



IN-VR



Vaca Muerta: Leading the way for Unconventional Development in Latin America

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Global E&P Summit
June 2, 2020

Unconventional Potential Latin America

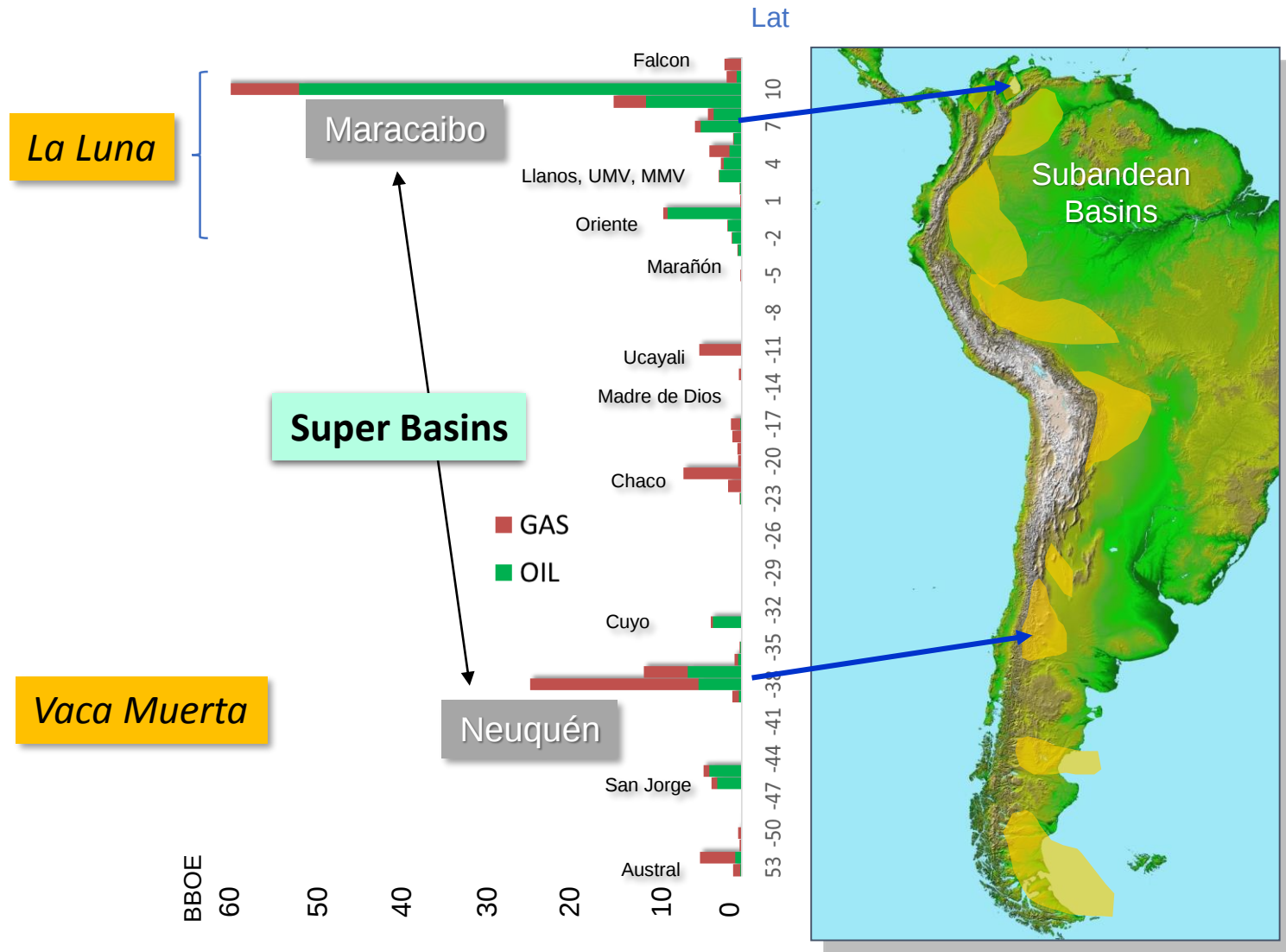


Resources

Basin	OIL	GAS
	Bbbls	TCF
Burgos, Sabina, Tampico Mizantla	12	542
Middle Magdalena	5	18
Neuquen	20	583
Total	37	1143

Data from Energy Information Administration, 2013

Latitudinal Distribution of HC per degree of latitude



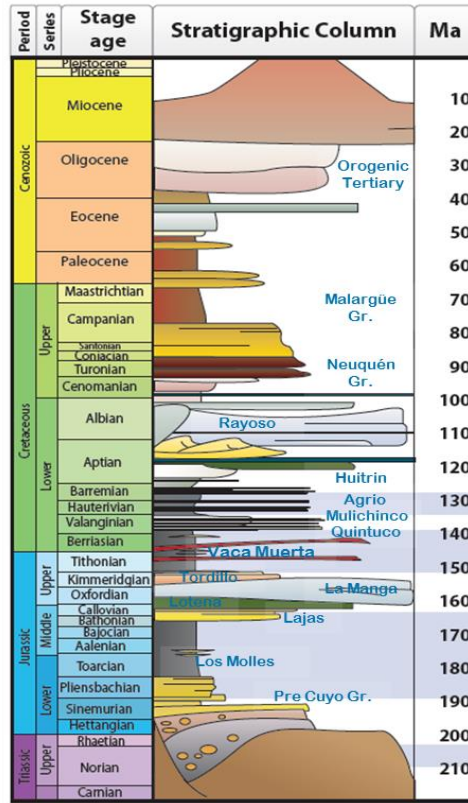
A photograph of a geological outcrop showing distinct sedimentary layers. A hammer is placed on the lower part of the outcrop for scale. The upper part of the outcrop consists of light-colored, blocky rock layers, while the lower part is darker and more fragmented. The text "Vaca Muerta" is overlaid in yellow.

Vaca Muerta

Evolution of Vaca Muerta



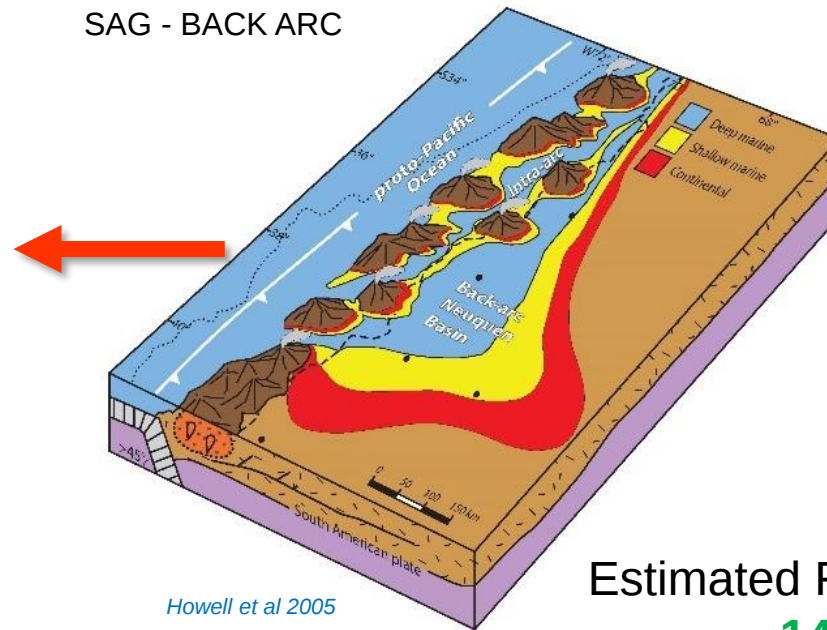
Quintuco-Vaca Muerta Depositional System



Stinco & Mosquera 2002

- Mixed clastic-carbonate succession deposited in a shallow to deep marine setting during the Tithonian-Berriasian time.
- Thickness reaches up to ~1000 m.

SAG - BACK ARC



Howell et al 2005

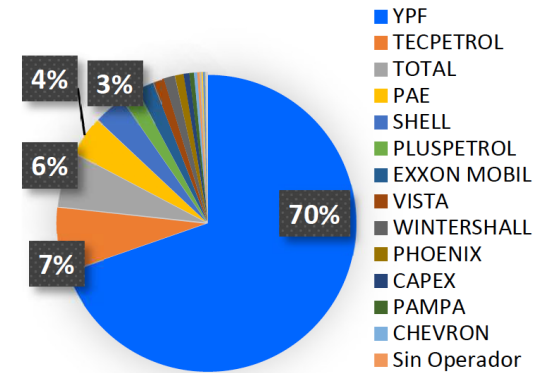
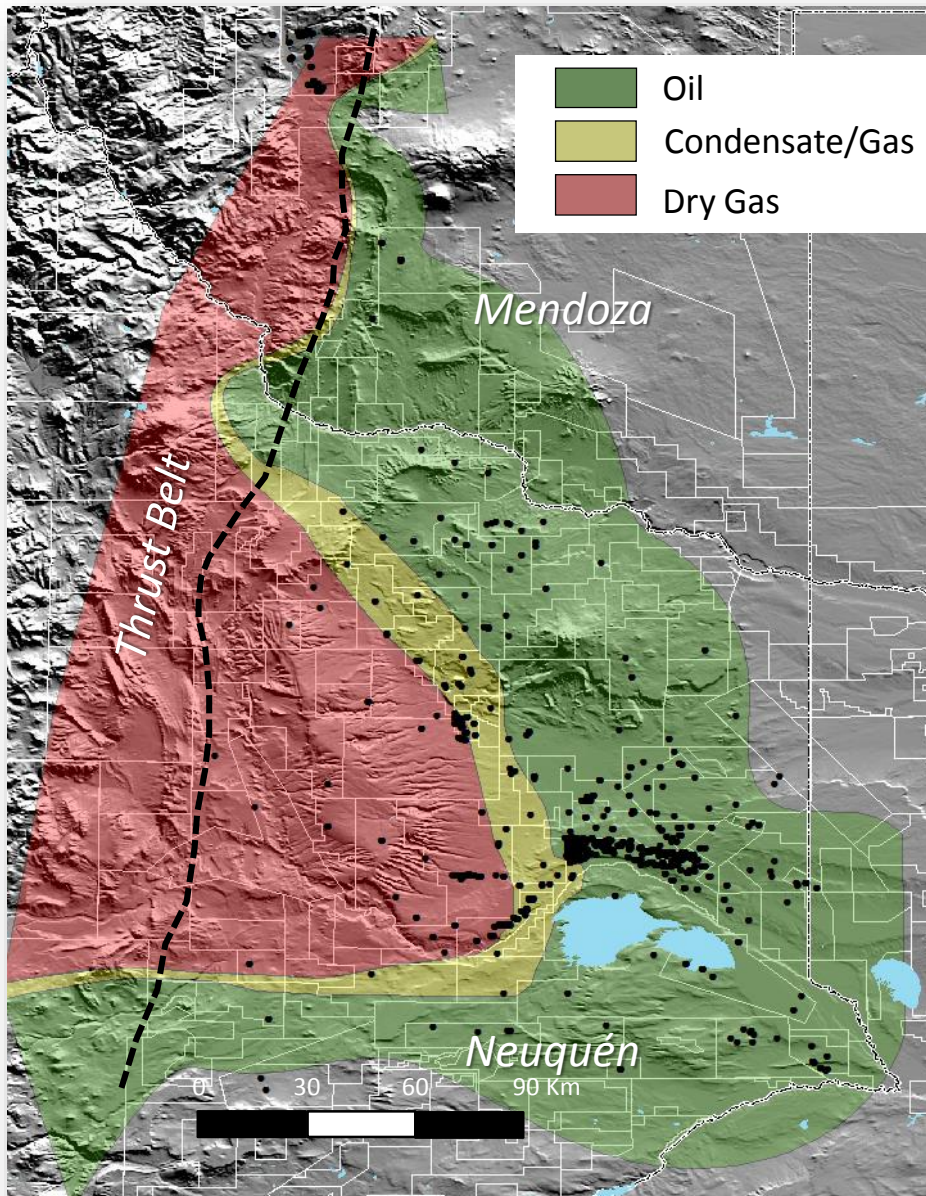


Estimated Resources Vaca Muerta

14.3 Bbo

91.5 TCF

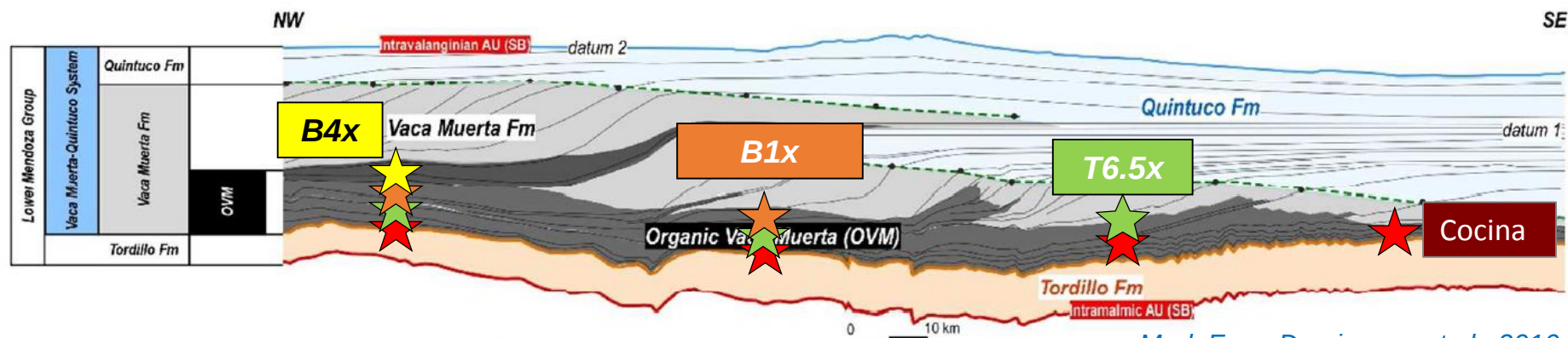
Vaca Muerta Maturity Windows and Wells



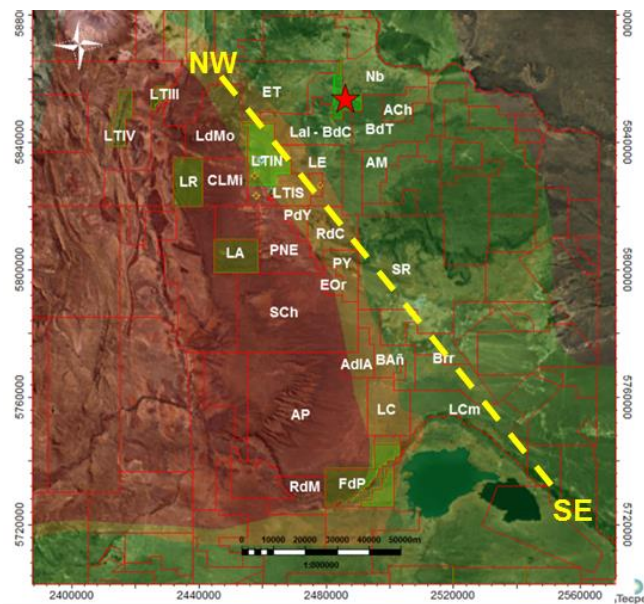
Operator	# Wells
YPF	814
TECPETROL	83
TOTAL	70
PAE	50
SHELL	39
PLUSPETROL	22
EXXON MOBIL	22
VISTA	14
WINTERSHALL	14
PHOENIX	11
CAPEX	7
PAMPA	6
CHEVRON	4
Otros	13
Total general	1169

Over 1160 wells drilled to date

Vaca Muerta – Quintuco System – Landing Zones



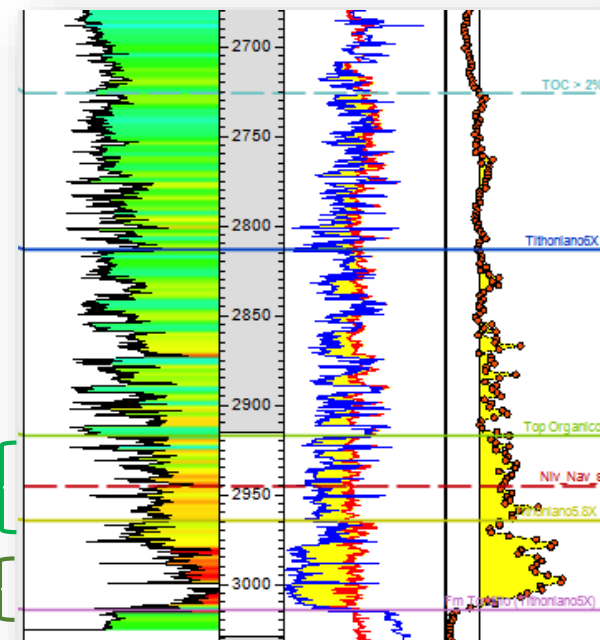
Mod. From Dominguez et al., 2016



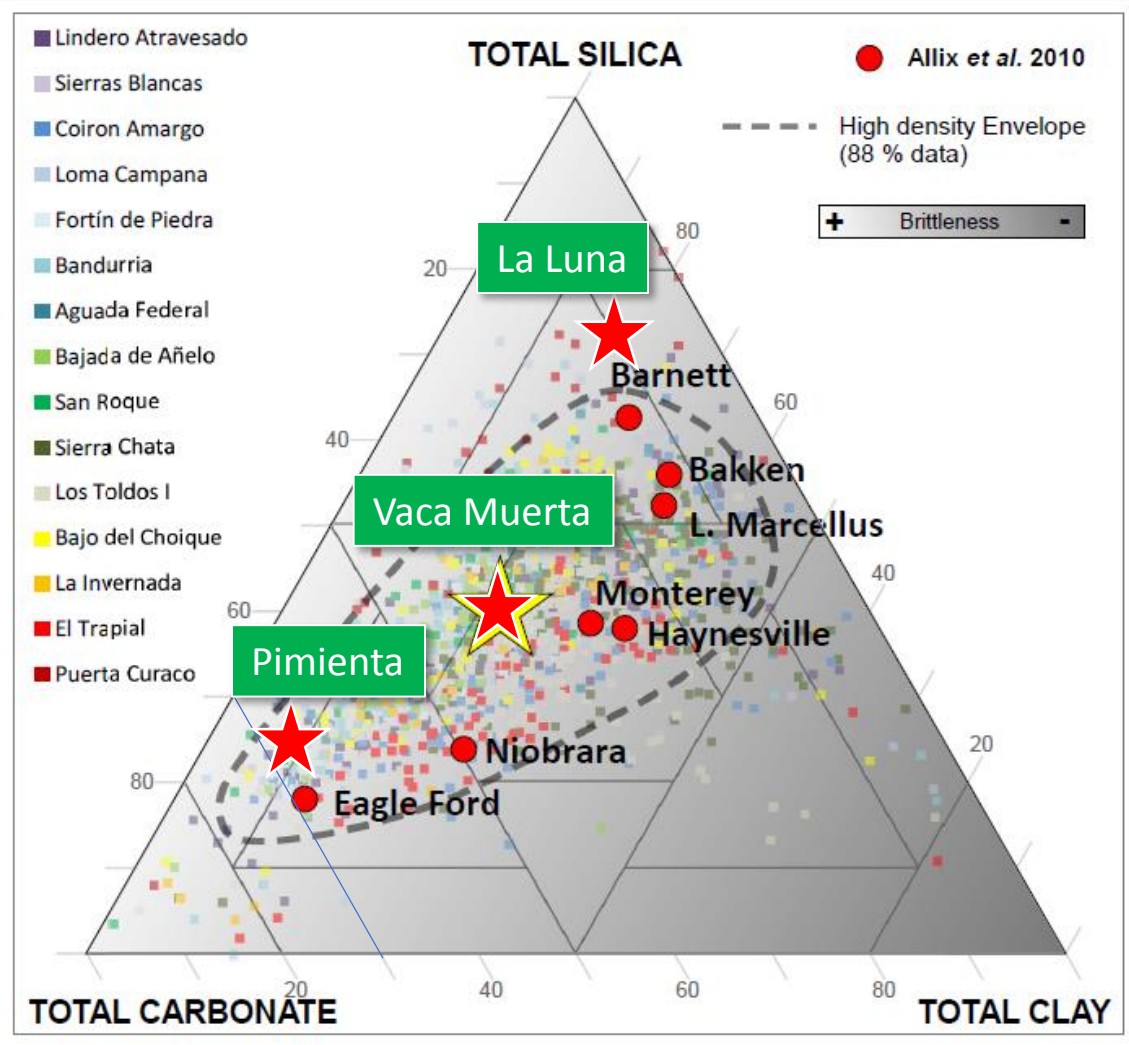
Main Landing Zones

- ★ B4x
- ★ B1x
- ★ Orgánico (T6.5x)
- ★ Cocina

Orgánico
Cocina



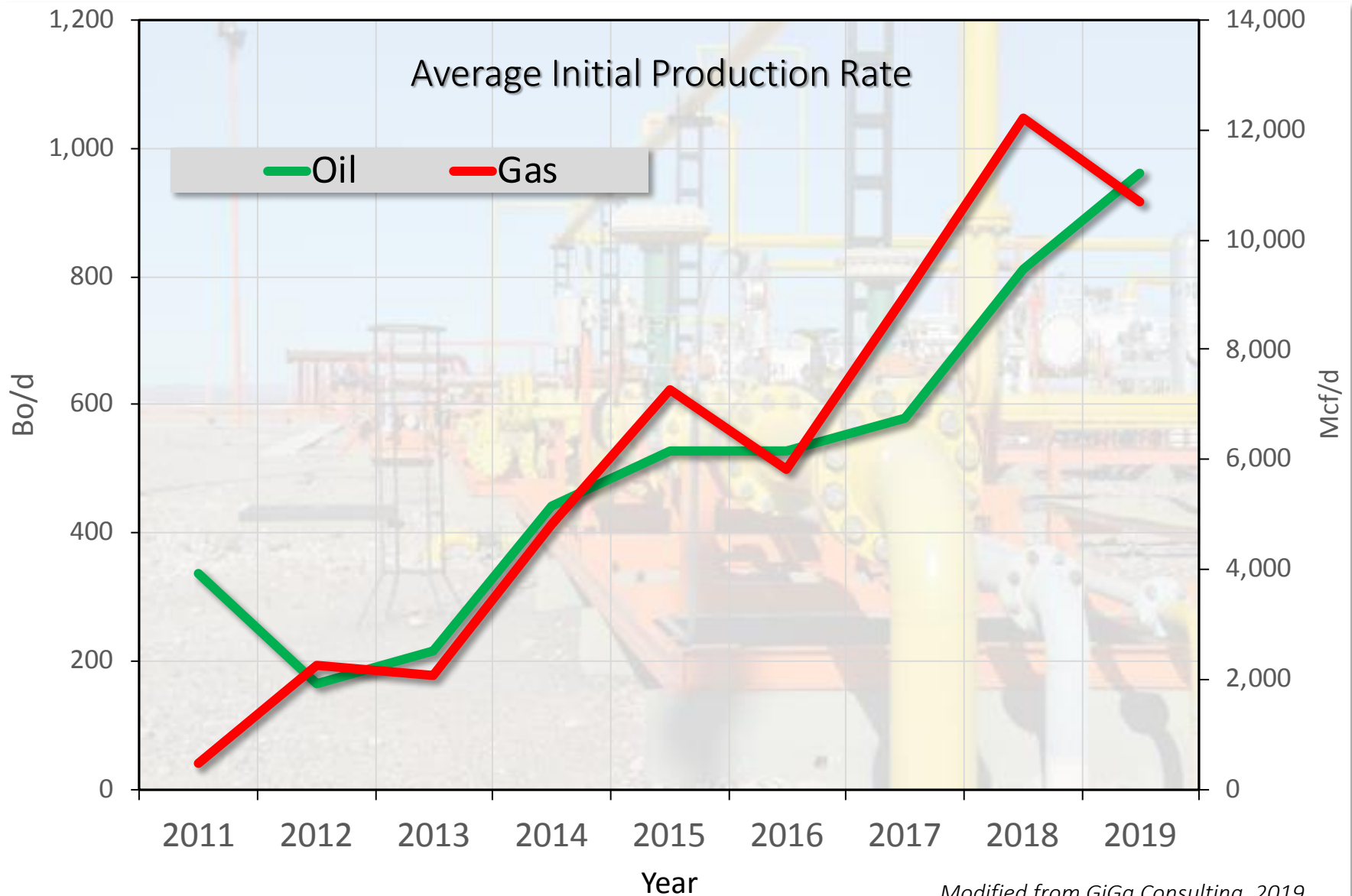
Source Rock Composition



Evolution of Performance Vaca Muerta Wells

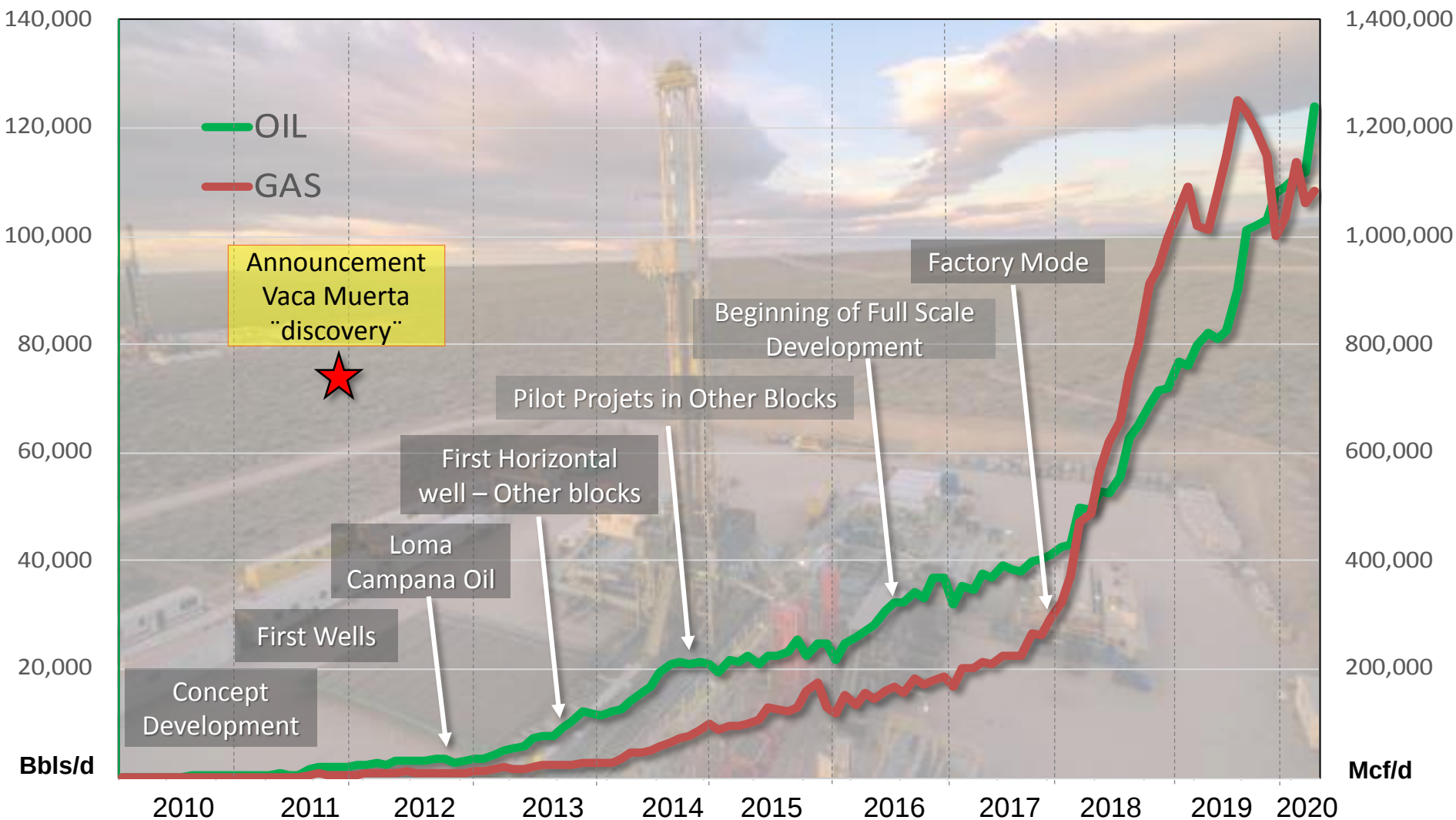


Average Initial Production Rate



Modified from GiGa Consulting, 2019

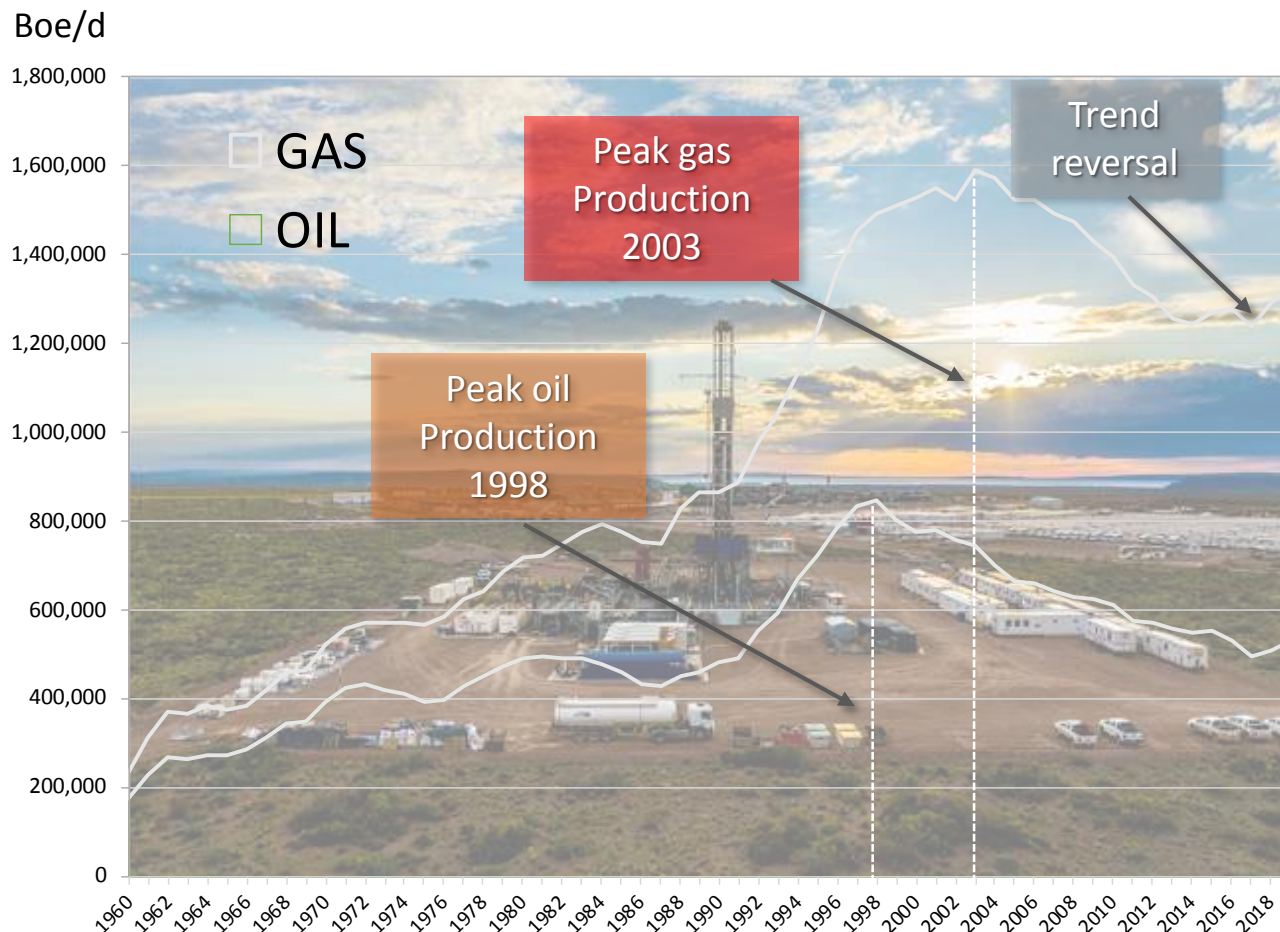
Vaca Muerta Production and Landmarks



Present day production = 124,000 bopd; 1.1 Bcf/d



Historic Production - Argentina



Total gas production of the country increased 5.8% in one year.

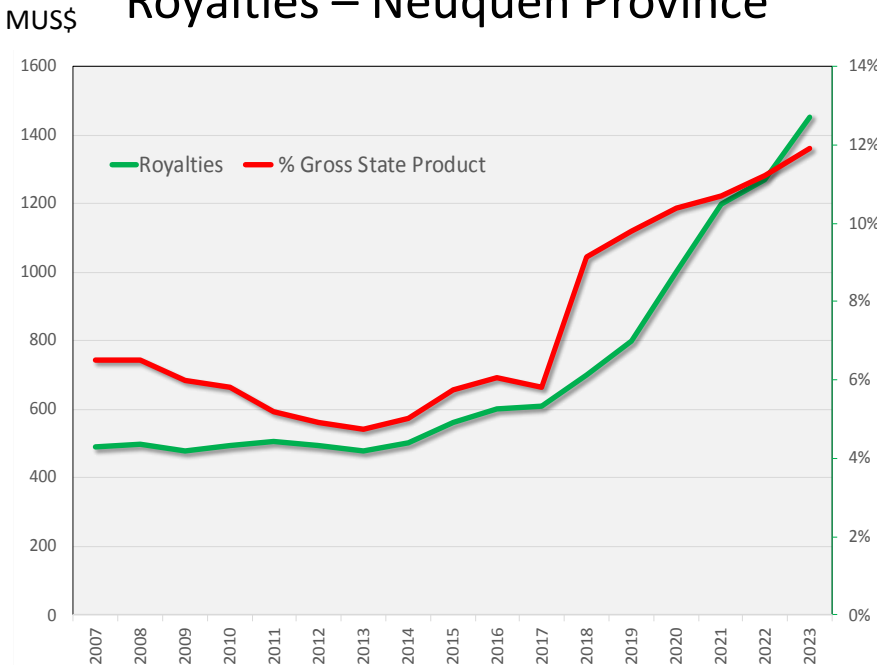
Energy deficit lowered from 2.3 Billion US\$ in 2018 to near 0 in 2019



Economic Impact of Vaca Muerta

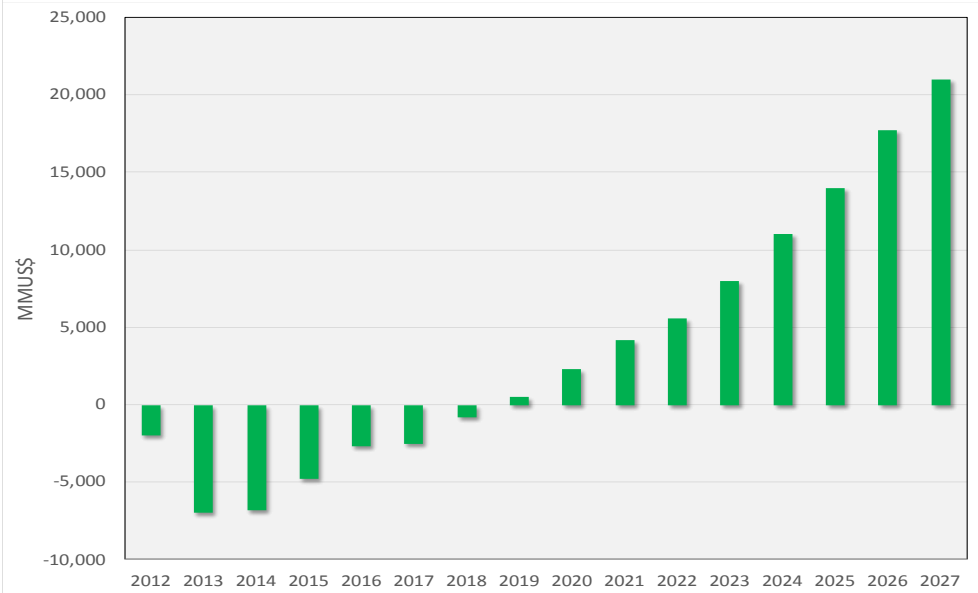


Royalties – Neuquén Province



Regional impact

Trade Balance – Argentina



National impact

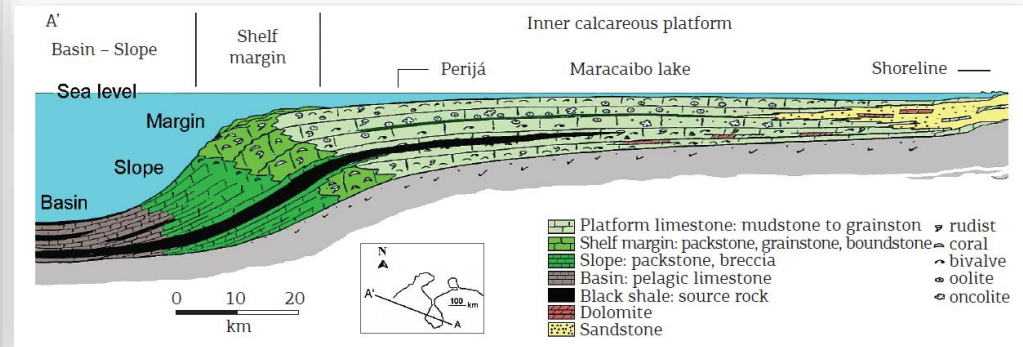
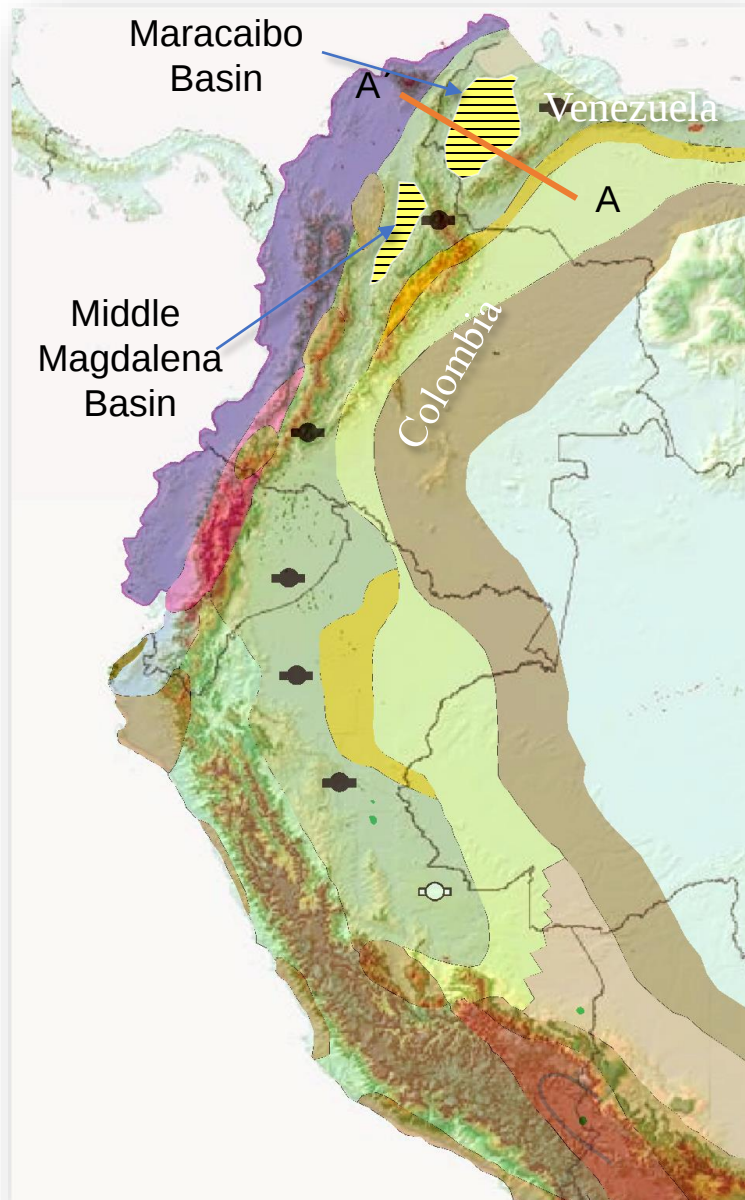
The change in the trade balance is due mainly to the gas development of Vaca Muerta

(modified from Arriazu, 2019)

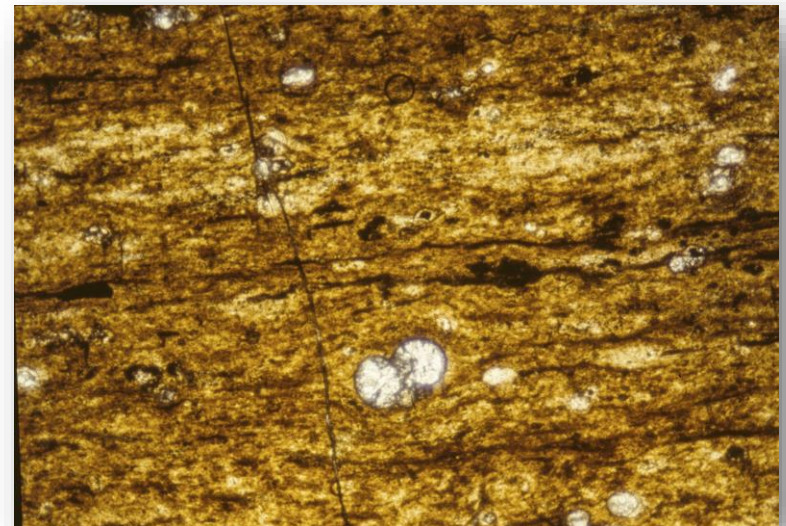
Neuquén Basin Landscape



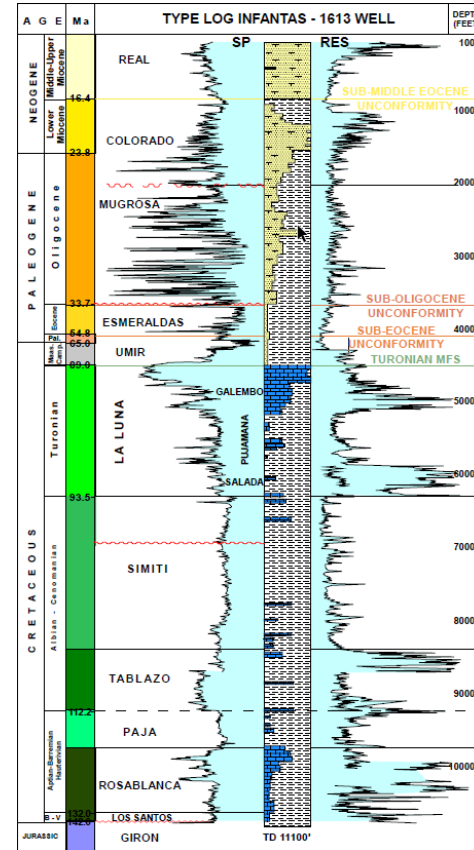
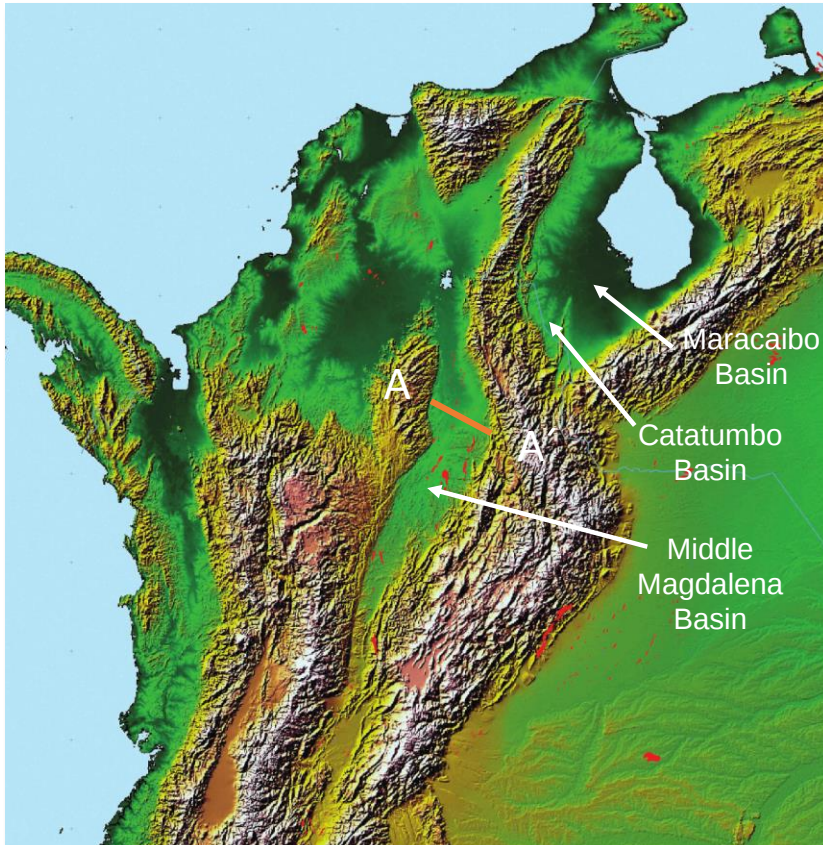
Paleogeography La Luna Sea – Upper Cretaceous



TOC: 0,3 – 12,25%



Unconventionals Northern South America

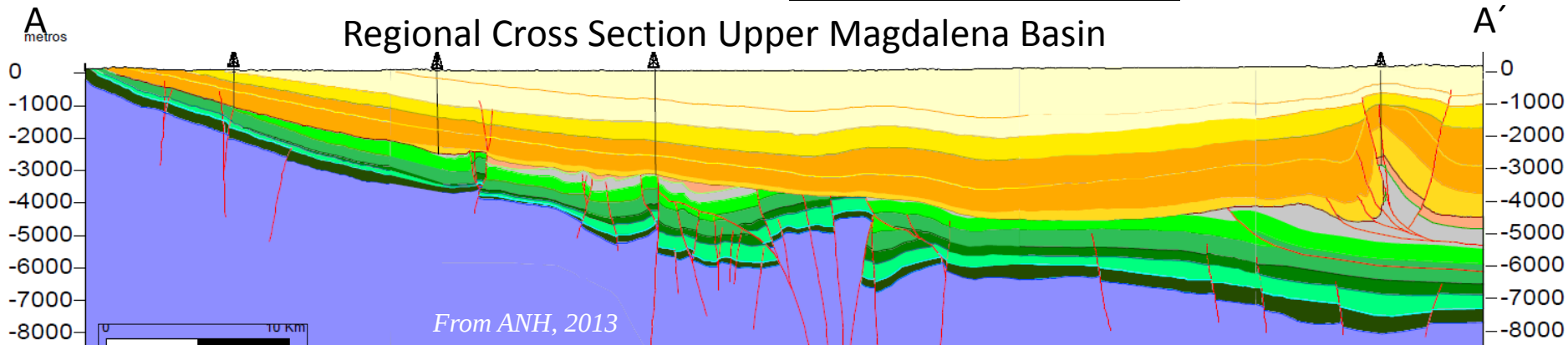


La Luna

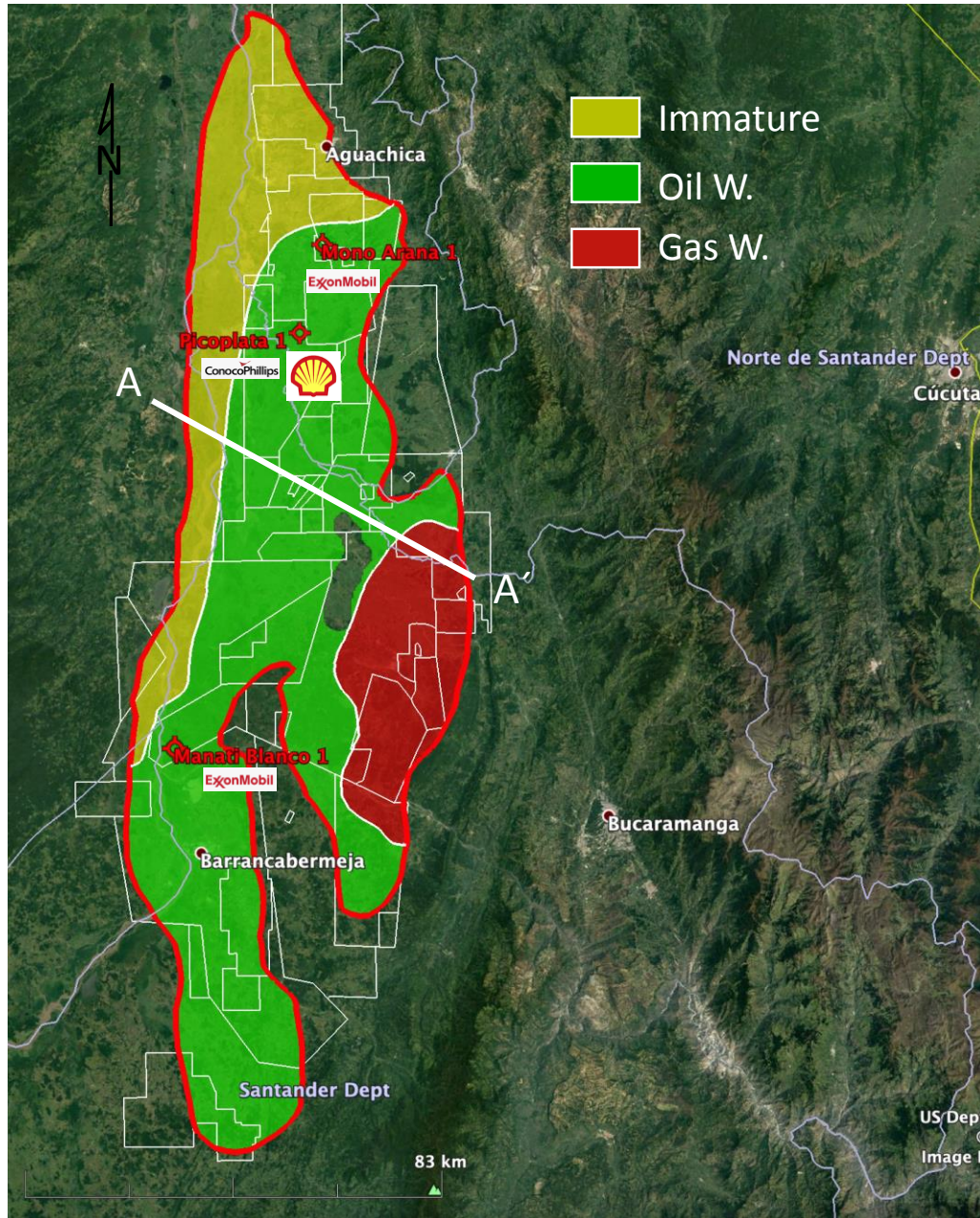
TOC: 0,3 – 12,25%

Ro: 0,3 – 4,92%

Regional Cross Section Upper Magdalena Basin



Maturity and Resources La Luna



Area Oil: 5070 Km²

Area Gas: 1080 Km²

Resources

EIA, 2015:

Oil = 4.76 Bbls

Gas = 18.30 Tcf

Mora et al, 2018:

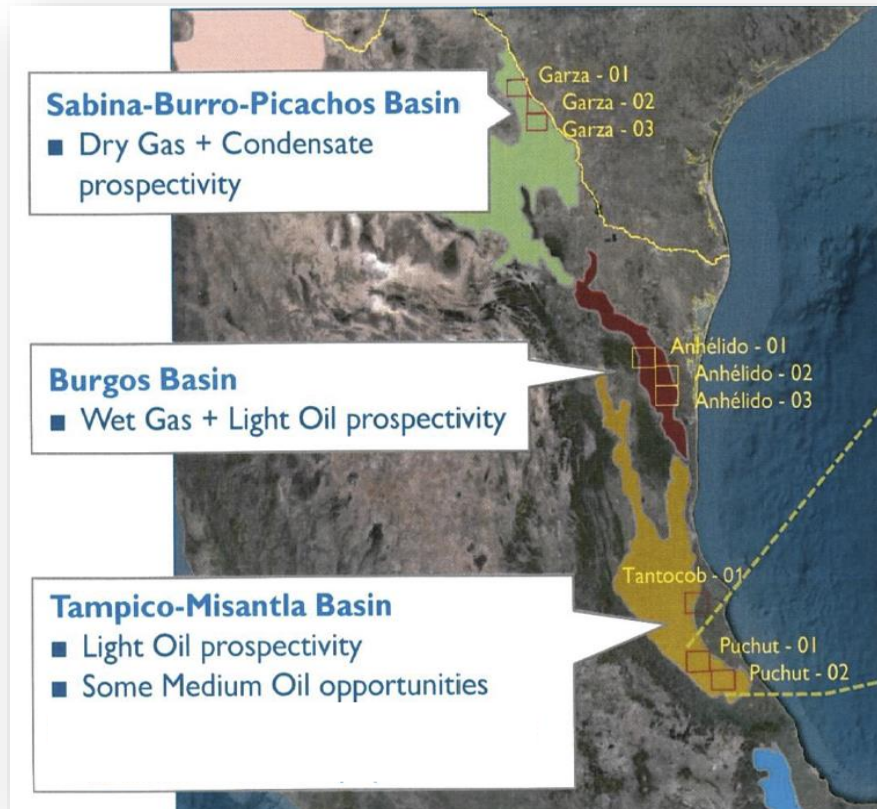
Oil = 8.29 Bbls

Gas = 24.83 Tcf

Upper Magdalena Valley Landscape

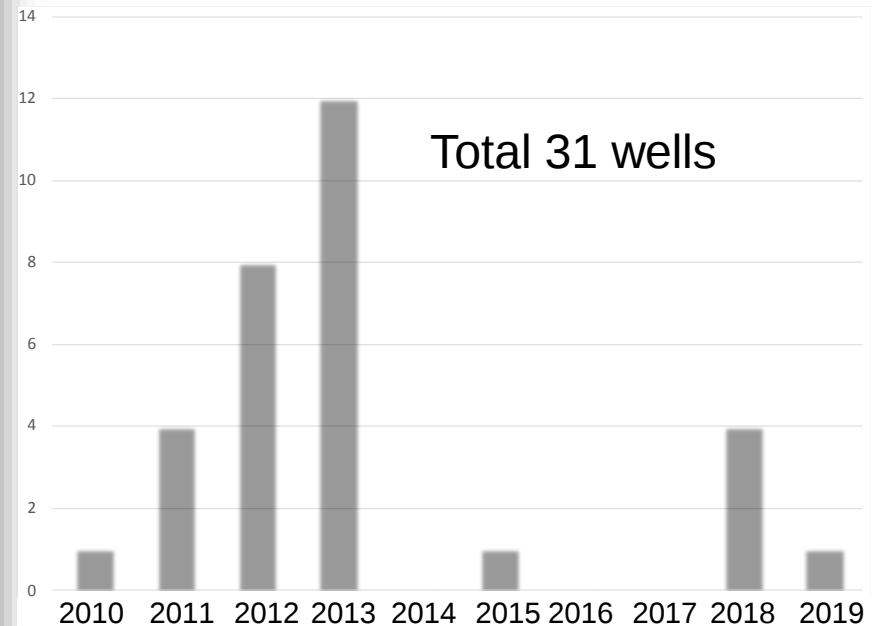


Mexico – Unconventional Basis and Activity



Modified from Arthur D. Little, 2017

Unconventional Exploratory Wells



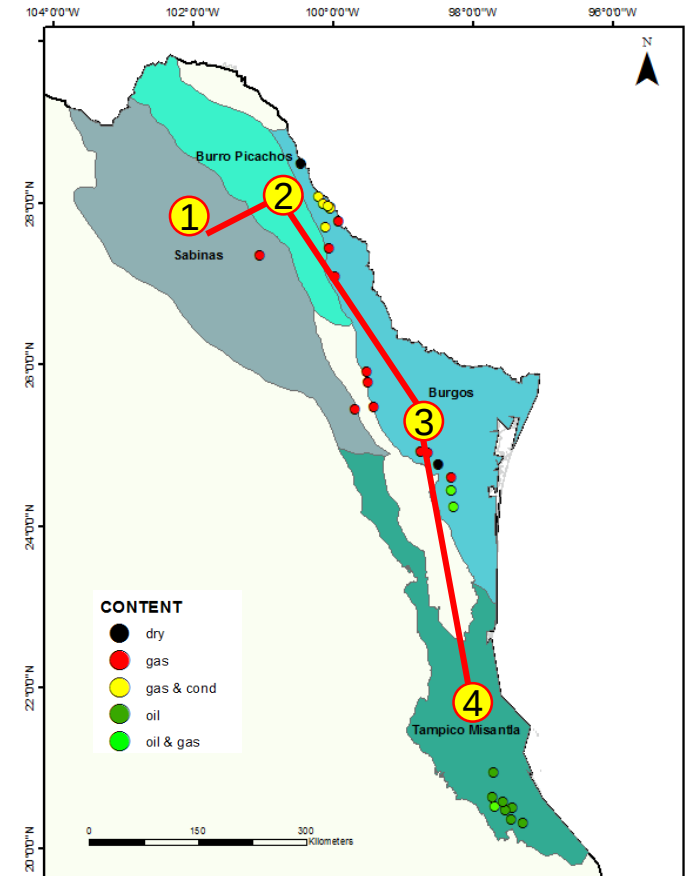
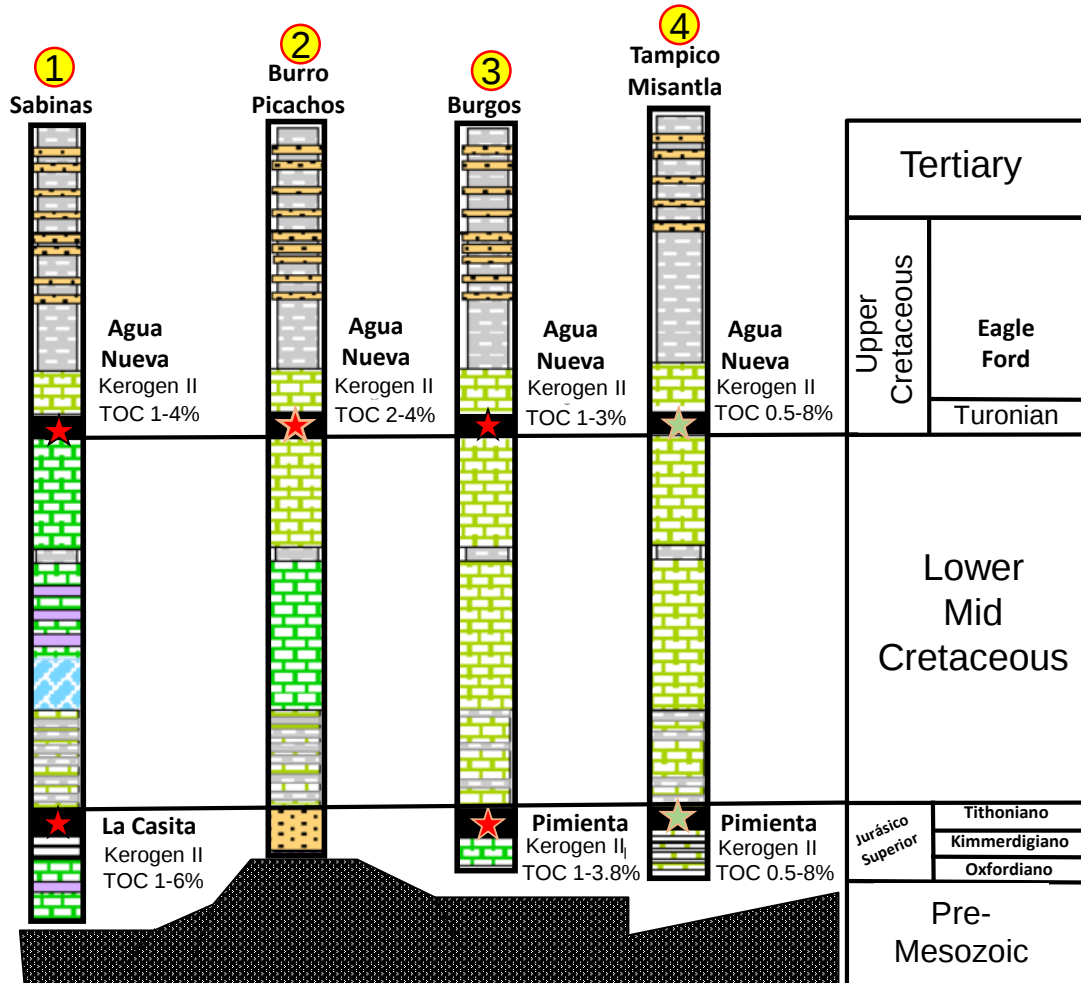
Prospective Resources

35.9 Bbo

141.5 TCF

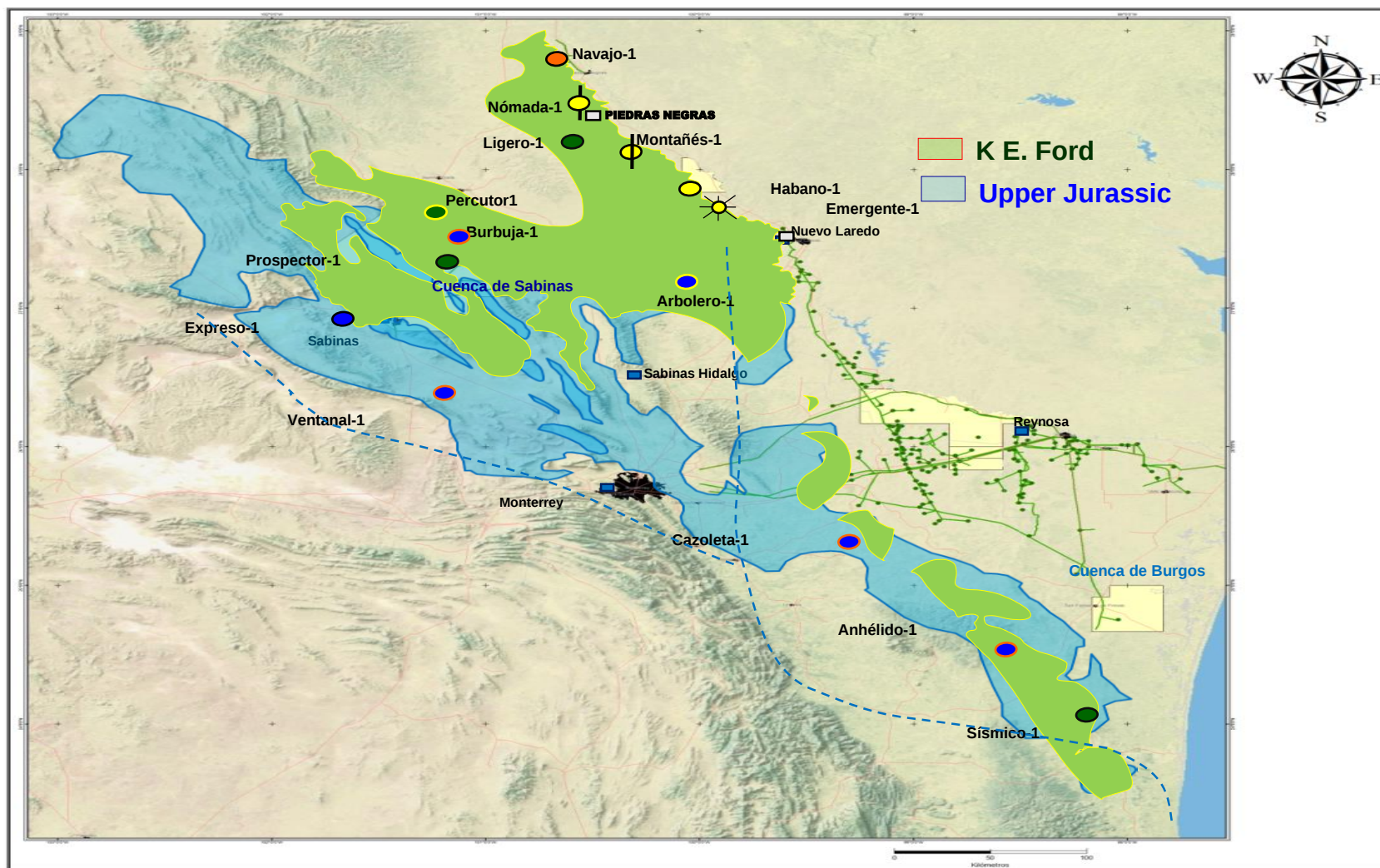
CNH, 2019

Mexico – Main Unconventional Basins

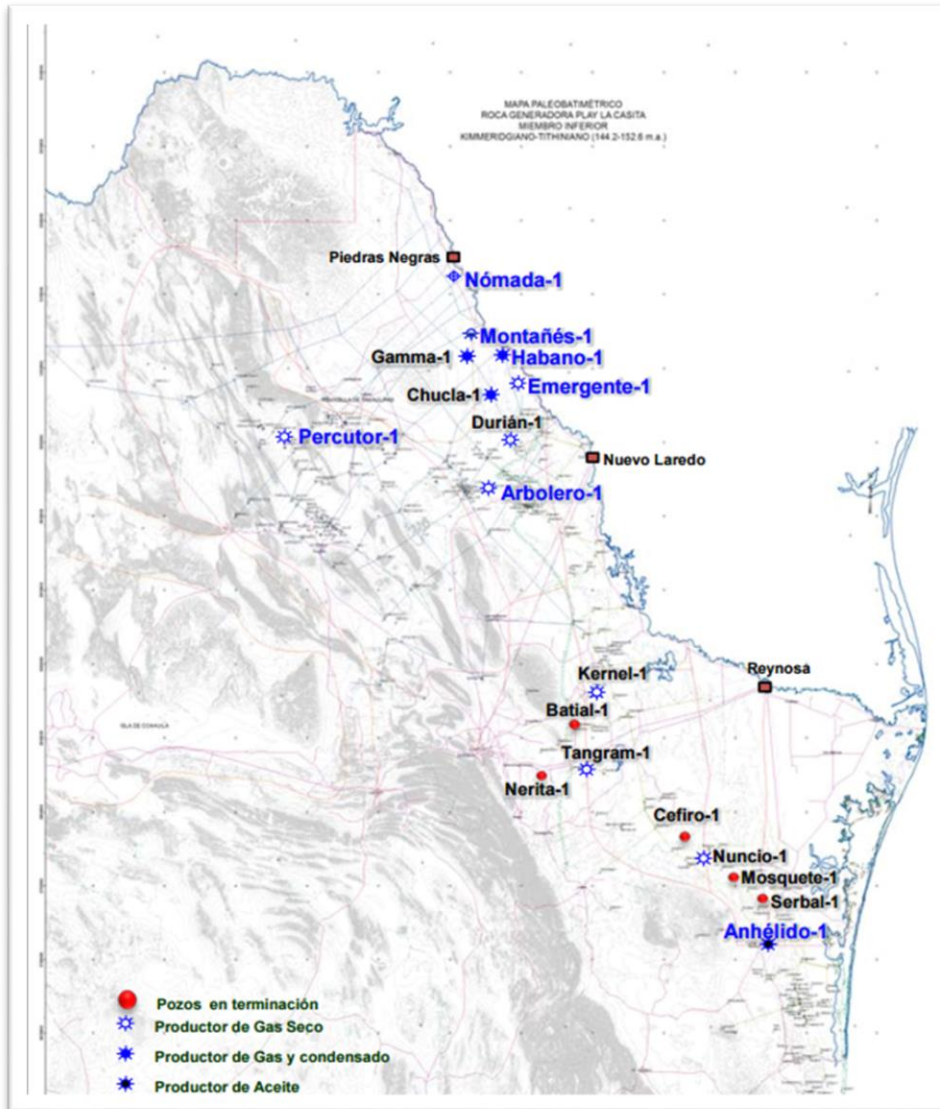




Sabinas – Burgos Basins – Unconventional Formations



Mexico – Burgos Basin Unconventional Wells

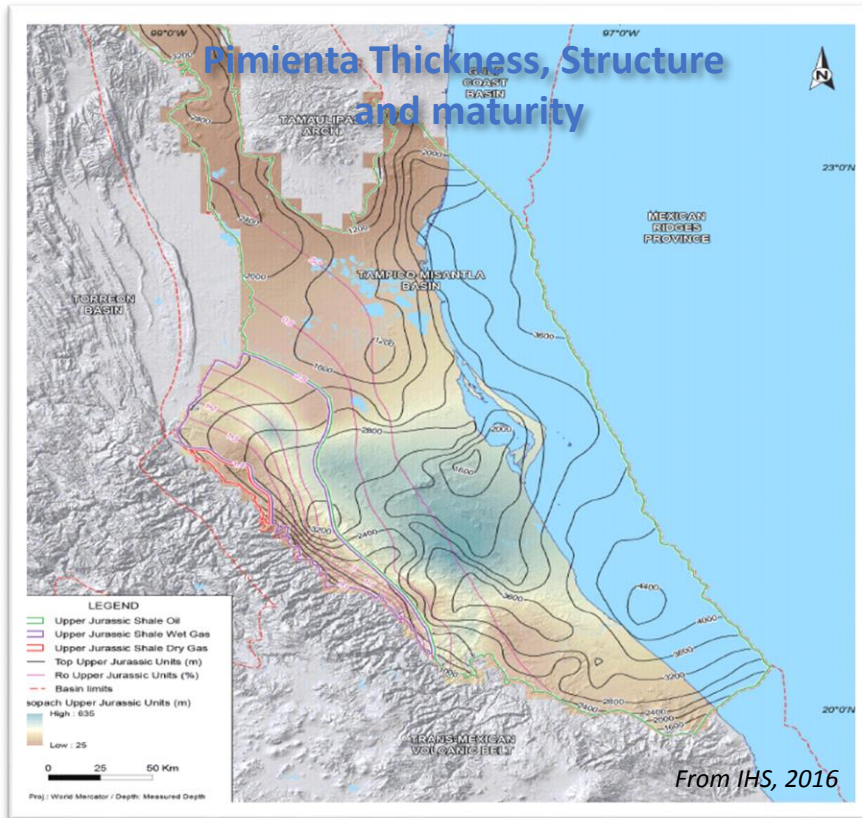


Exploration wells

Year	N.	Name	Measured Depth (m)	Initial Production	
				MMpcd	Bpd
2010	1	Emergente 1	4071	2.9	
2011	2	Nómada 1	2850	traces	
	3	Montañés 1	3200	0.18	20
2012	4	Percutor 1	3436	2.36	
	5	Habano 1	3770	2.8	123
	6	Arbolero 1	4007	4.15	
	7	Anhélido	3550	1.12	192
2013	8	Chucula 1	4100	1.9	24
	9	Durián 1	4200	4.17	
	10	Nuncio 1	4900	3.3	
	11	Gamma 1	3793	1.46	12
	12	Kernel 1	4404	2.3	
	13	Tangram 1	4426	10.9	
	14	Serbal 1	4800	3	
	15	Batial 1	4196	0.5	
	16	Céfiro	4700	12	
	17	Mosquete 1	4181		
	18	Nerita 1	3810	0.4	
	19	Semilla 1		6.8	900

Pimienta Fm (Jurassic)
 Eagle Ford Fm (Cretaceous)

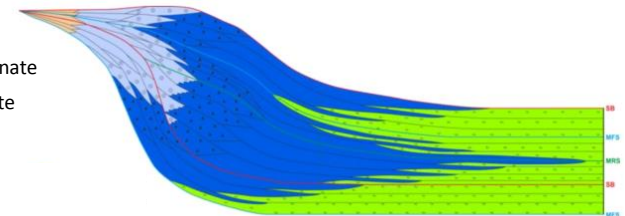
Tampico Mizantla Basin – Pimienta Fm.



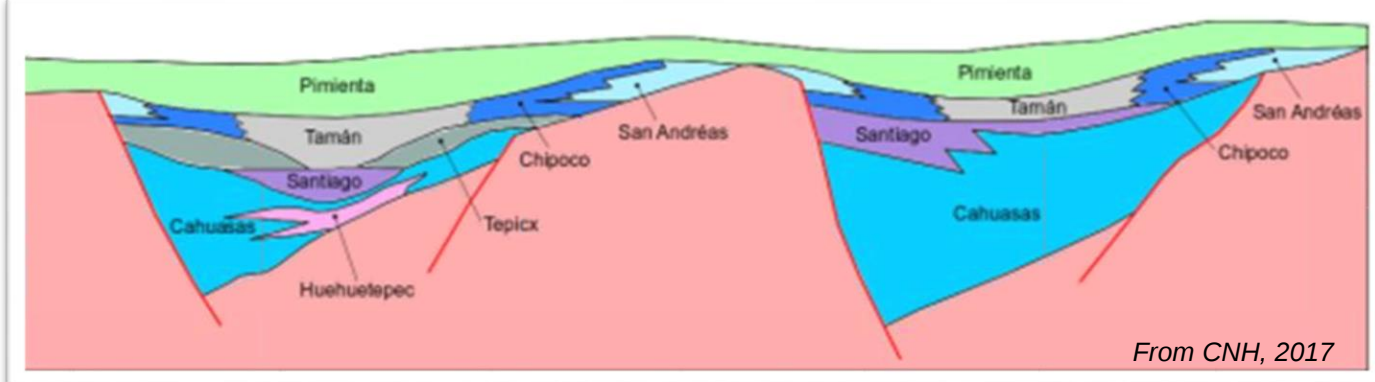
- Marine Type II kerogen with TOC ranging from 1 – 5%
- Oil Mature in most of the basin
- Depth ranges from 1600 to 3600 m
- Existing Paleohighs controlled deposition
- Play is unrisks

Depositional Model Pimienta

- Organic rich facies
- Shallow-water carbonate
- Deep-water carbonate
- Shallow-water shale



Neftex, 2018



Environmental Concerns



WATER USE



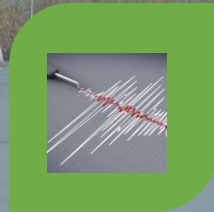
AQUIFER
CONTAMINATION



CHEMICAL
PRODUCTS



DISPOSITION
OF FLOW-BACK
WATER

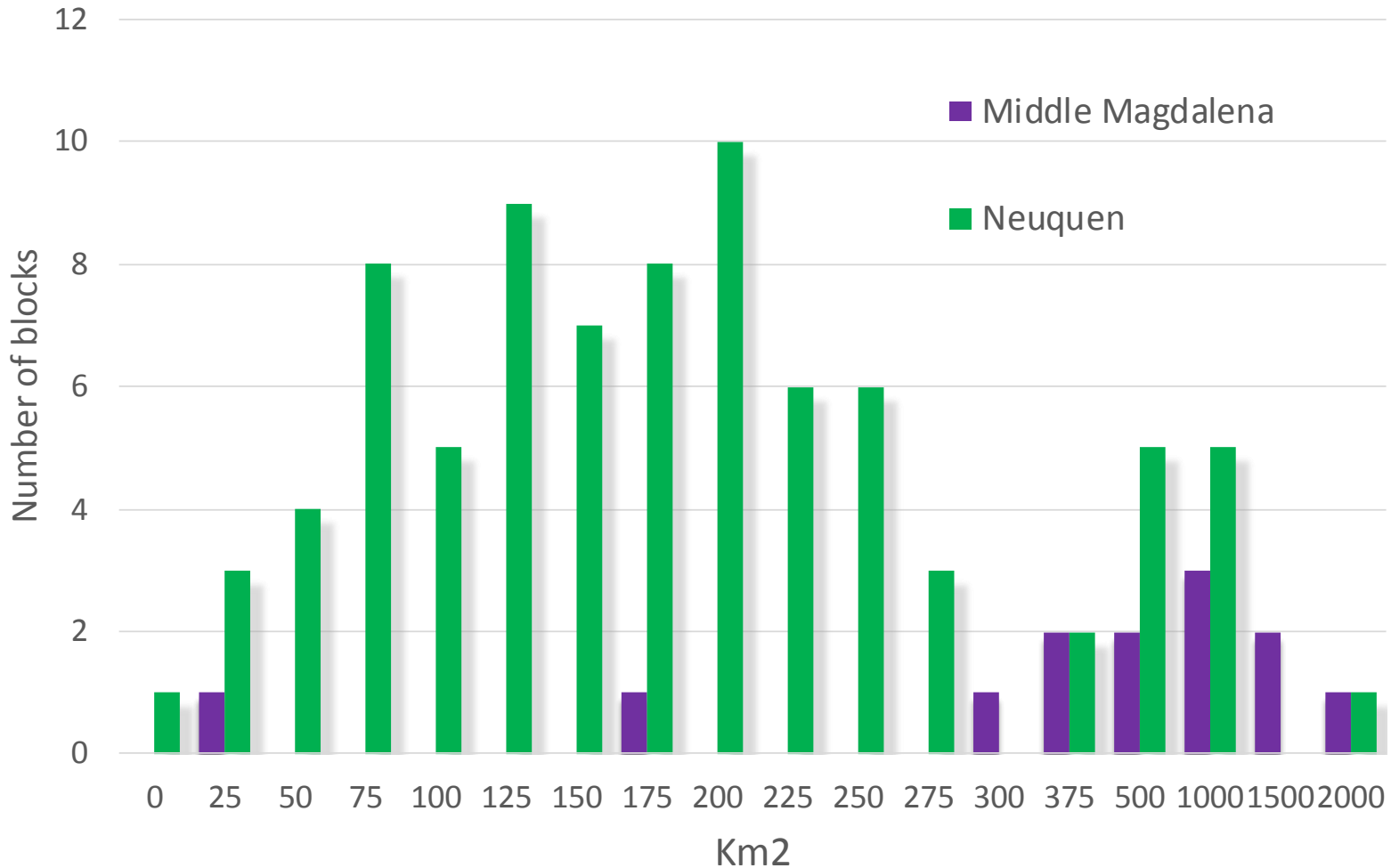


INDUCED
SEISMICITY



IMPACT IN THE
COMMUNITIES

Size of Unconventional Blocks



Large block sizes in Latin America allow planned development with less impact

Maturity of Unconventional Plays



Key SuccessFactors				
Technical	Play quality			
	Maturity of the Play			
	Optimization			
	Service Industry availability			
	Access to infrastructure			
Non-Technical	Environmental Aspects			
	Social acceptance			
	Fiscal terms			
	Clear regulatory environment			



Below Surface

1) Understanding the rock: Pilot Vertical Wells:

- Identify potential landing zones
- Understand the geopressure regime
- Geomechanical aspects
- Oil yield
- Water saturation and flow back

2) Understanding the Productivity: Pilot Horizontal Wells

- Establish best completion parameters (proppant, water, spacing of clusters, plugs, lateral length, etc)
- Choque management
- Define the optimal well spacing through pressure measurements, tracers and microseismic
- Optimize well design

3) Optimization of the process

Achieve operational and economic efficiency through the implementation of factory mode processes and optimization in conjunction with the service providers.



Above Surface

- Engage the support of communities and society with a clear communication of the activities to be conducted and the benefits expected.
- Obtain the support of local associations and government
- Fluid communication with the National and Local authorities



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Andes Energy
Consulting

Thank you

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