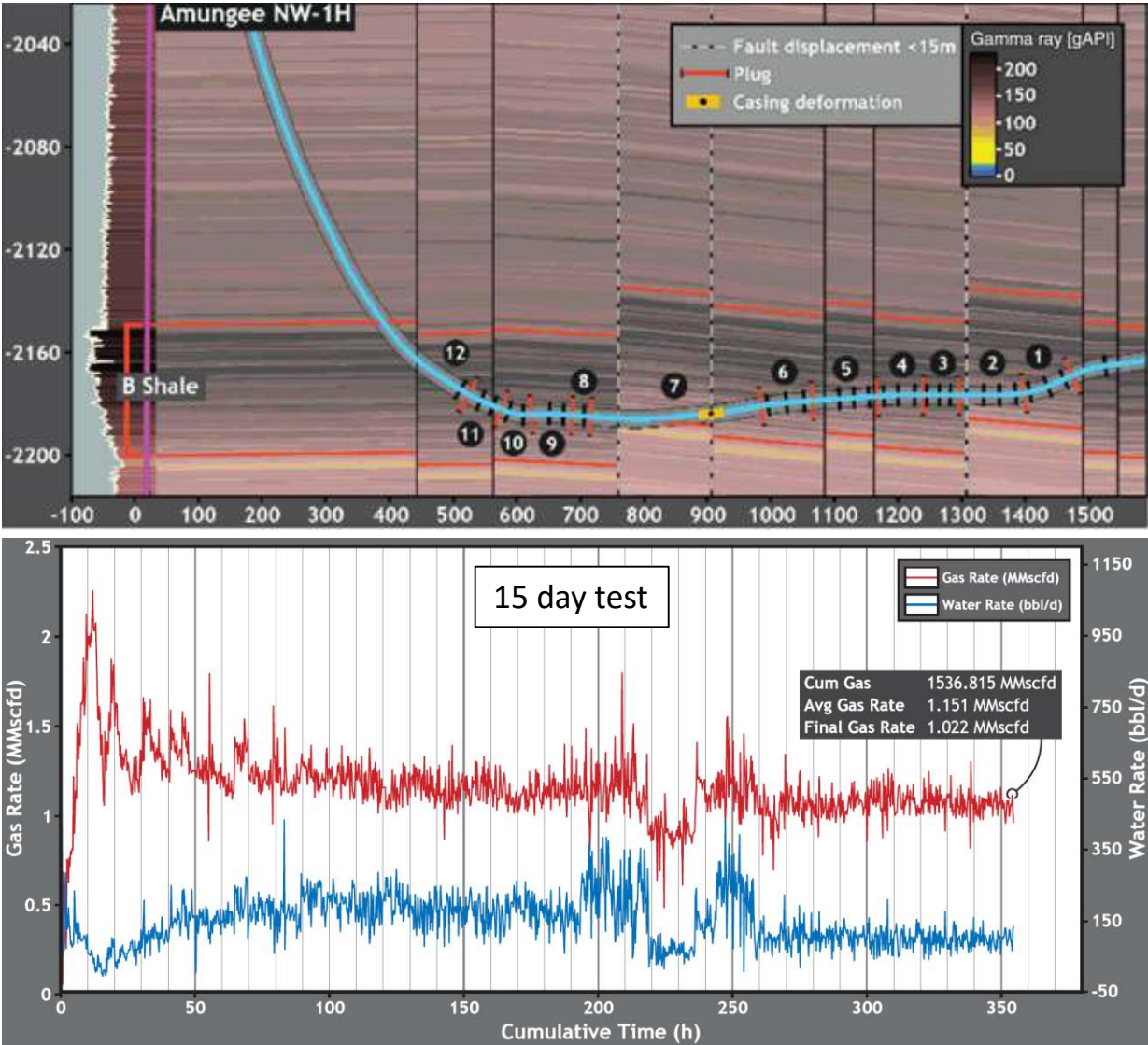
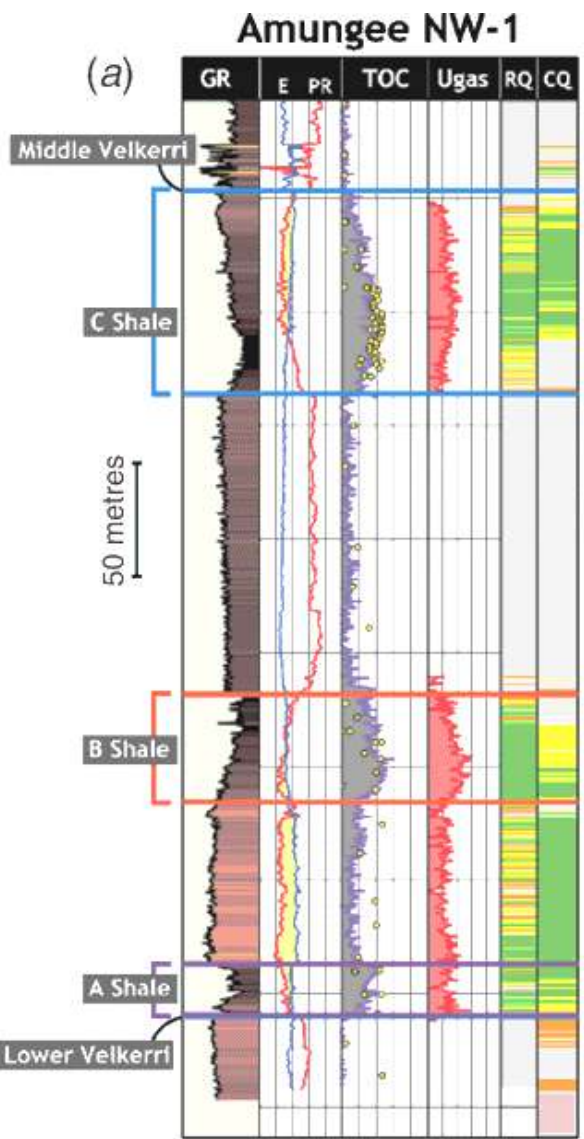


Proterozoic shale gas plays in the Beetaloo Basin and the Amungee NW-1H discovery

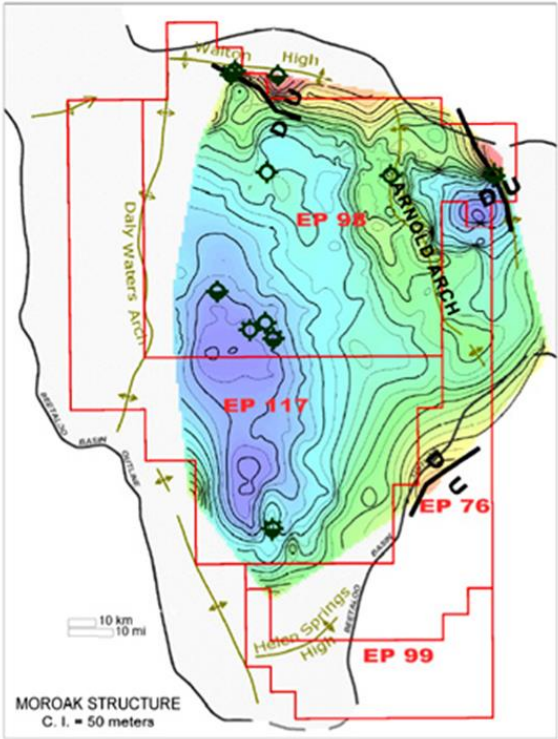
David I Close^{1,2}, Alexander J Côté¹, Elizabeth T Baruch¹, Carl M Altmann¹, Faiz M Mohinudeen¹, Brenton Richards¹ and Rachael Ilett¹



Beetaloo Basin - Proterozoic Middle Velkerri tight gas prospect



Tier 1 (RQ&CQ)	B Shale
Thickness (m)	29.5
TOC (%)	4.1
Phi gas (%)	4-4.5
Poisson's ratio	0.2
Young modulus (GPa)	32.8



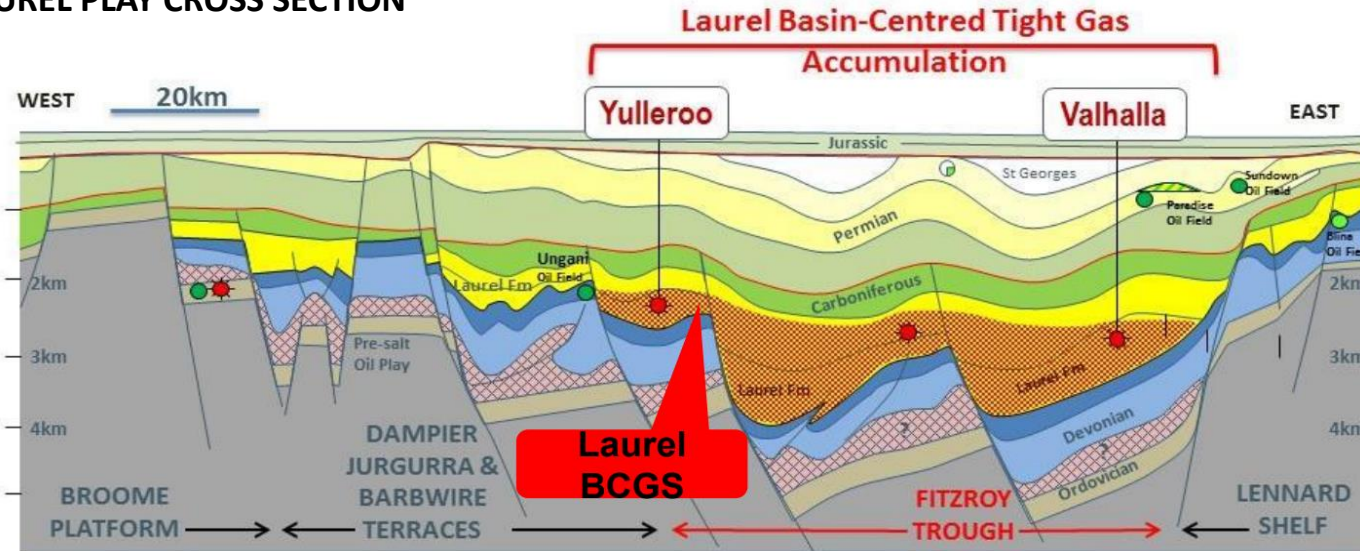
Proterozoic shale gas plays in the Beetaloo Basin and the Amungee NW-1H discovery

David I Close^{1,2}, Alexander J Côté¹, Elizabeth T Baruch¹, Carl M Altmann¹, Faiz M Mohmudeen¹, Brenton Richards¹ and Rachael Ilett¹

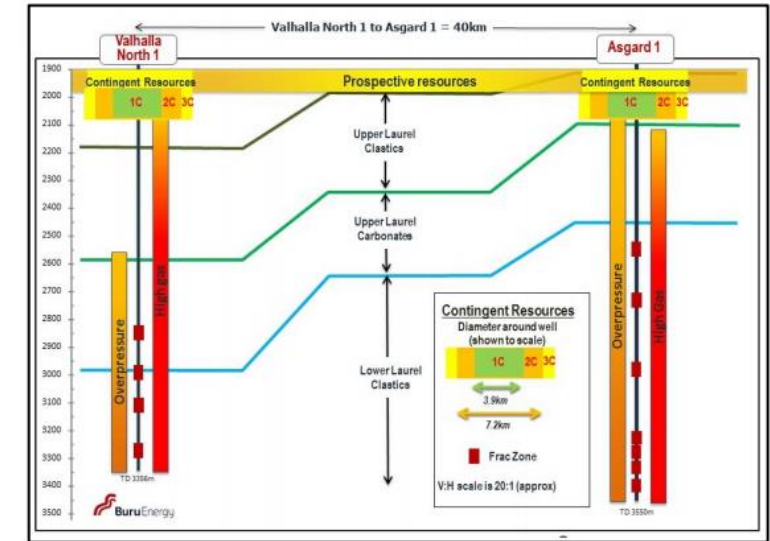
Canning Basin - Carboniferous Lower Laurel tight gas prospect



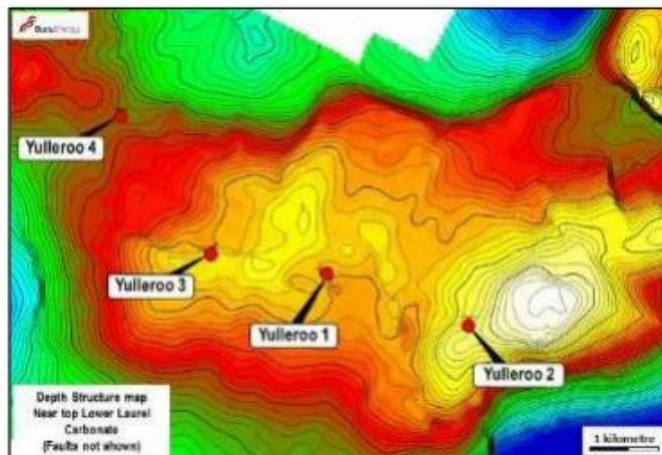
LAUREL PLAY CROSS SECTION



VALHALLA – ASGARD FRAC ZONES



YULLERRO TIGHT GAS DISCOVERY



VALHALLA – ASGARD TESTING



2015 VALHALLA – ASGARD TESTING

- Two vertical wells, 11 zones stimulated
- Commingled tests over limited period with gas flows between 0.5 – 3mmcf (unstabilised rates, wells still cleaning up)
- Indications of liquids component (25-38 bbls/mmcf commingled)

Canning Basin - Carboniferous Lower Laurel tight gas prospect



BURU YULLEROO TIGHT GAS PLAY AREA

190km

MITSUBISHI VALHALLA TIGHT GAS PLAY AREA

YULLEROO 4

YULLEROO 3

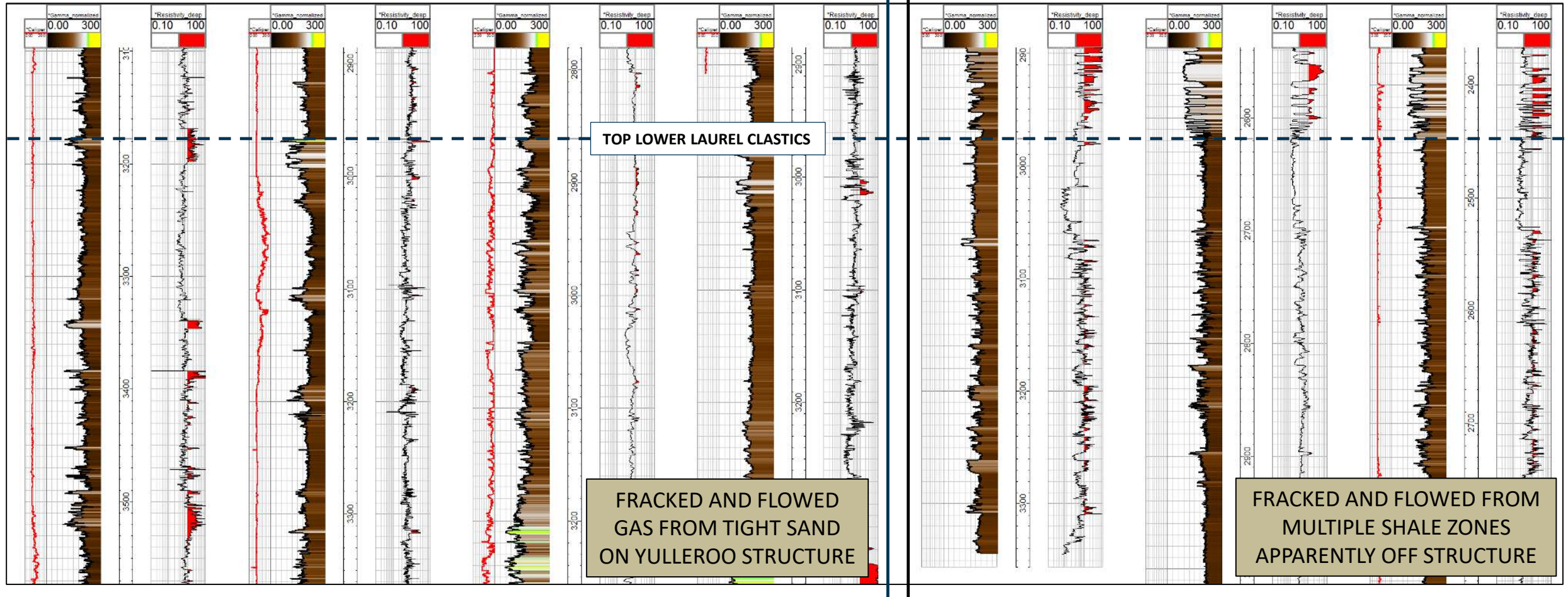
YULLEROO 1

YULLEROO 2

VALHALLA NORTH

VALHALLA 1

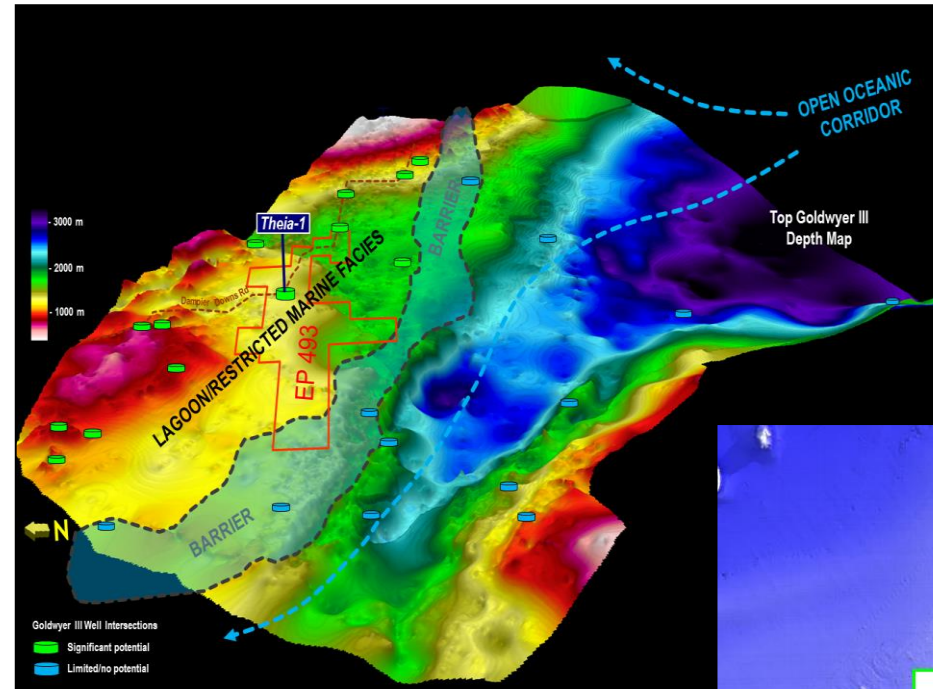
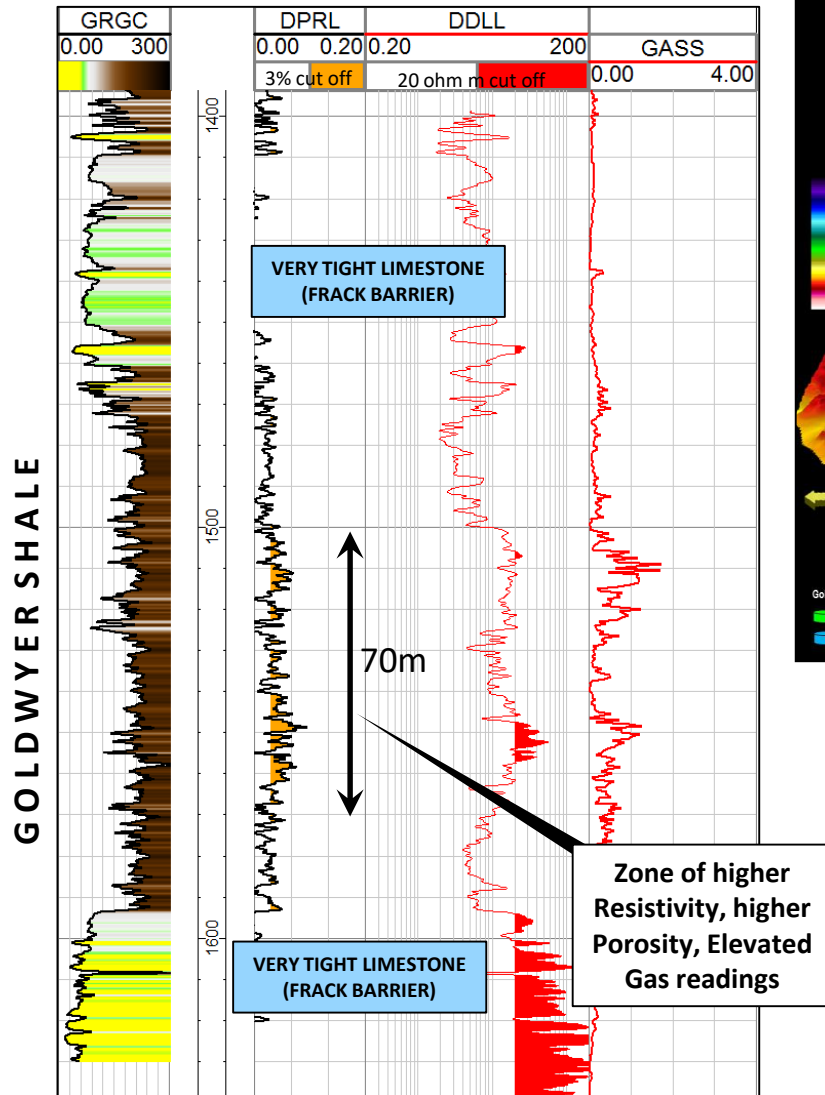
ASGARD 1



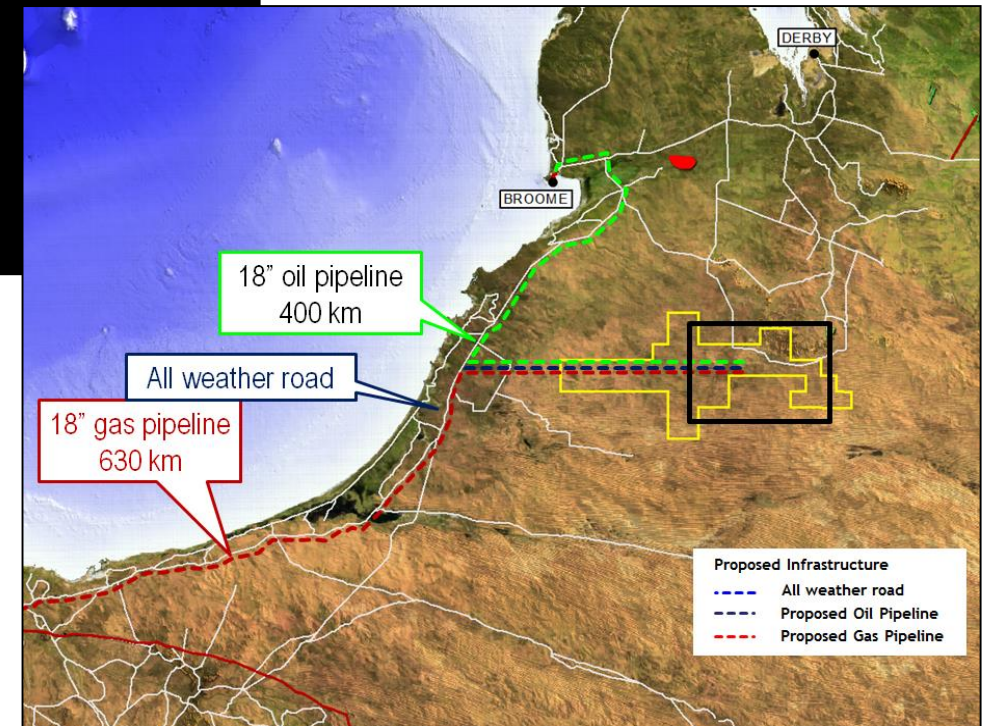
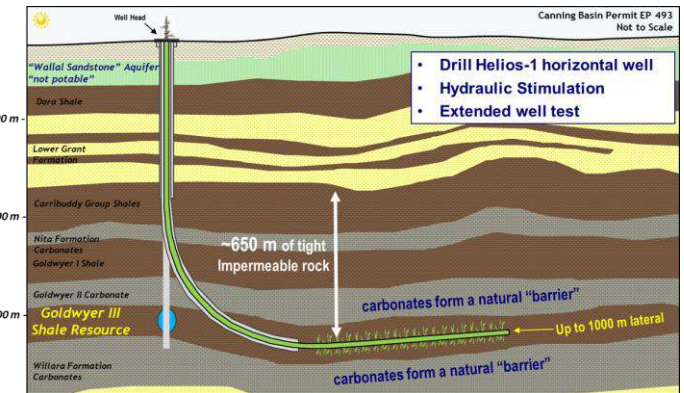
Canning Basin - Ordovician Goldwyer Shale tight oil prospect



THEIA-1



Theia-1 acquired excellent data for analysis (now open file)
A follow-up horizontal well (Helios-1) is planned to fracture stimulate and attempt to flow test the Goldwyer zone of interest (subject to WA WA fracking moratorium)

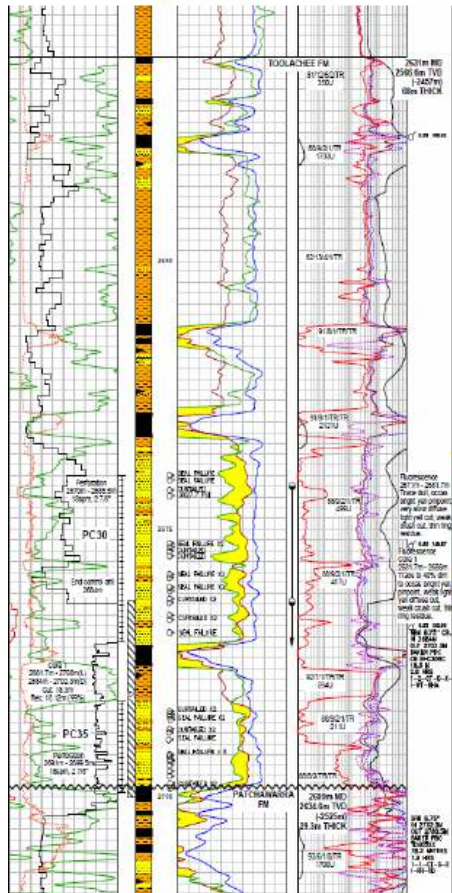


Cooper Basin – Permian Toolachee tight gas prospect

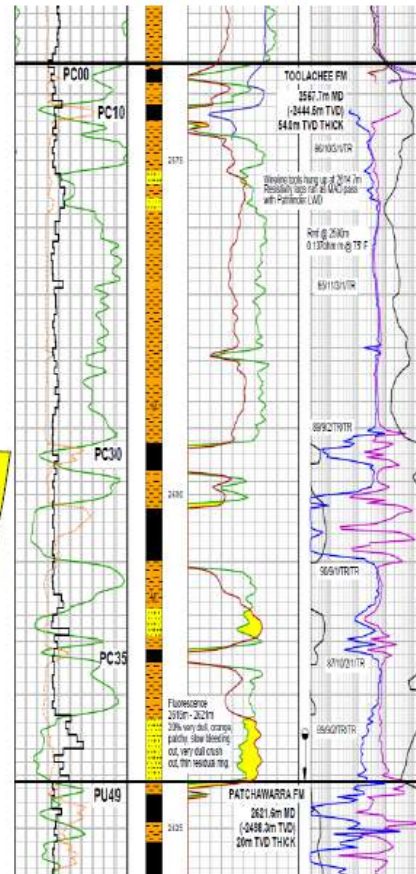


- Immediate focus is on conventional Permian gas opportunities that are nearby to Barrolka, Marengo and other fields within 'basin centred gas fairway'.

Barrolka-16



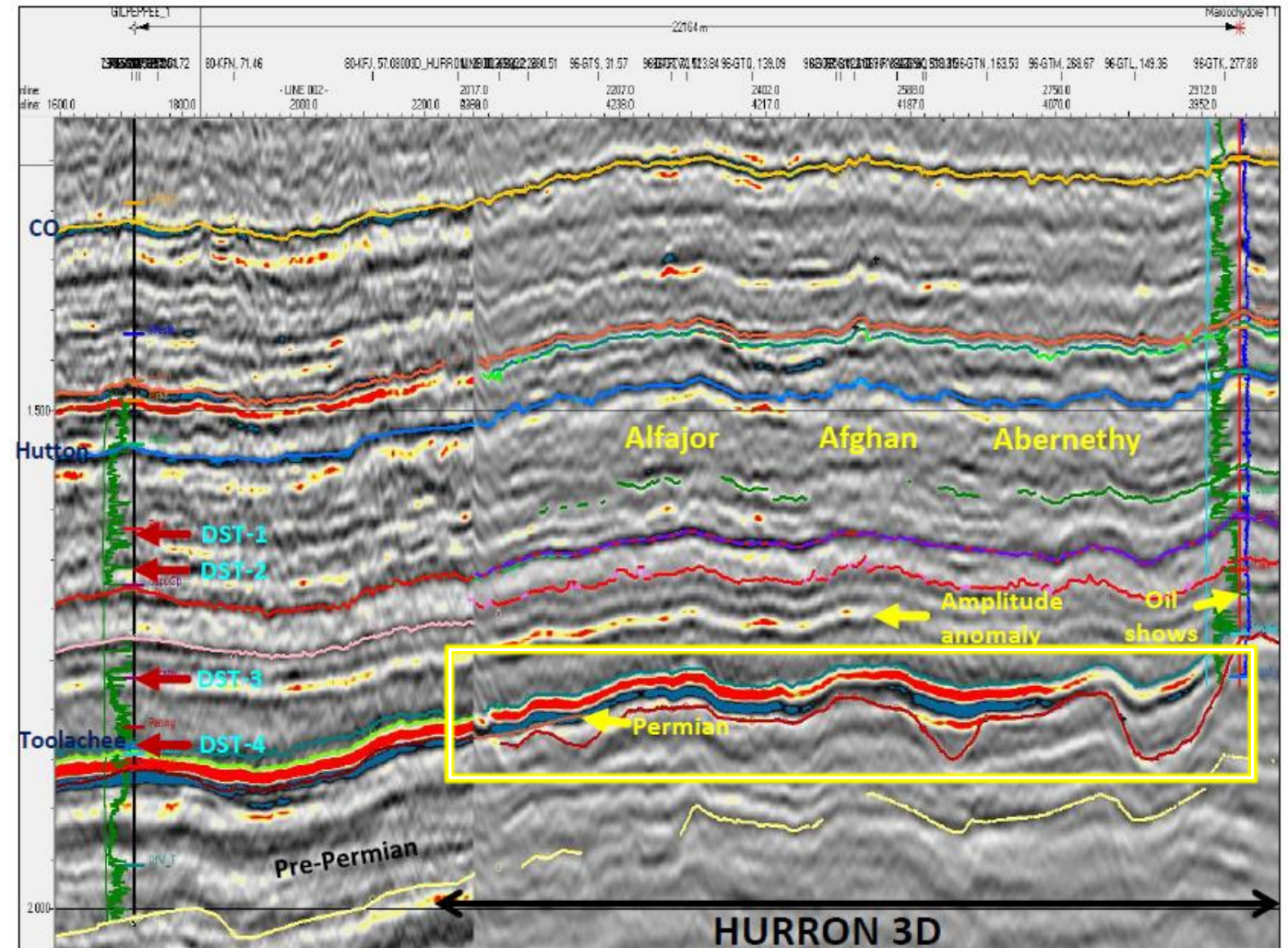
Barrolka-17



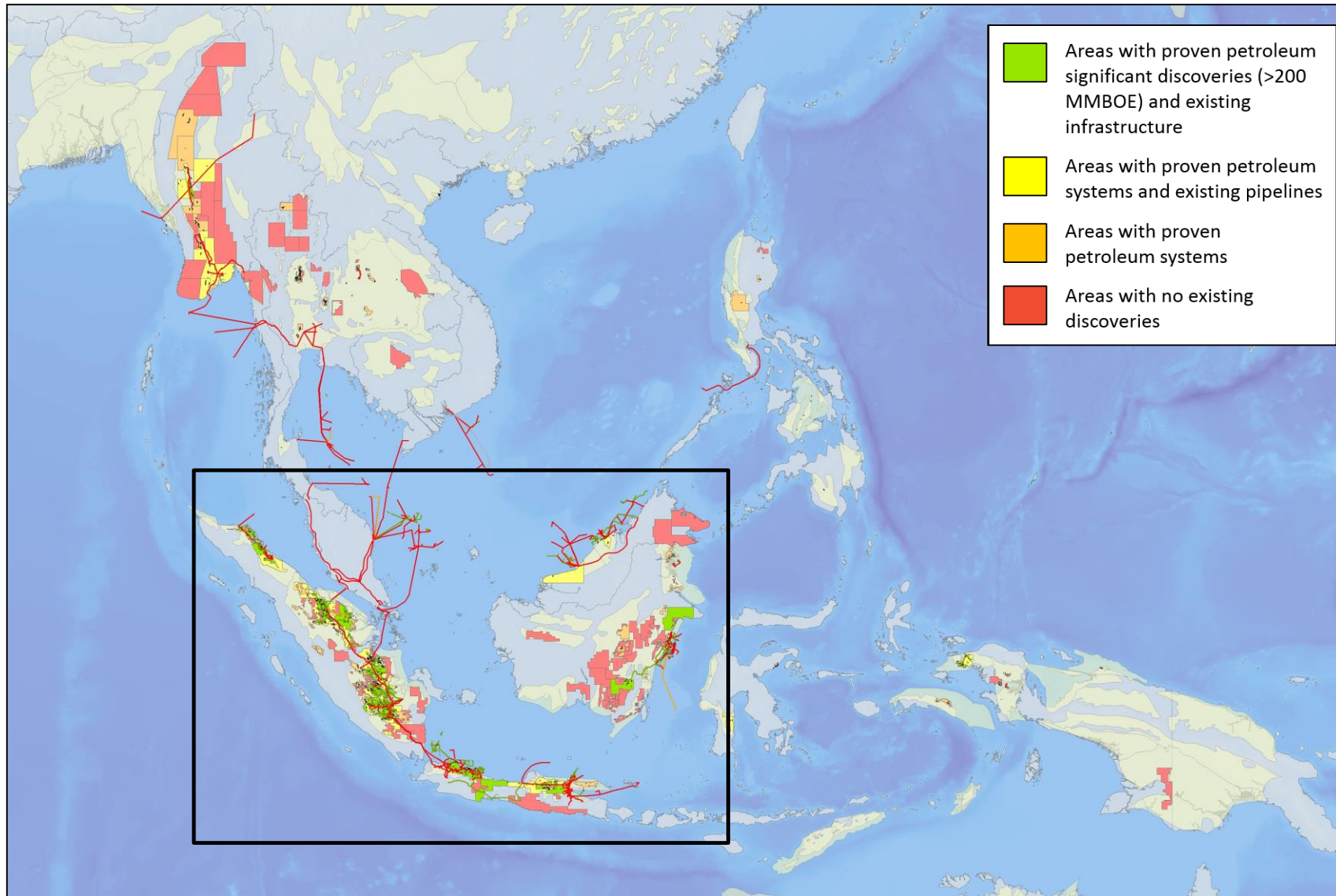
Permian Channel sands

Gilpeppe-1

Maroochyore-1

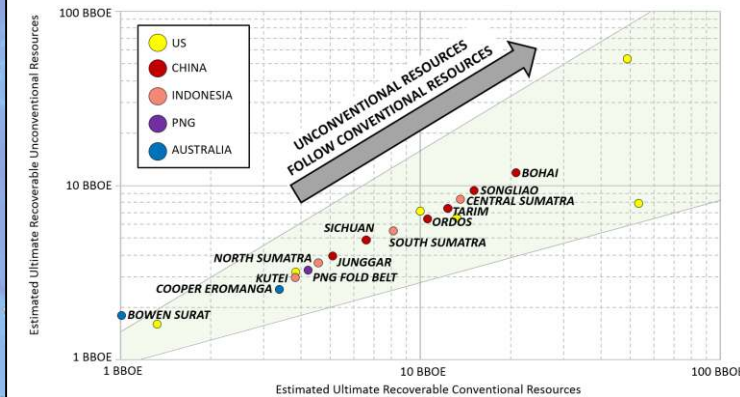


South East Asian onshore proven petroleum systems

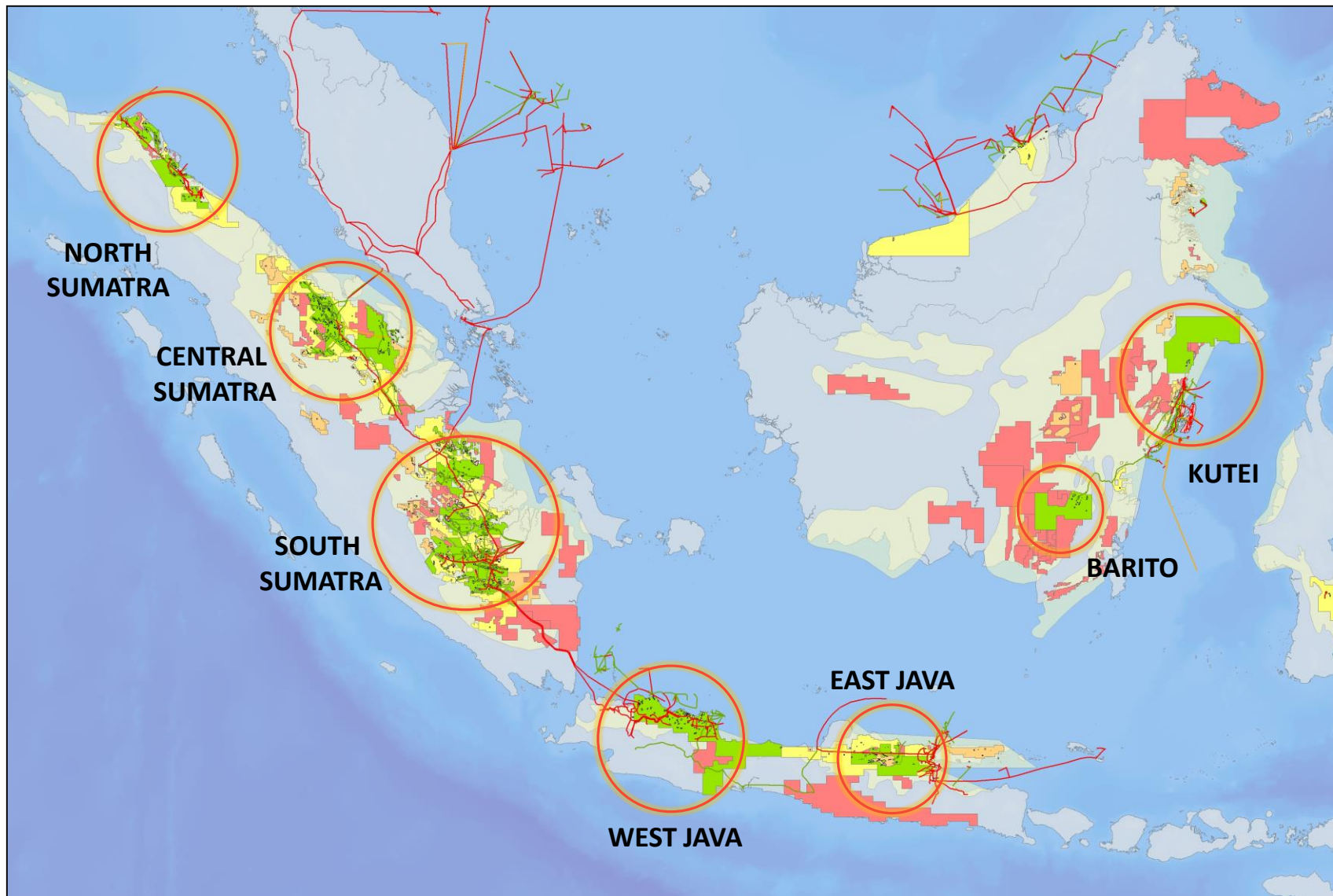


North American Observations

- Proven hydrocarbon systems
- Big Unconventional resources will follow big Conventional resources
- Existing infrastructure
- Supportive industry framework and stakeholders







Indonesian unconventional potential

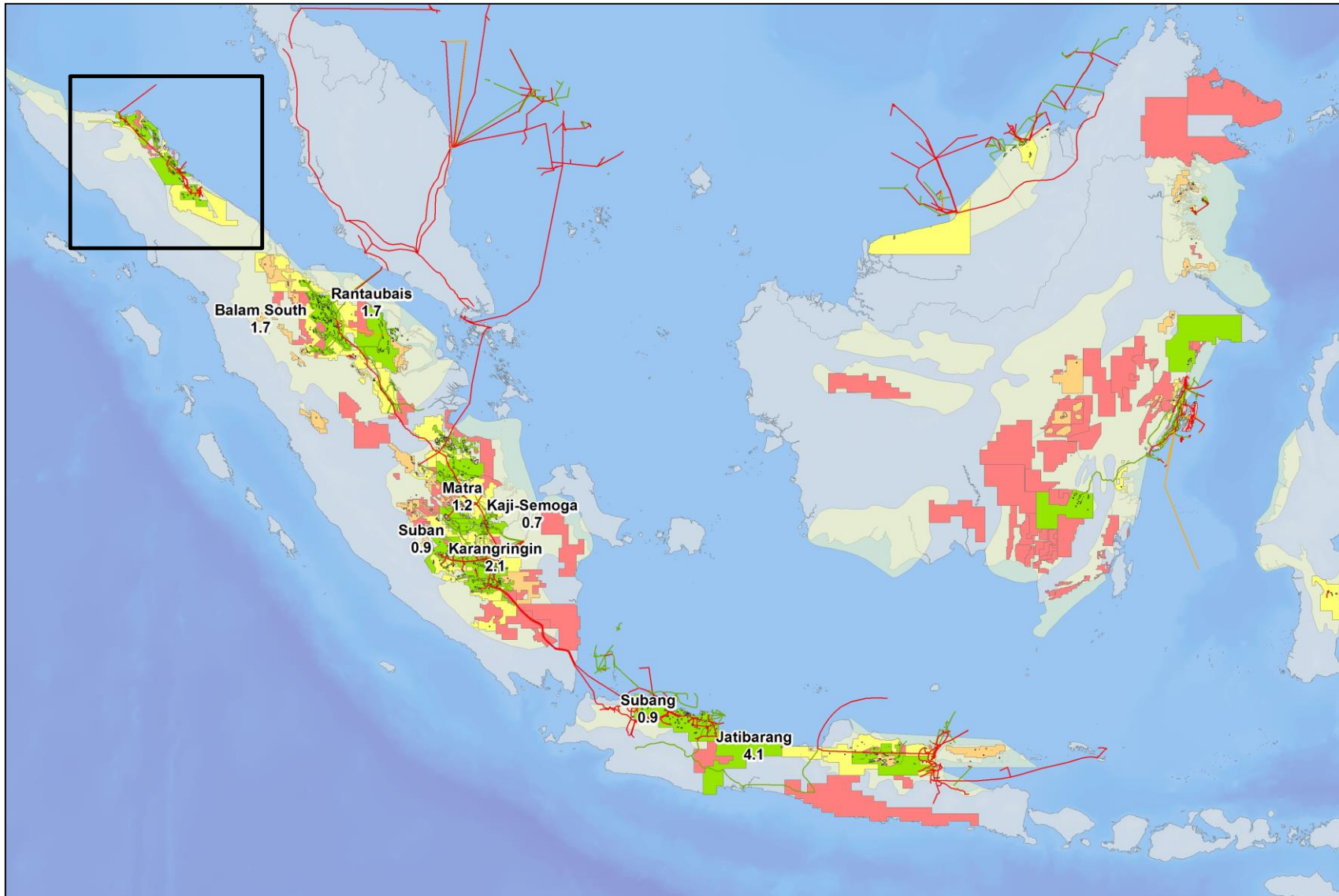


North American Observations





- Proven hydrocarbon systems
- Big Unconventional resources will follow big Conventional resources
- Existing infrastructure
- Supportive industry framework and stakeholders

-  Areas with proven petroleum significant discoveries (>200 MMBOE) and existing infrastructure
-  Areas with proven petroleum systems and existing pipelines
-  Areas with proven petroleum systems
-  Areas with no existing discoveries

Indonesian gas flaring



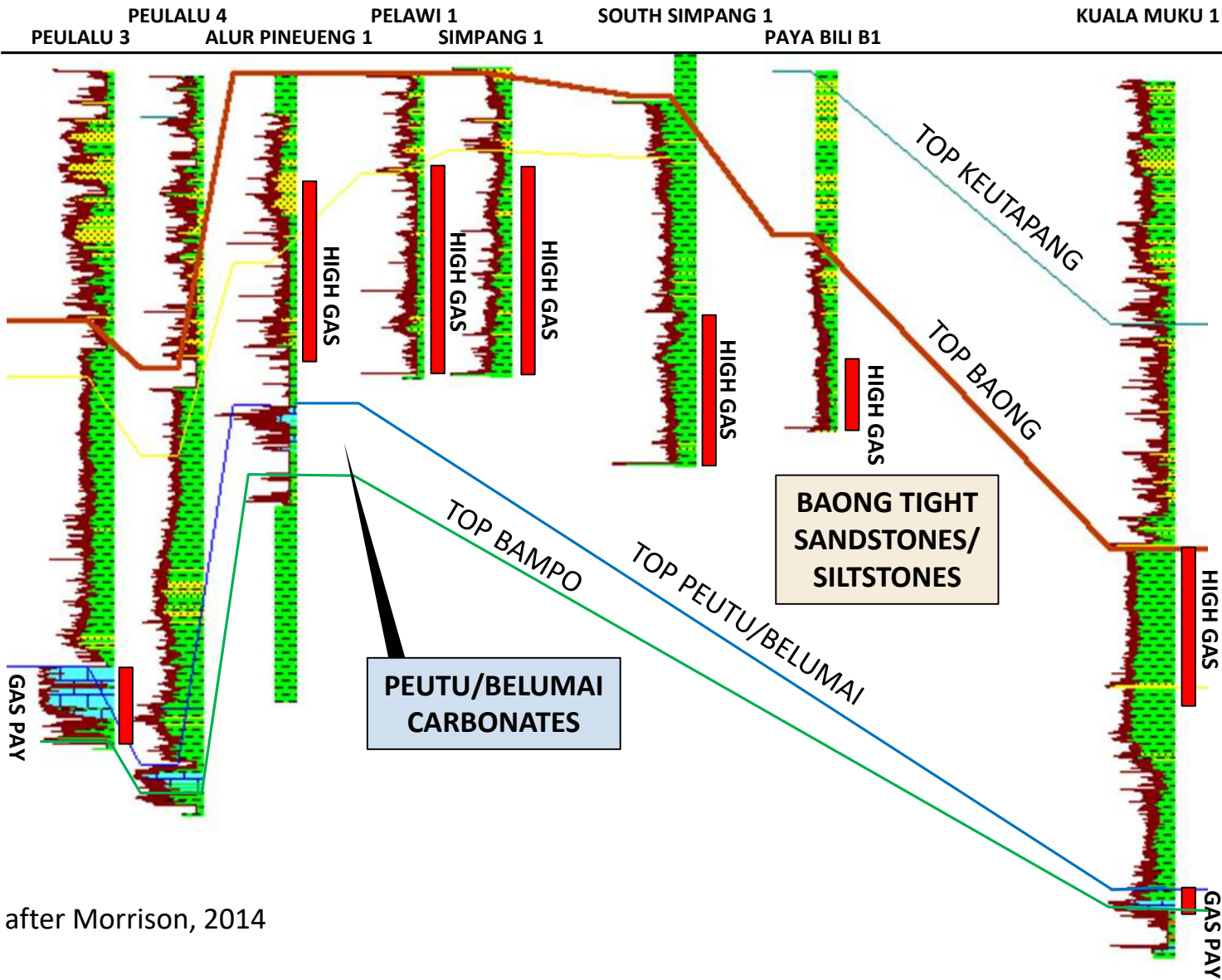
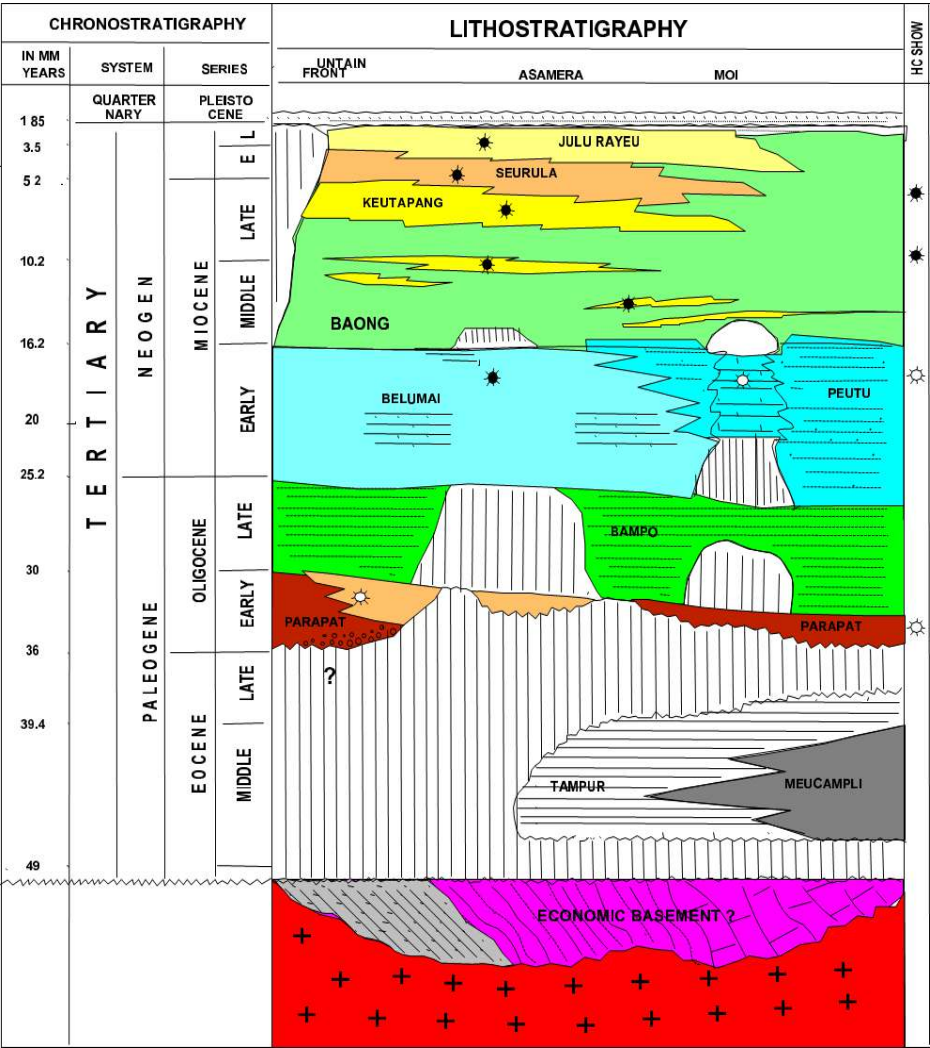
- Unconventional Gas development in areas of ongoing Gas Flaring
- Shorter term opportunity would be in finding a market for flared Gas

-  Areas with proven petroleum significant discoveries (>200 MMBOE) and existing infrastructure
-  Areas with proven petroleum systems and existing pipelines
-  Areas with proven petroleum systems
-  Areas with no existing discoveries

North Sumatra Basin – Potential unconventional resource targets



North Sumatra Basin Stratigraphy



after Morrison, 2014

North Sumatra Basin – Quantifying unconventional resource potential

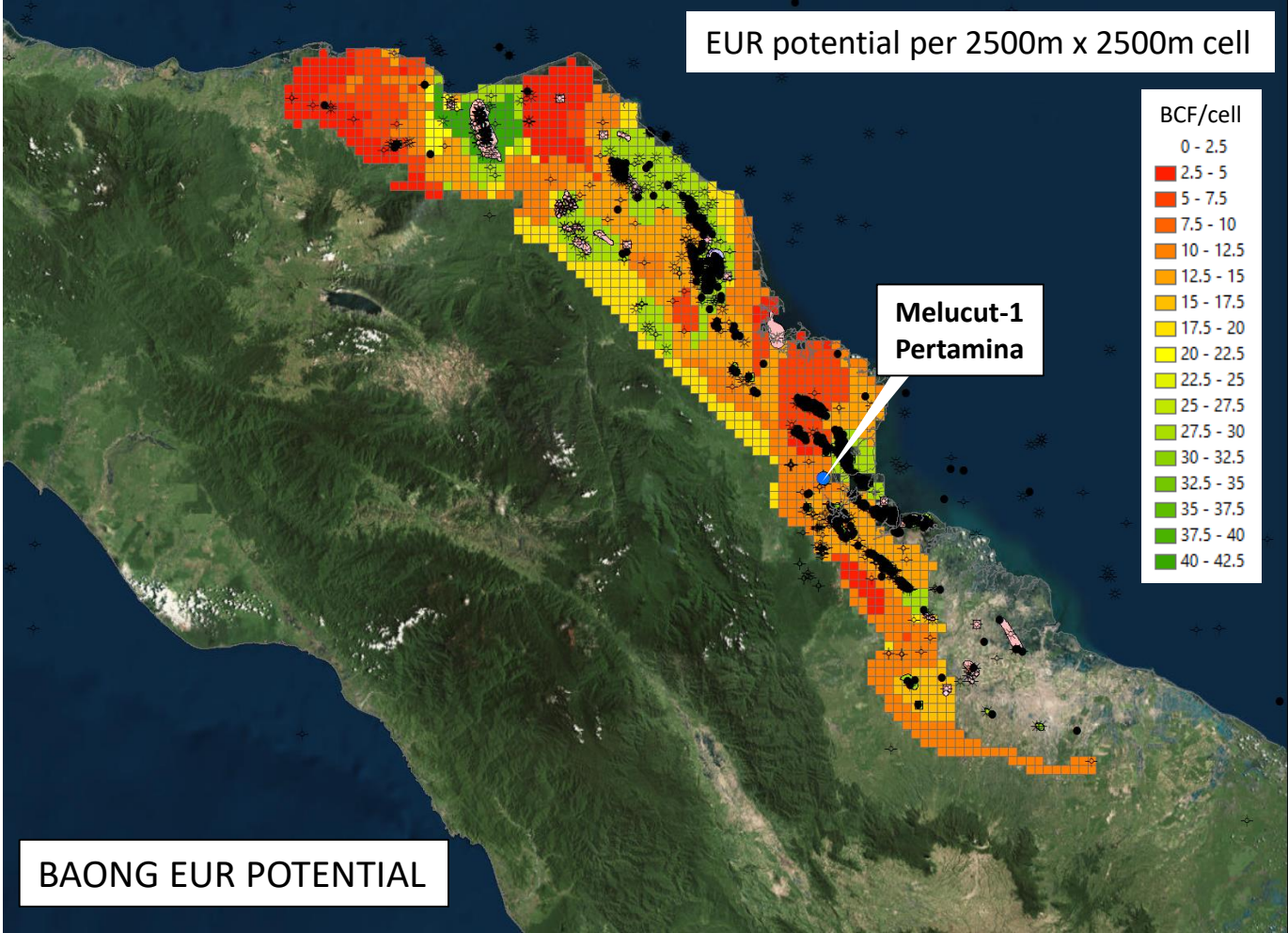


COMMON RECOVERY SEGMENT MAPPING

TYPE CURVE EUR RANGE

Control EUR Development Plan	Low	Mid	High
Wells per zone	4	4	4
Well lateral spacing	400 m	400 m	400 m
Type curve length	2500 m	2500 m	2500 m
Type curve EUR	2.0 BCF	6.5 BCF	13.0 BCF
wells per cell	6.25 wells	6.25 wels	6.25 cells
EUR/drainage cell/zone	12.79 BCF	40.63 BCF	81.06 BCF

**‘STACKING’ OF
PARAMETERS
INFLUENCING
UNCONVENTIONAL
RECOVERY**

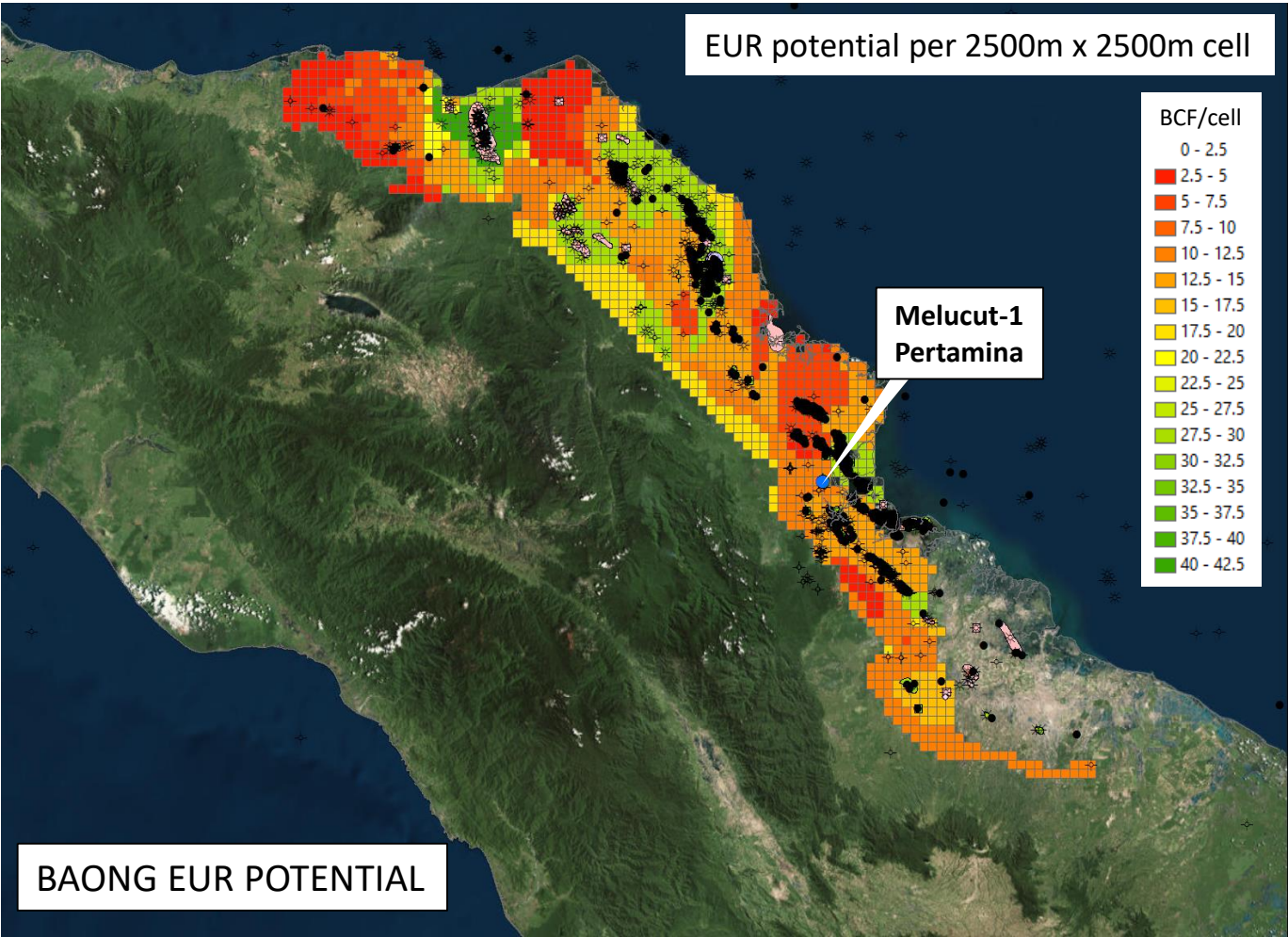
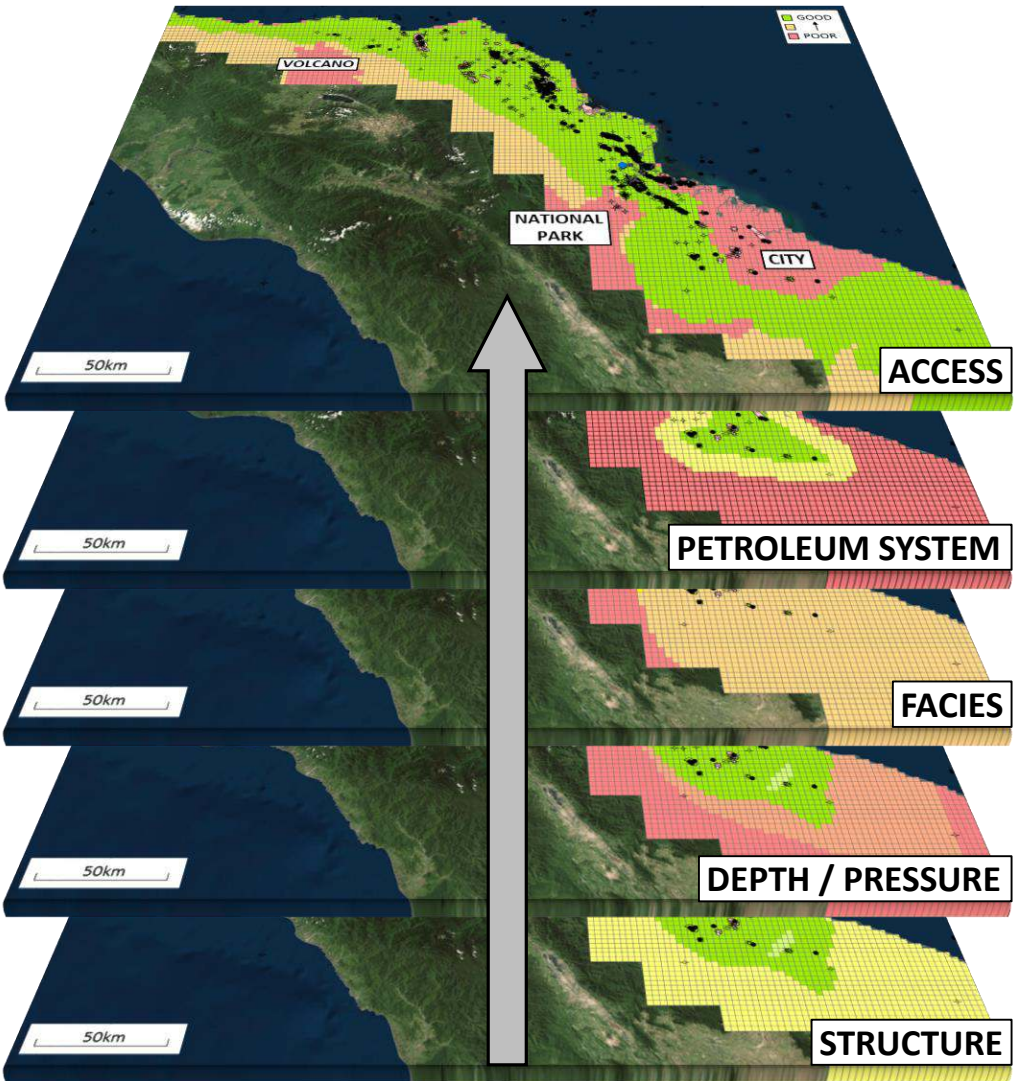


BAONG EUR POTENTIAL

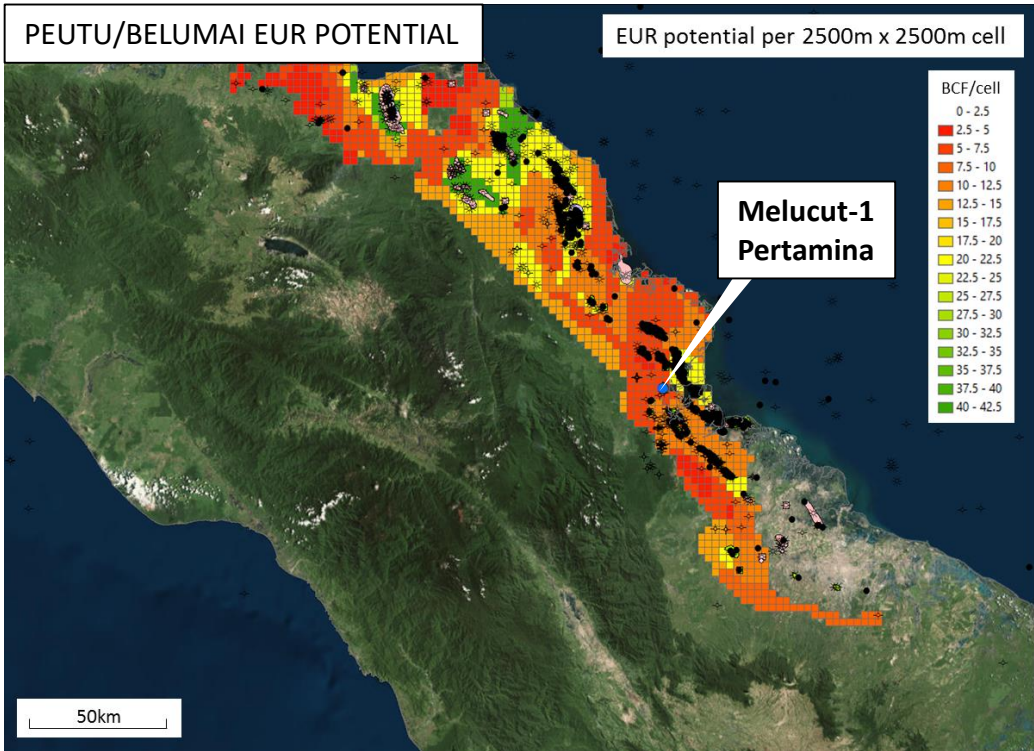
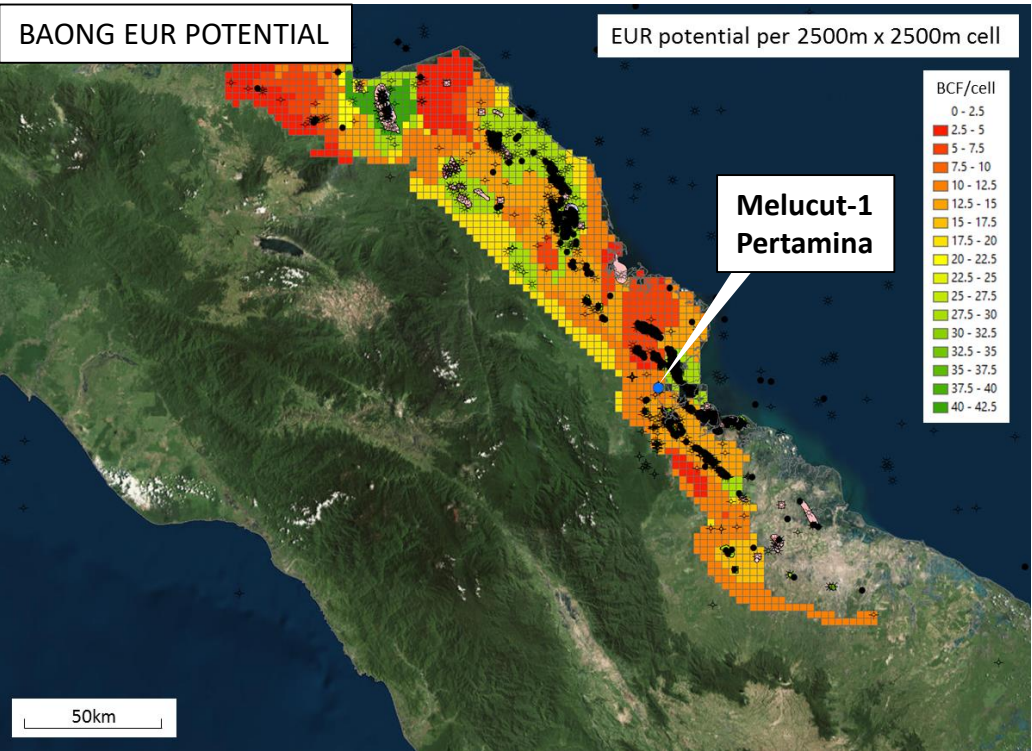
North Sumatra Basin – Quantifying unconventional resource potential



COMMON RECOVERY SEGMENT MAPPING



North Sumatra Basin – Quantifying unconventional resource potential



Assumes –

- 2500m laterals at 400m spacing with a type curve distributions of 2BCF (low) – 6.5 BCF (mid) – 13BCF (high)
- Common Recovery Segment Mapping using multiple regional input factors
- Probabilistic resource estimate of between 1 and 2 working zones in the Peutu/Belumai
- Probabilistic resource estimate of between 1 and 3 working zones in the Baong
- Development efficiency of 40-80%

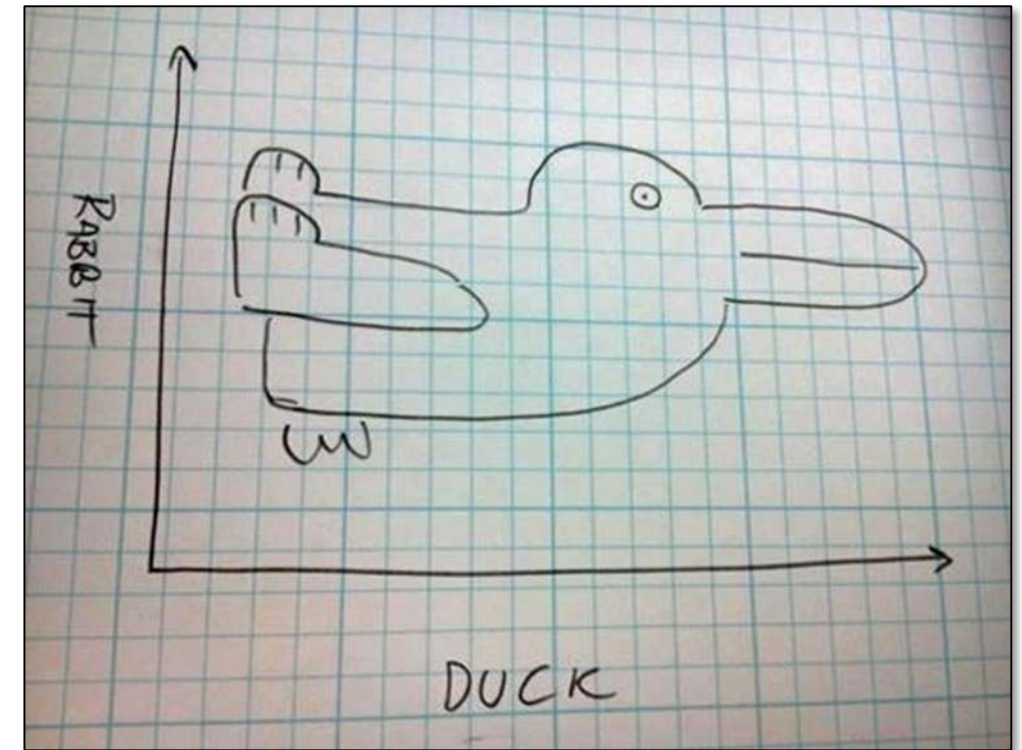
Technically Feasible Estimated Ultimate Recoverable Resource

Zone	P90 (TCF)	P50 (TCF)	P10 (TCF)
Peutu/Belumai	5.2	10.1	17.9
Baong	8.1	18.0	30.4

Some closing thoughts

- BIG unconventional hydrocarbon plays will **follow** BIG conventional hydrocarbon plays. North American unconventional systems are typically extensions of conventional petroleum systems
- **Low-cost business environments** for conventional plays will be the lower-cost areas for unconventional plays. Unconventional plays are about cost efficiencies
- **Heterogeneity** in unconventional opportunities can be seen at a global scale through to a play scale. Heterogeneity sets up opportunities. There are winners and losers
- Indonesia has good geological potential but infrastructure and cost challenges
- Australia has challenging geology, limited infrastructure, cost and above-ground stakeholder challenges
- China has good geology, a hungry market, industry support, but access to opportunities are limited

Opportunities are created by those who see things differently





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