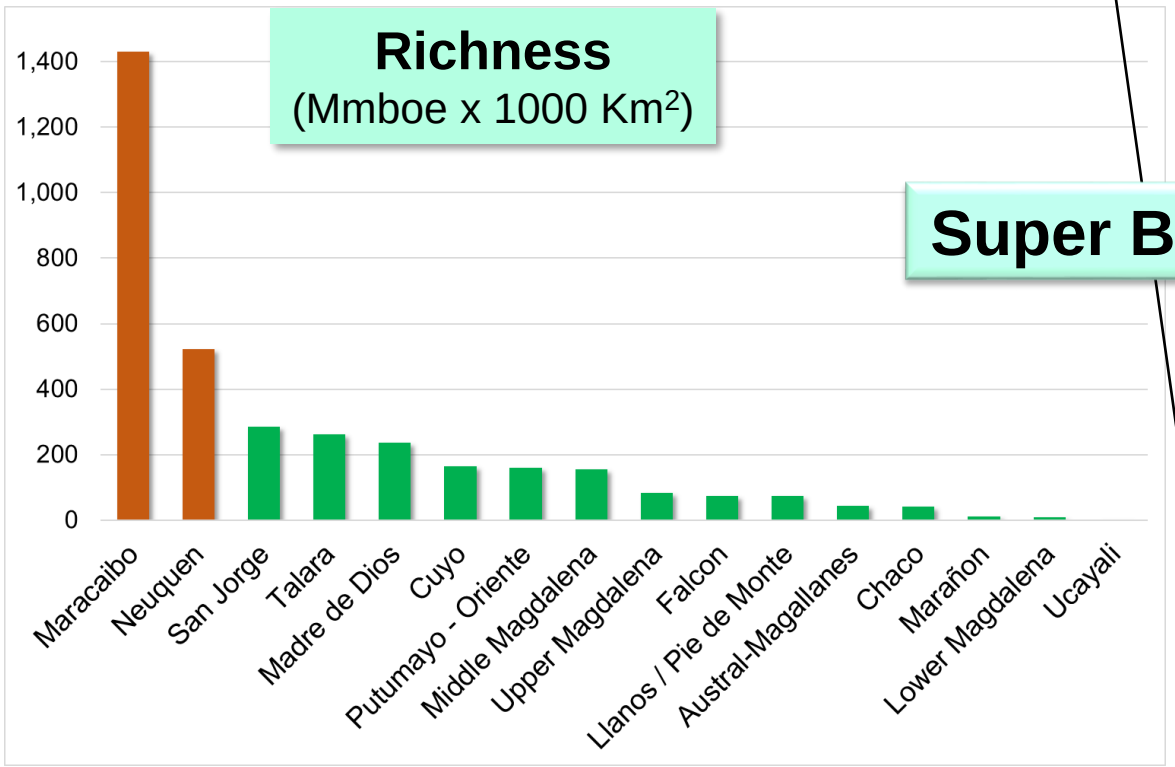
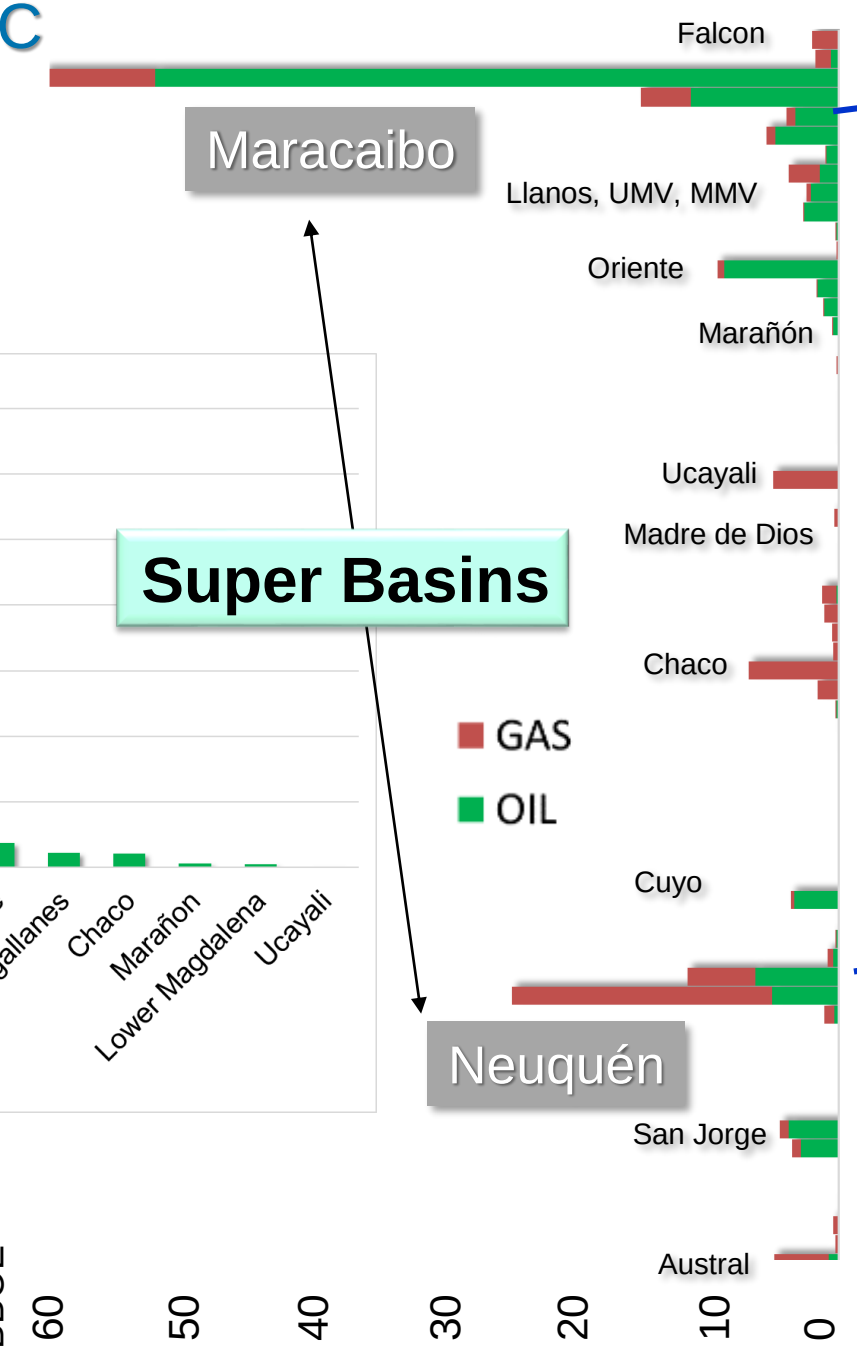
The Neuquén Super Basin: from Promise to Reality

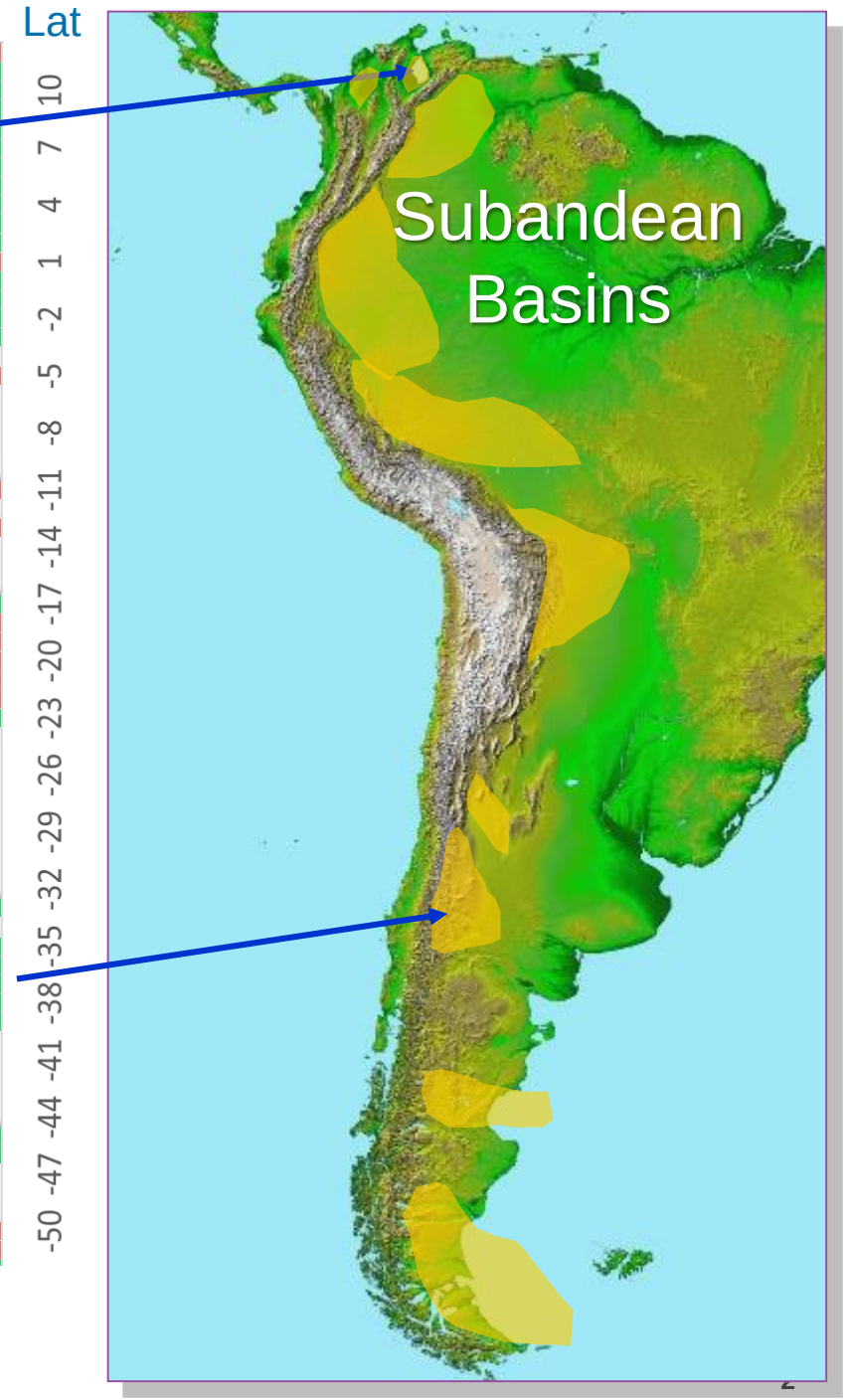
Carlos E. Macellari

Latitudinal Distribution of HC per degree of latitude



Super Basins



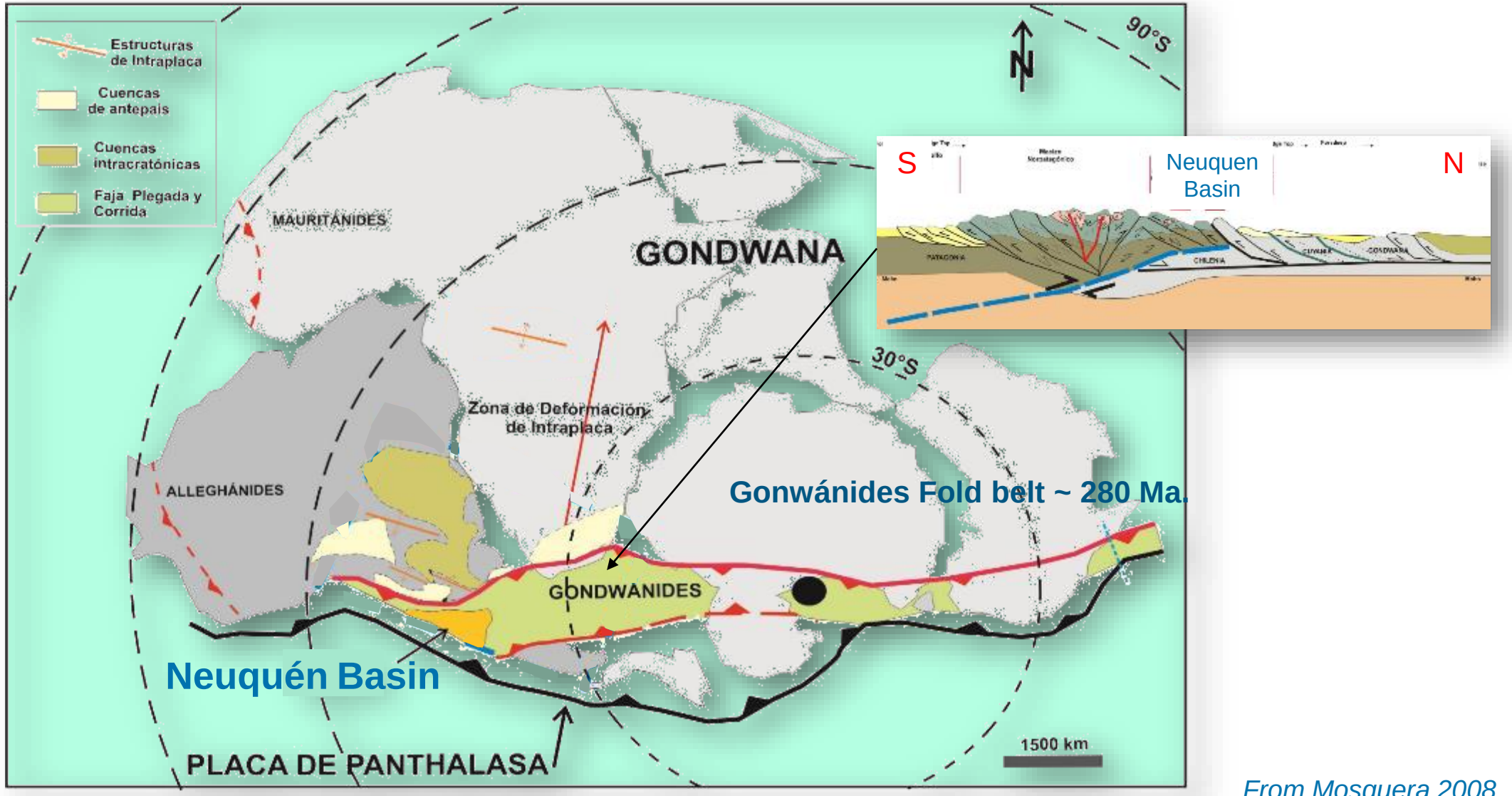


Age of main Source Rocks for the Subandean Basins

- Tertiary
- Cretaceous
- Tr-Jurassic
- Cb -Permian
- Devonian
- Silurian

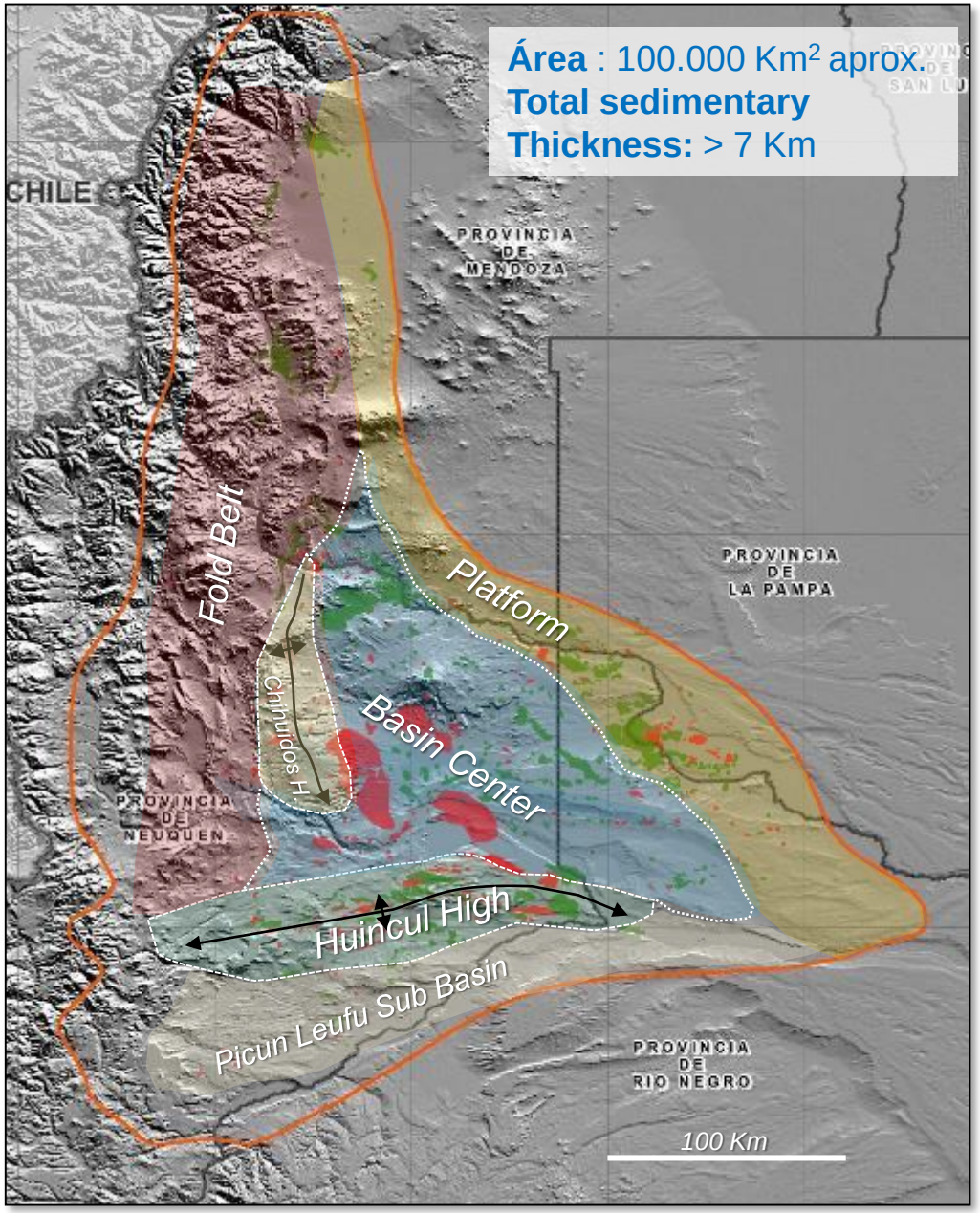
The Neuquén Basin has four source rocks

Origin of the Neuquén Basin



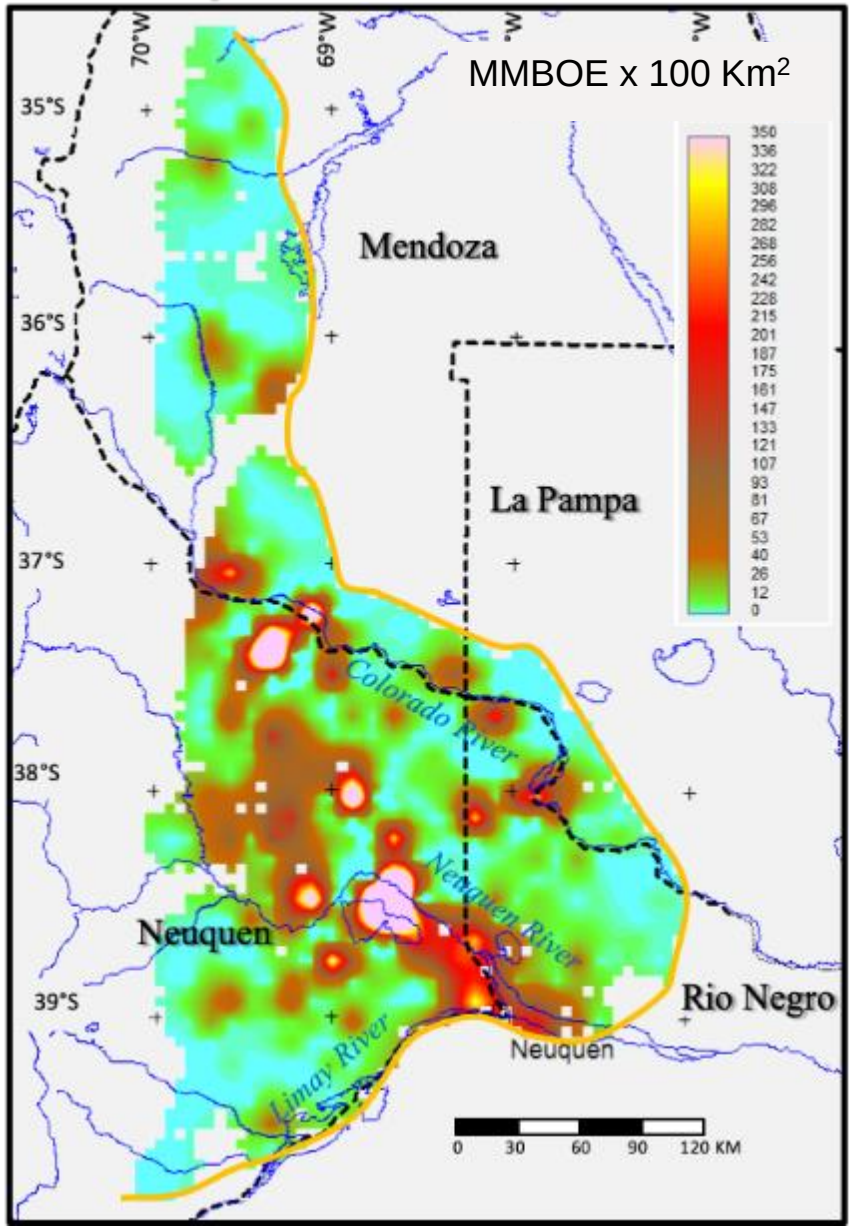
From Mosquera 2008

Neuquén Basin Structural Environments

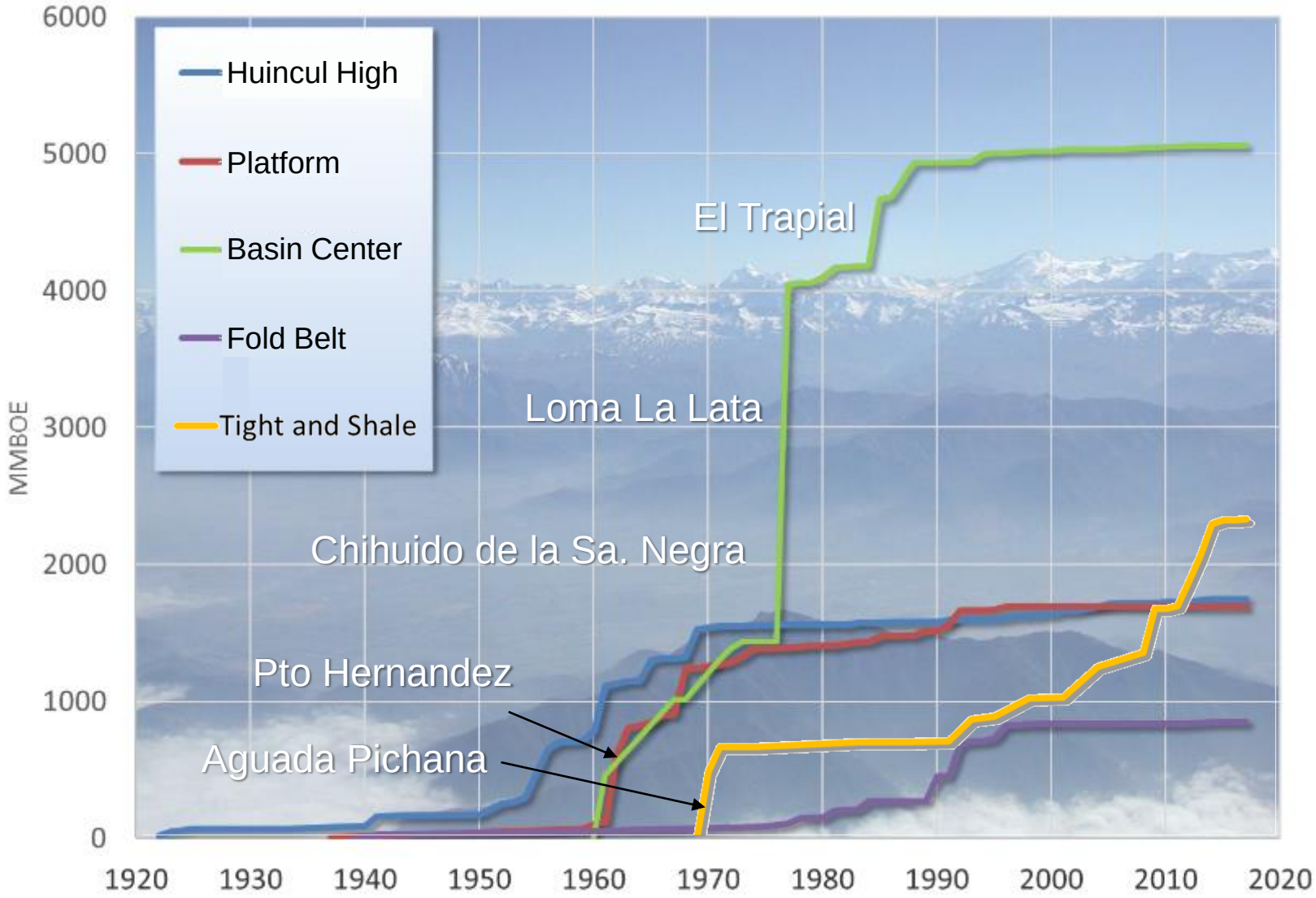


- **14.2B boe** (6.76 B bbls oil and 44.5 TCF) discovered to date

Hydrocarbons discovered per area

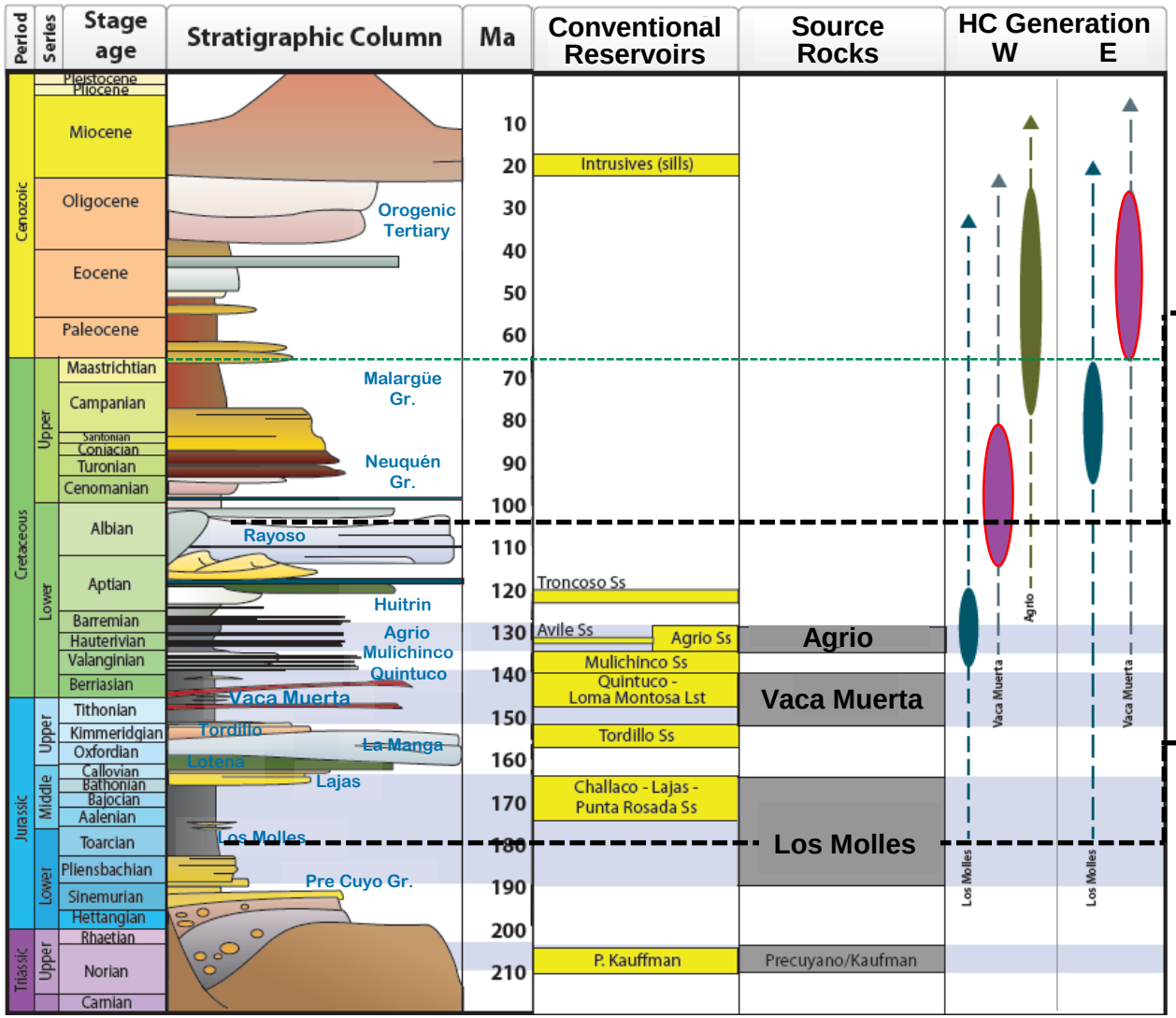


Creaming Curves – Neuquén Basin

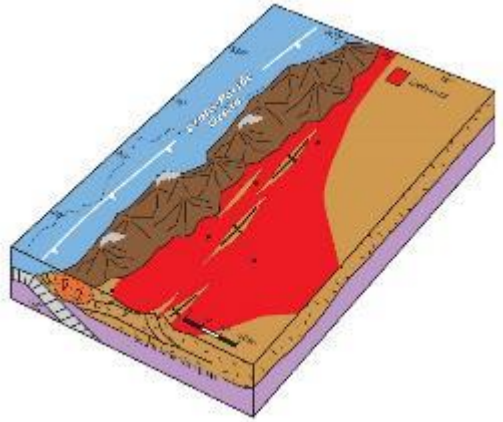


Data from IHS

Neuquén Basin – Tectonic Evolution

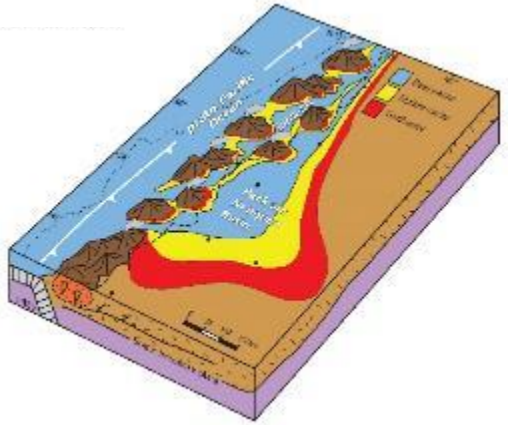


Brisson & Veiga *Legarreta 2005* *Kotulova 2012*



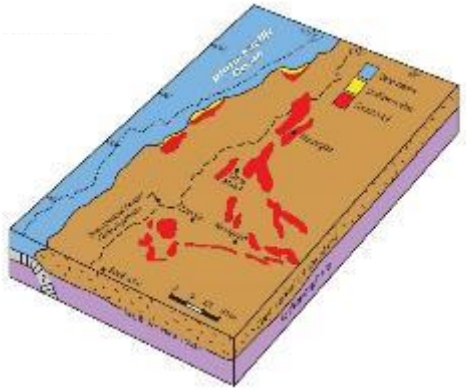
FORELAND

- Andean Orogeny – Total desvinculation from the Pacific ocean.



SAG - BACK ARC

- Regional thermal subsidence
- Most Important Transgresion: VM-Q System



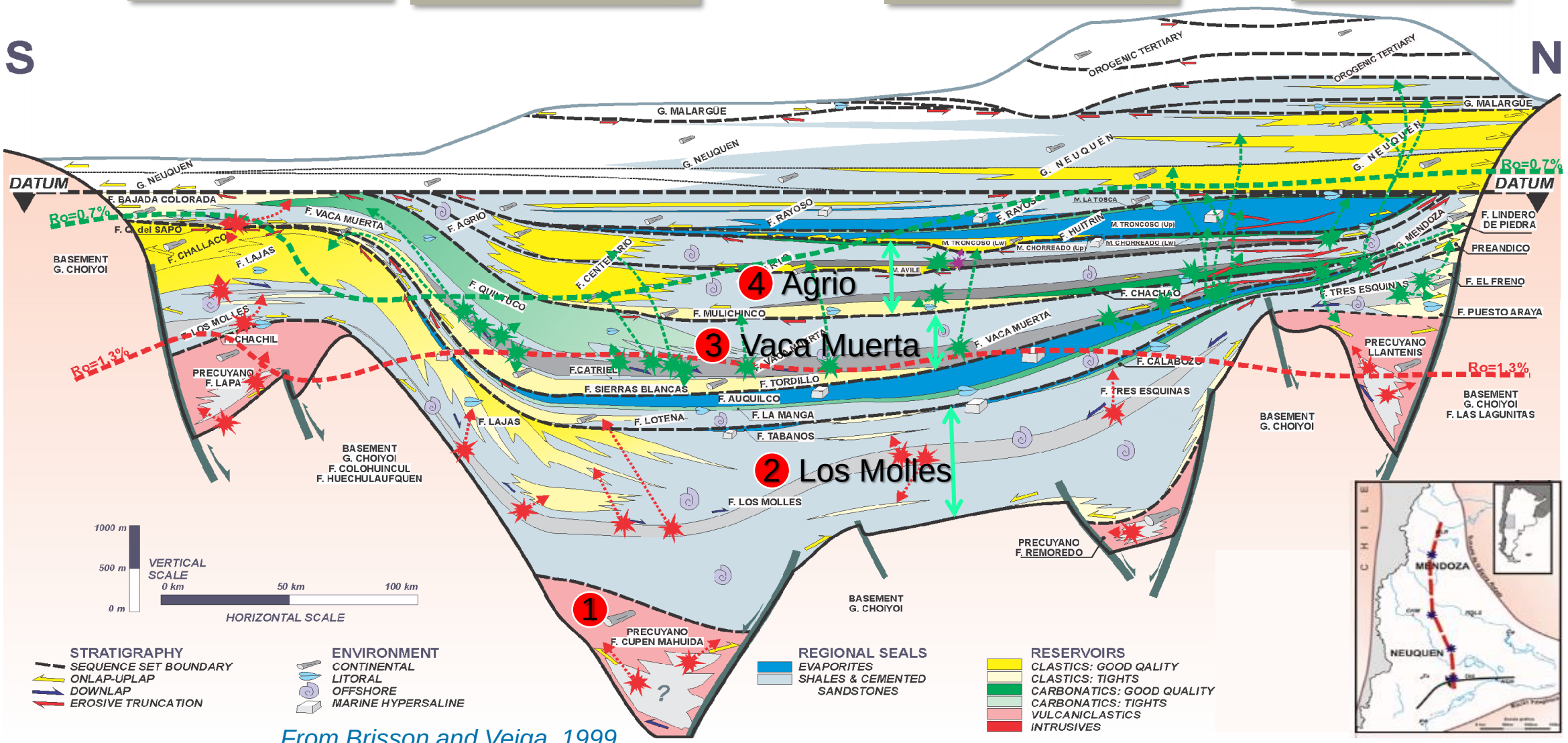
RIFT STAGE

- Localized depocenters with lacustrine source rock

Howell et al 2005

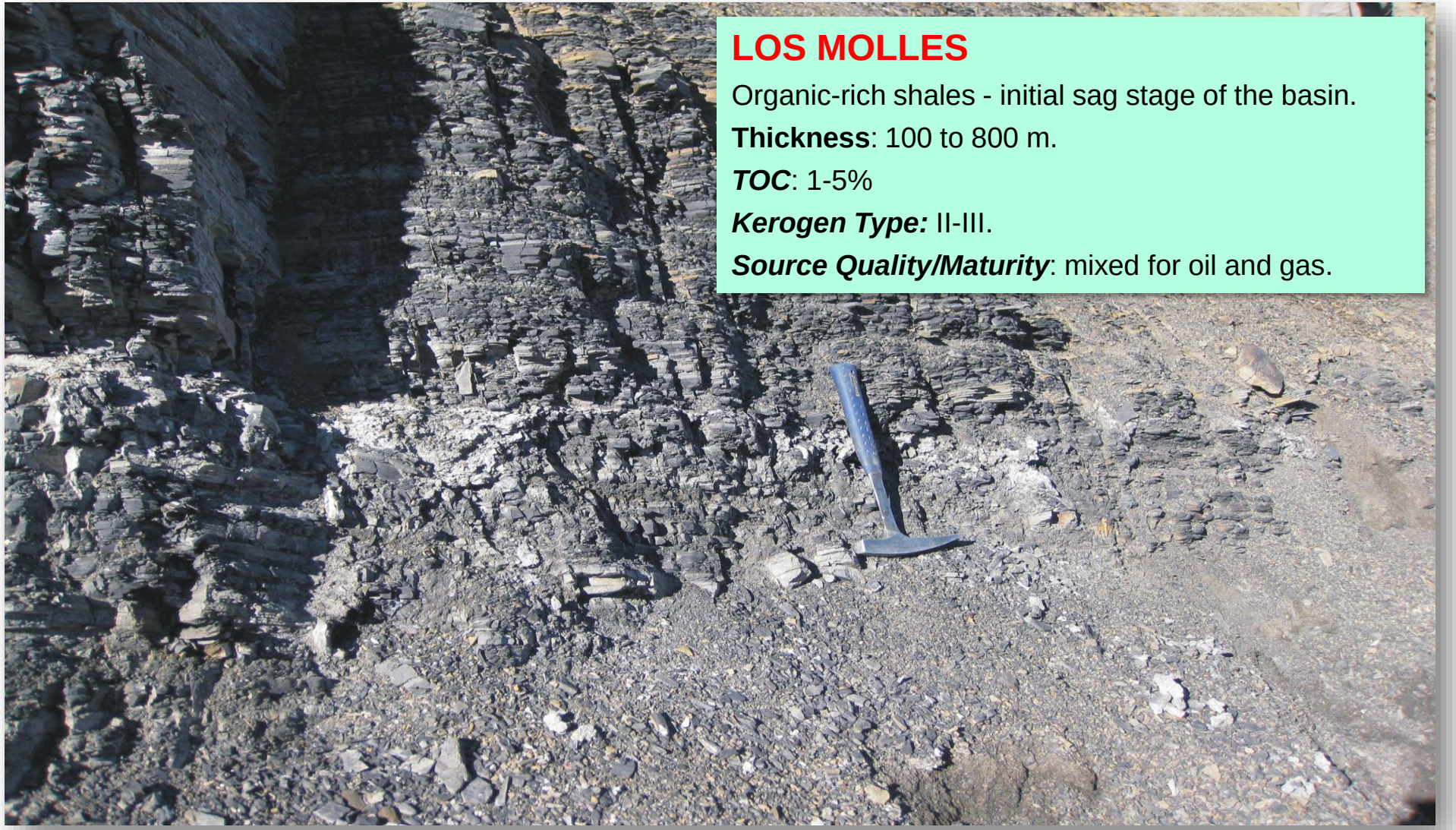
Reservoirs and Plays – Neuquén Basin

Huincul Arch Play | Basin Center Play | Fold / Thrust Play | Platform Play



From Brisson and Veiga, 1999

Los Molles



LOS MOLLES

Organic-rich shales - initial sag stage of the basin.

Thickness: 100 to 800 m.

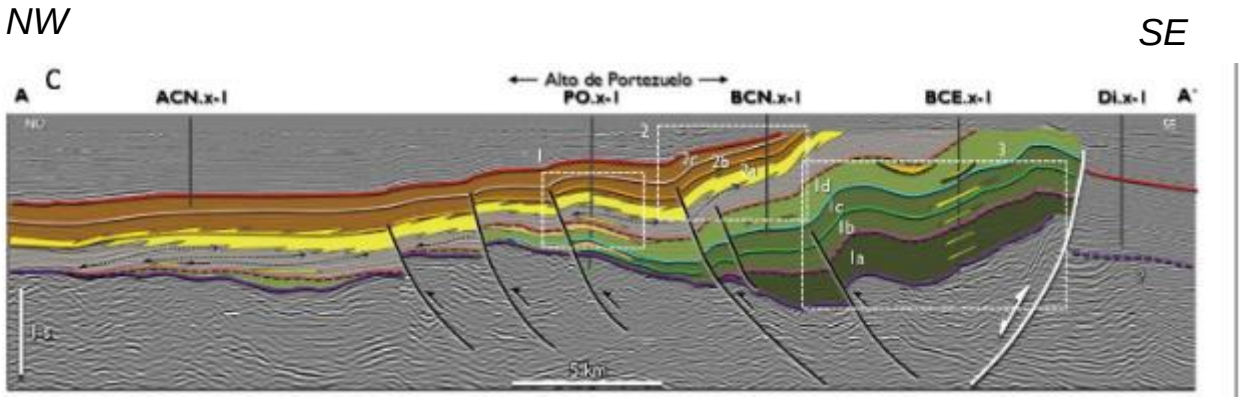
TOC: 1-5%

Kerogen Type: II-III.

Source Quality/Maturity: mixed for oil and gas.

G. Vergani

First Marine Ingression: L. Jurassic Cuyo Gr Los Molles SR

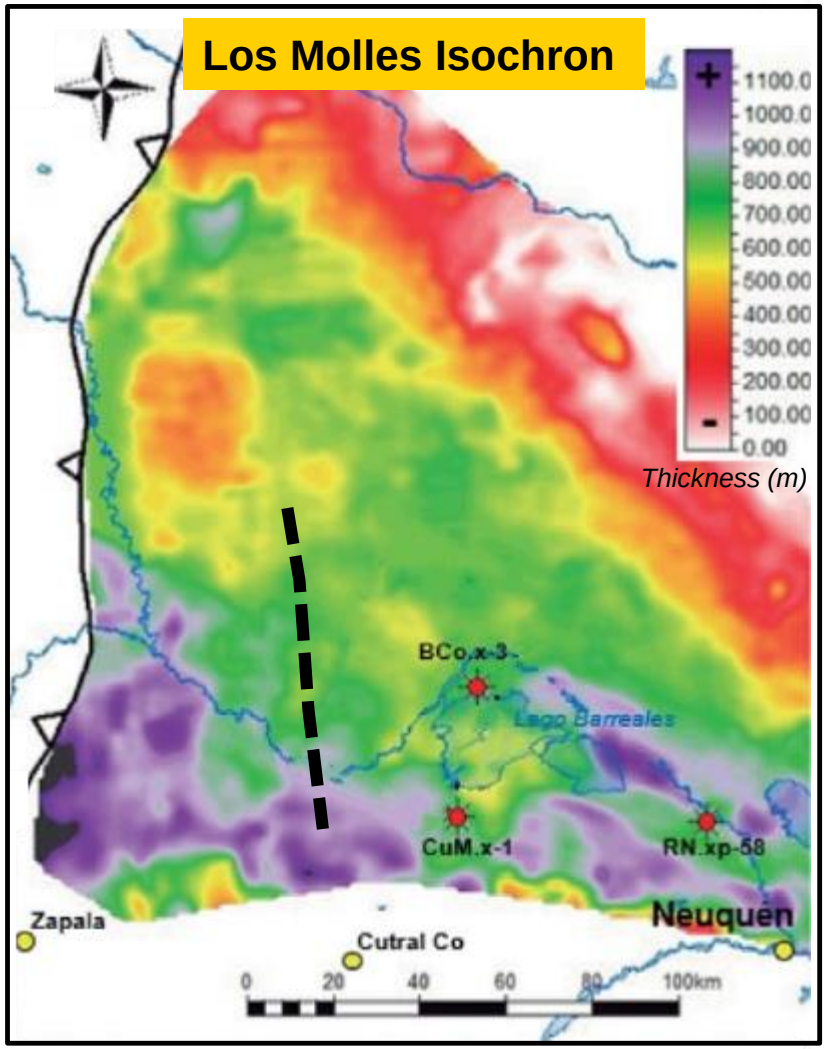


Giunta et al, 2018

Resources of

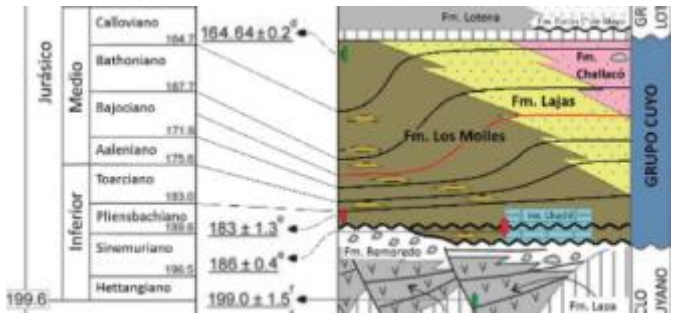
- 3.66 BO
- 275 TCF

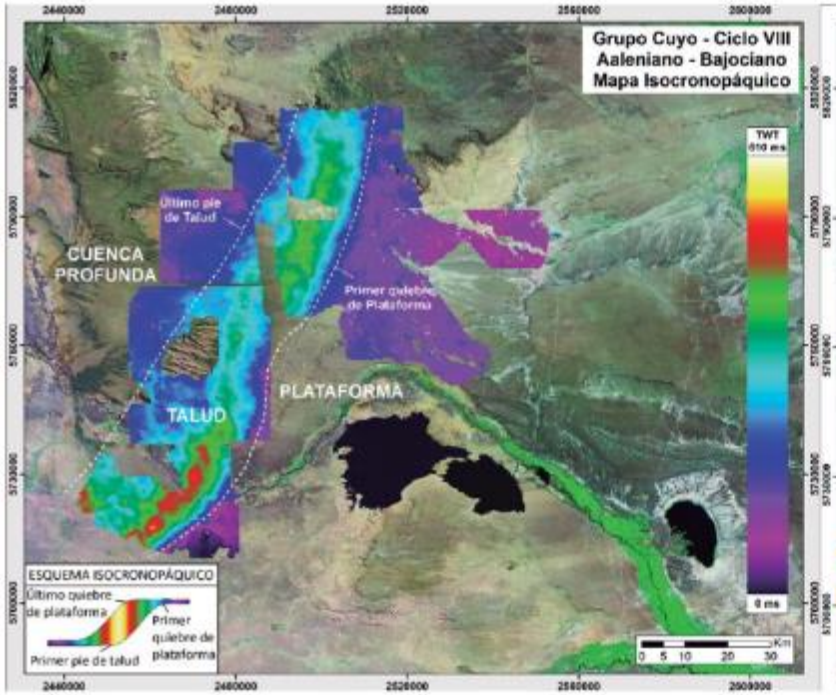
EIA, 2013

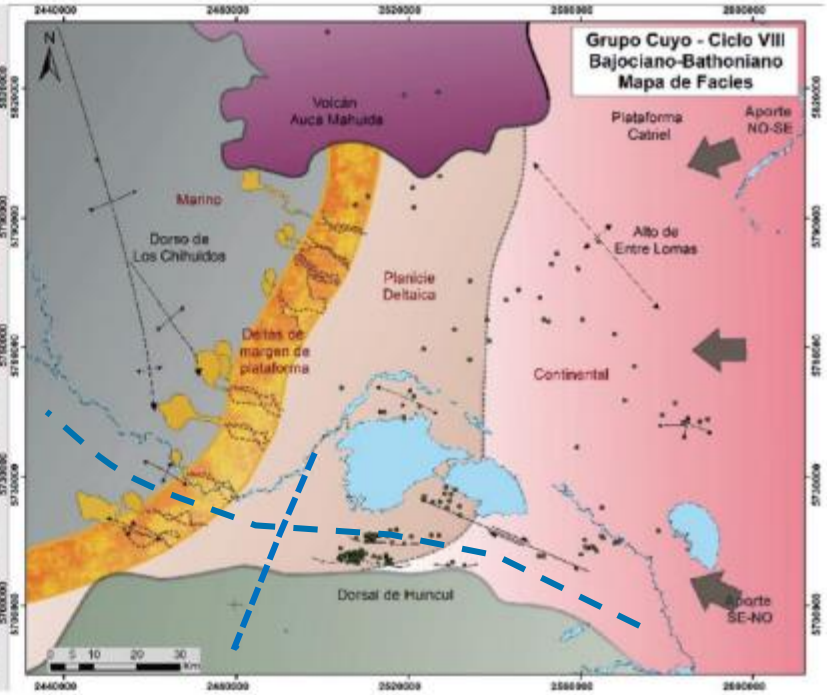


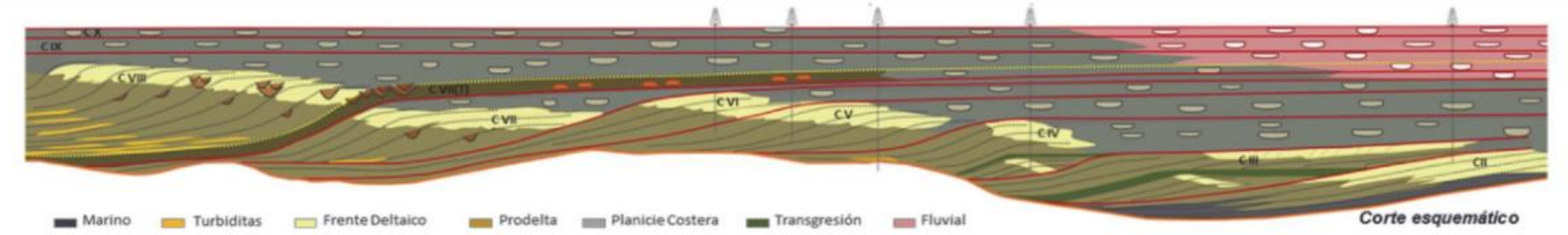
Pagán et al., 2018

First Marine Ingression: Lower Jurassic Cuyo Gr. – Los Molles SR.









From Brinkworth, et al., 2018

Vaca Muerta

VACA MUERTA

Organic-rich shale and marls.

Thickness: 25 to 700 m

TOC: 3-17%

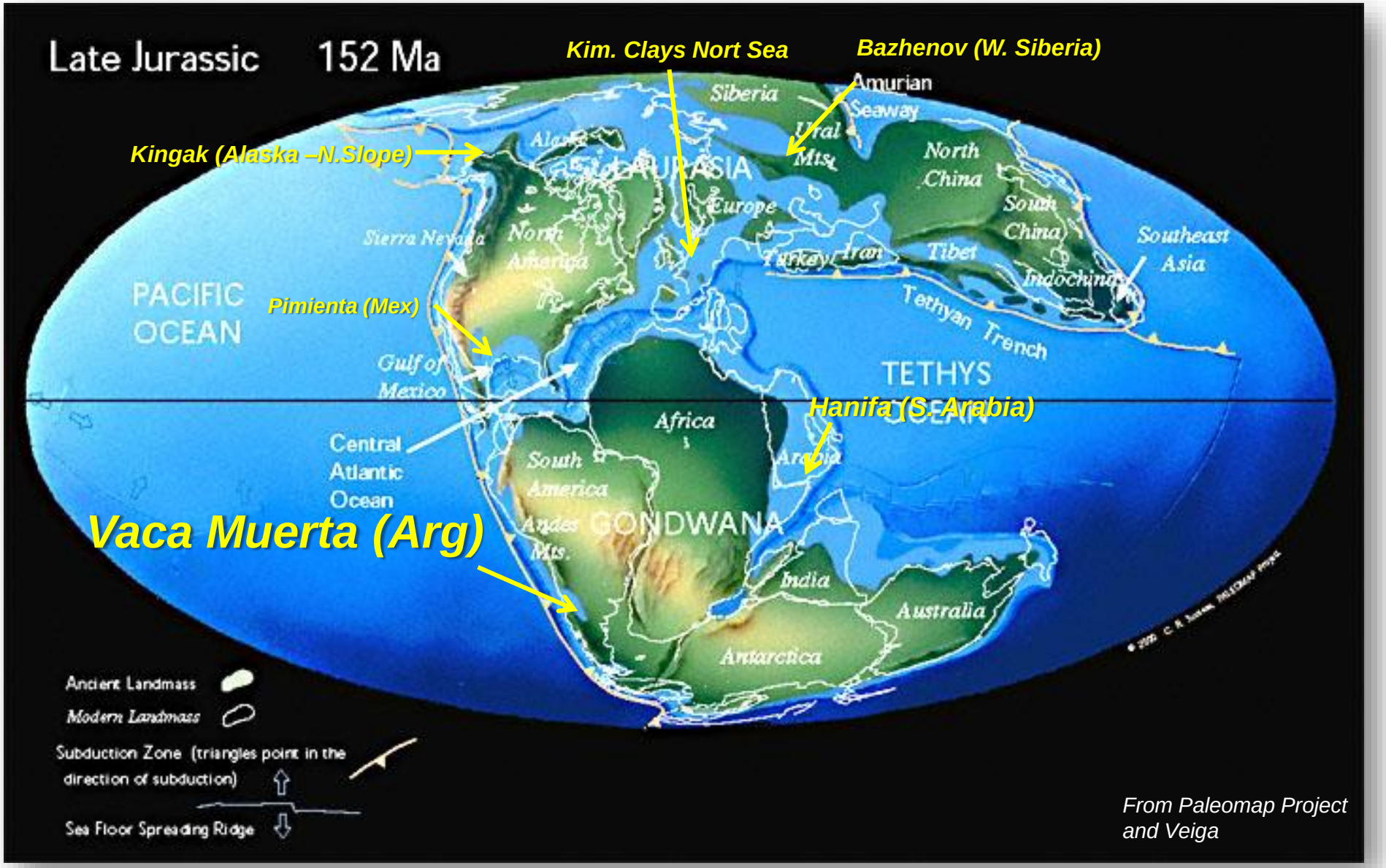
Kerogen Type: I/II; locally restricted type II-S facies

H. Leanza

Vaca Muerta Characterization

- Great Areal Extent (30.000 km^2)
- Large thickness of organic rich section (30 - 400 m) allowing multiple navigation horizons.
- Good Porosities (4 – 16%)
- Burial depth between 2000 and 3500 m.
- Overpressured (0.75 to 0.85 psi/ft)
- TOC: up to 17%
- Mineralogy and elastic parameters adequate for hydraulic fracturing
- **Only about 20% of hydrocarbons generated were expelled**.

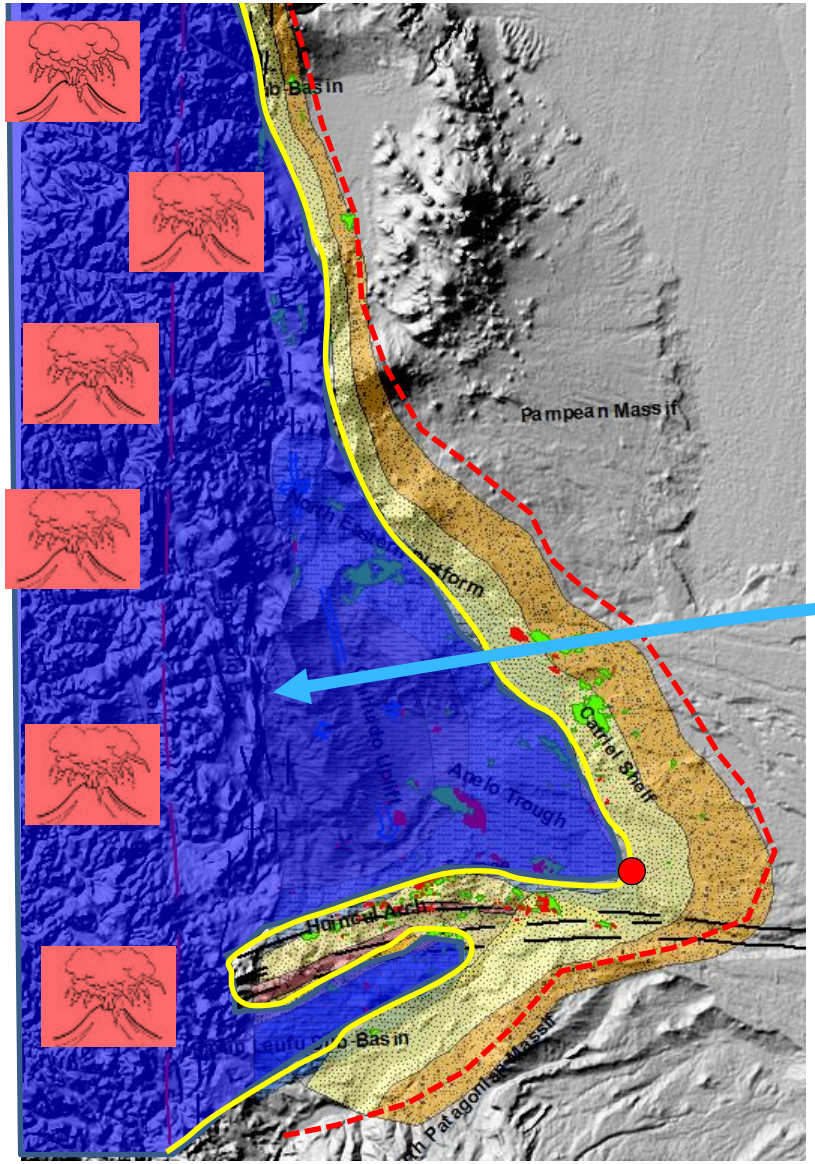
The Late Jurassic World



From Paleomap Project and Veiga

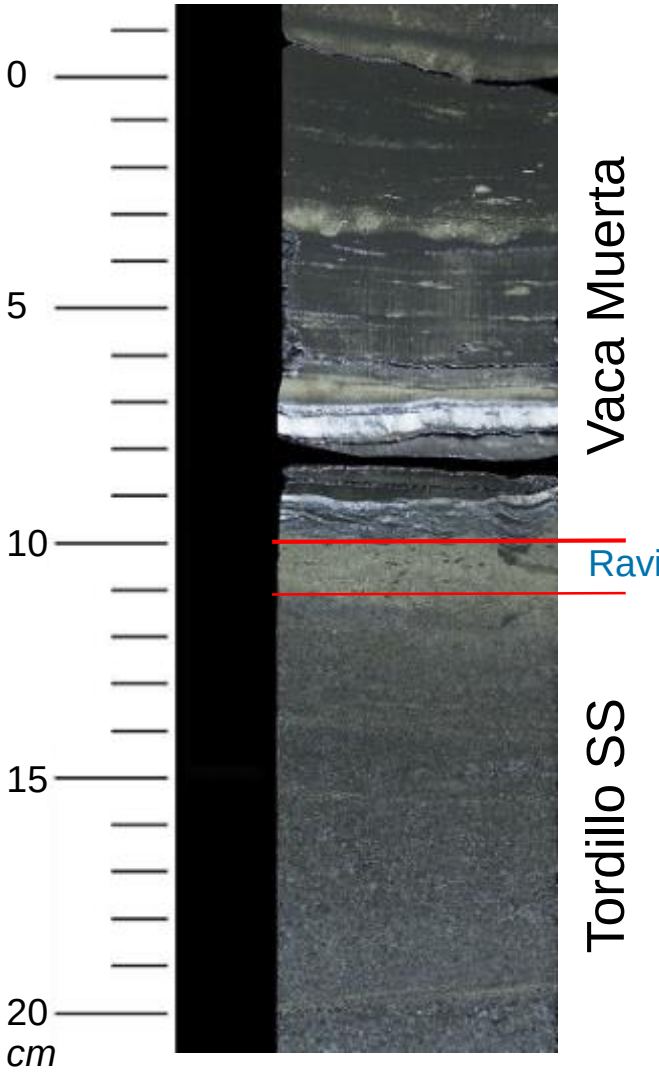
Vaca Muerta - Paleogeography

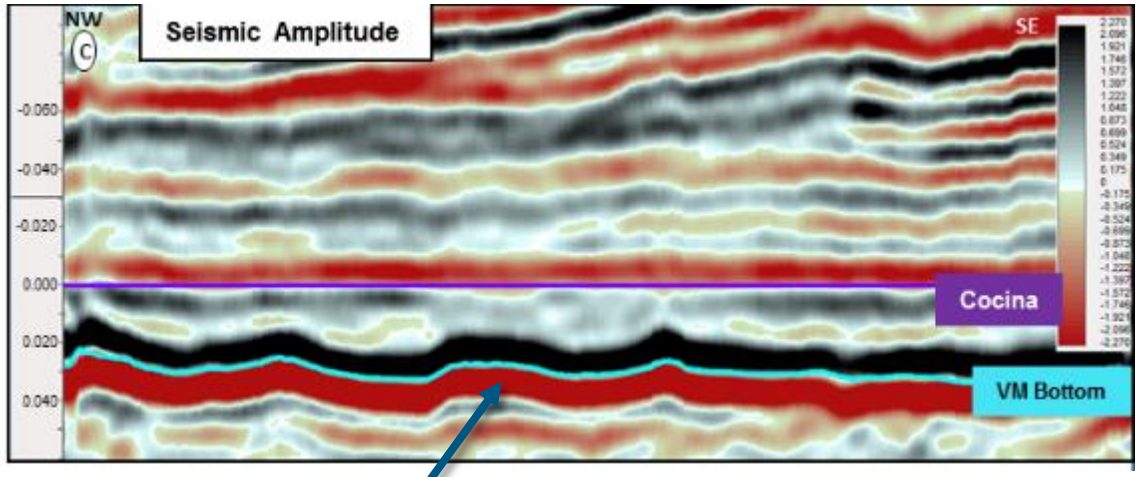
Paleocirculation restricted by volcanic chain. Water depth from 100 to 200 mt.



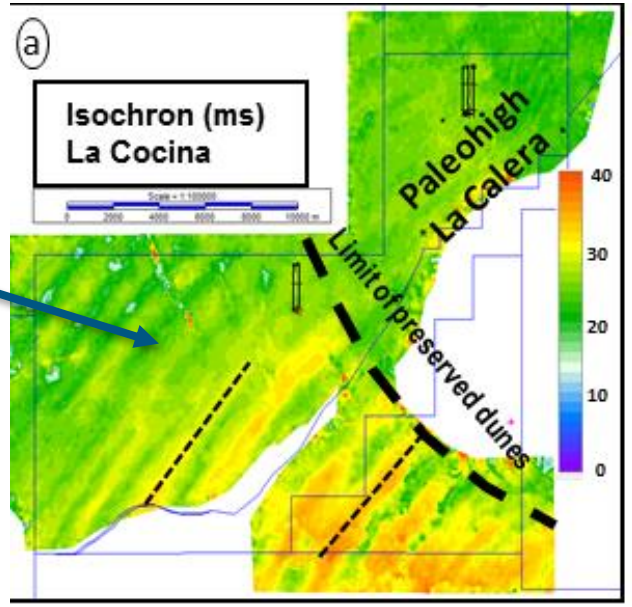
From Veiga

Vaca Muerta: Extremely fast inundation of the basin

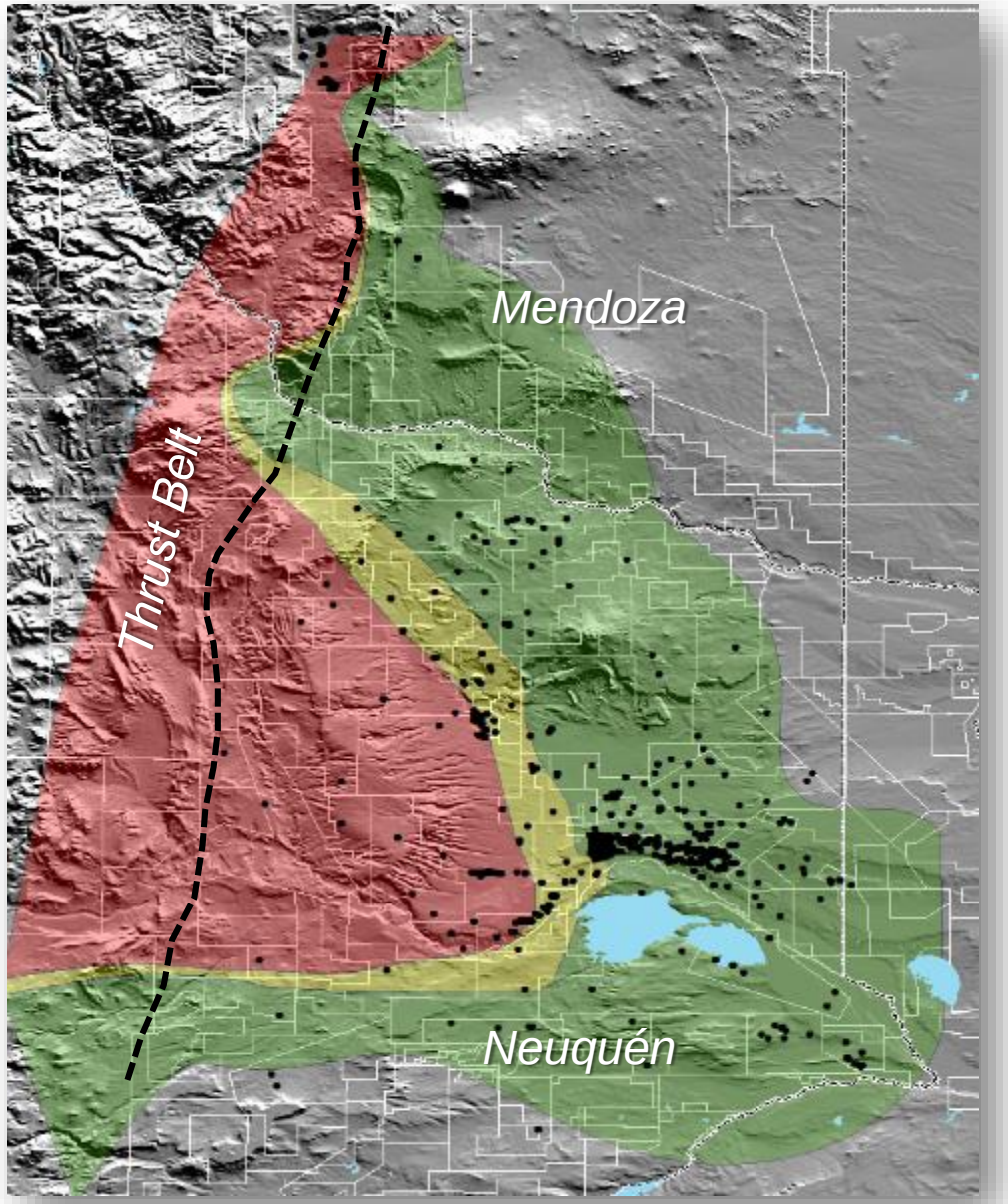




Tordillo paleodunes preserved



Maturity Zones and wells drilled in Vaca Muerta

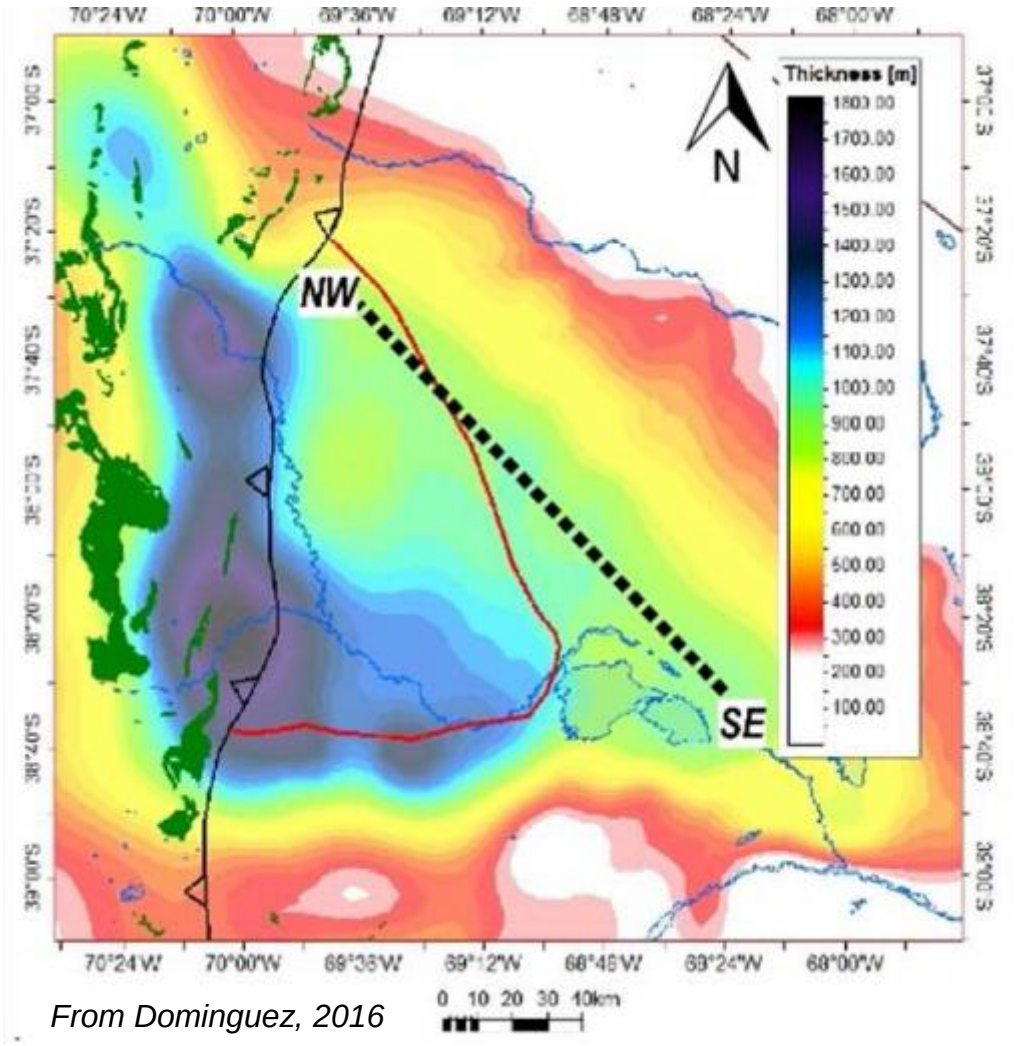


- Dry Gas Window
- Wet Gas Window
- Oil Window
- Vaca Muerta well

Aproximately 1100 wells drilled to date

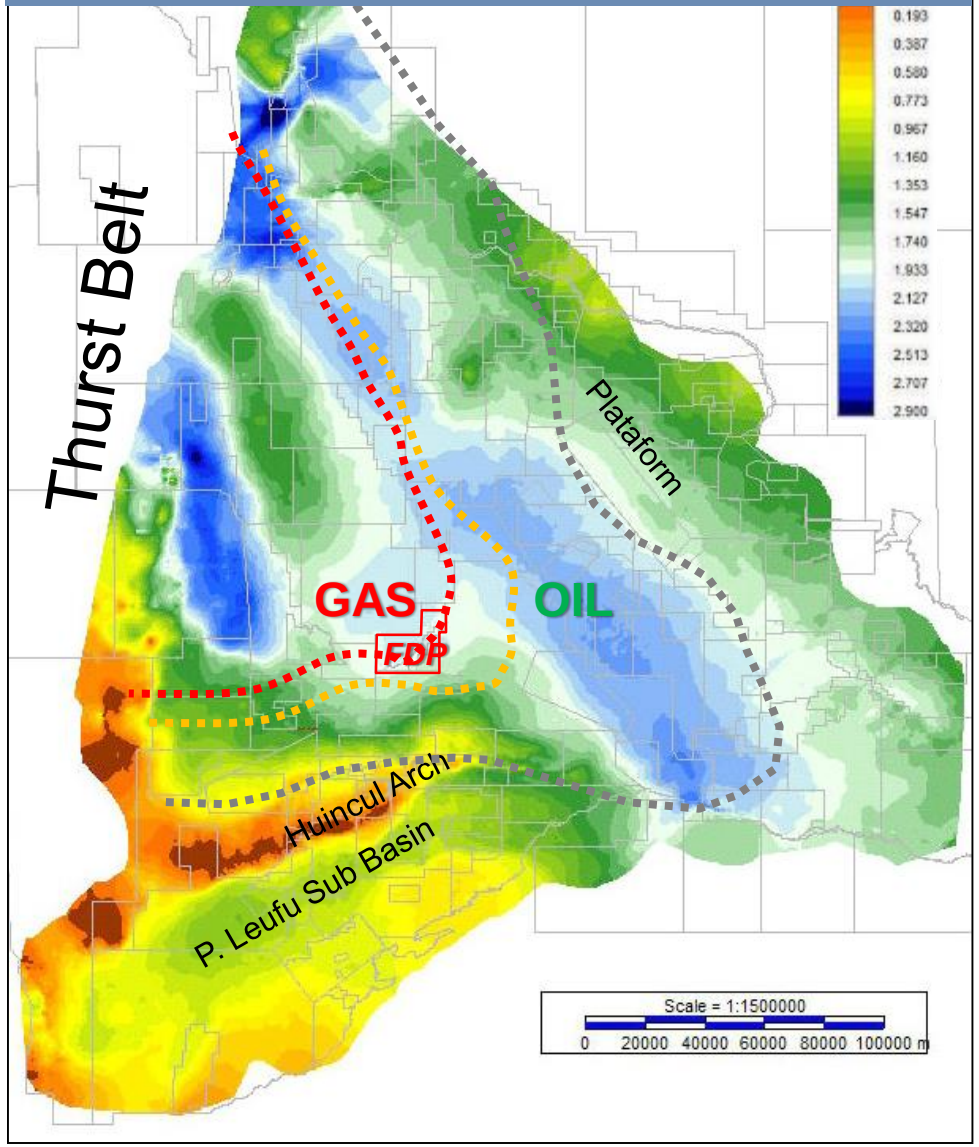
Vaca Muerta Structure and Isopach

Thickness of Vaca Muerta-Quintuco System

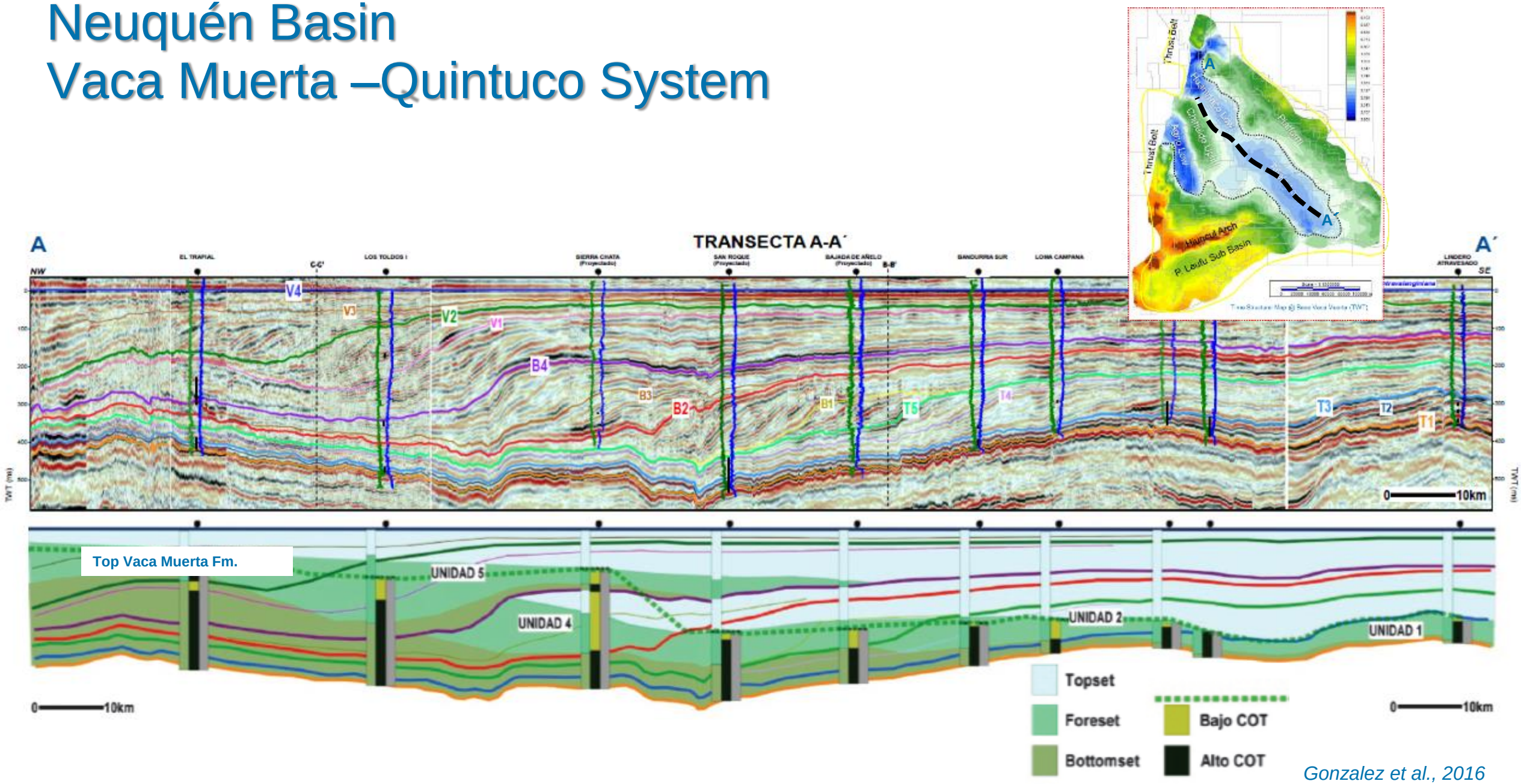


From Dominguez, 2016

Structural Map @ Base Vaca Muerta (TWT)

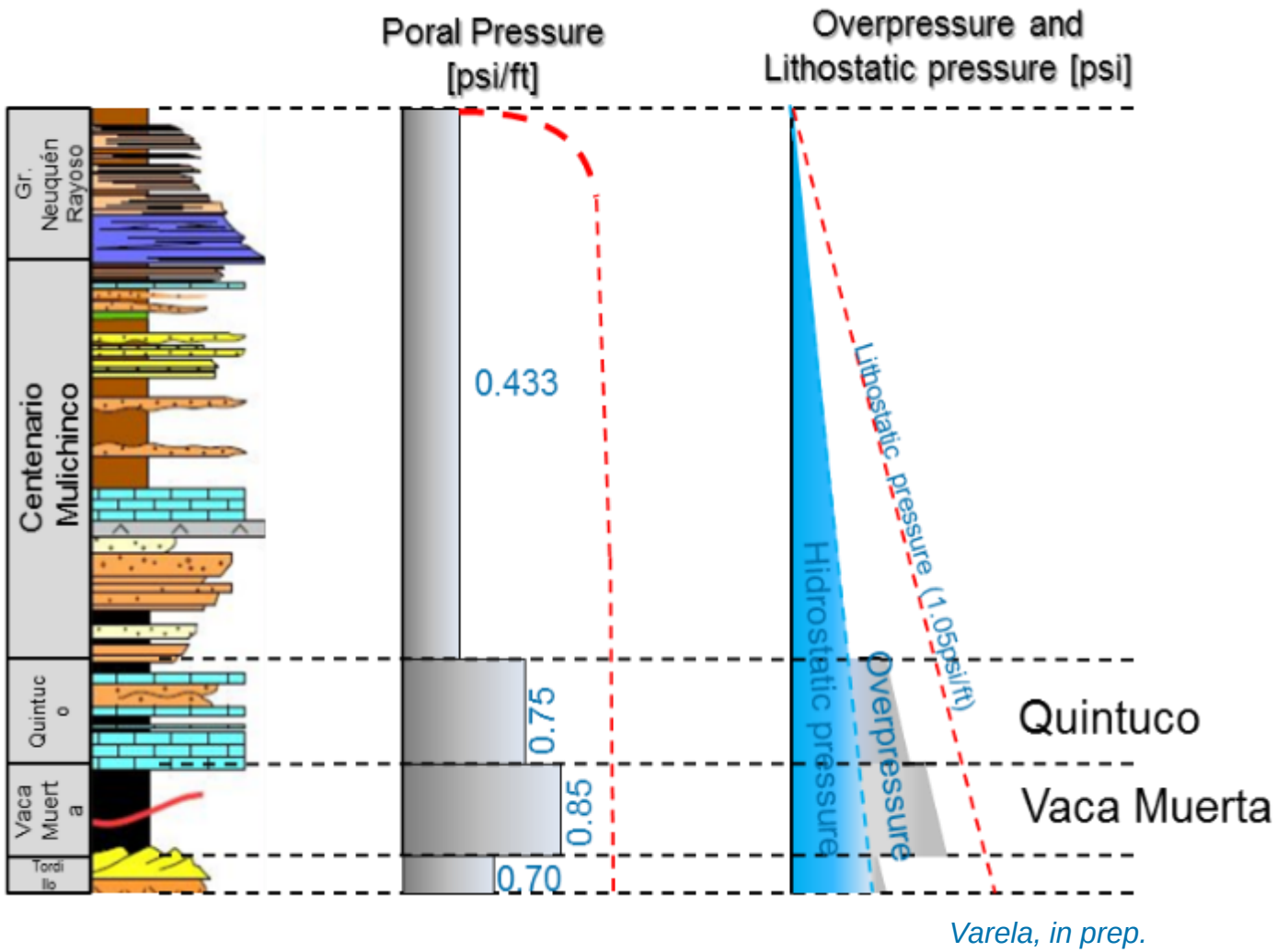


Neuquén Basin
Vaca Muerta –Quintuco System

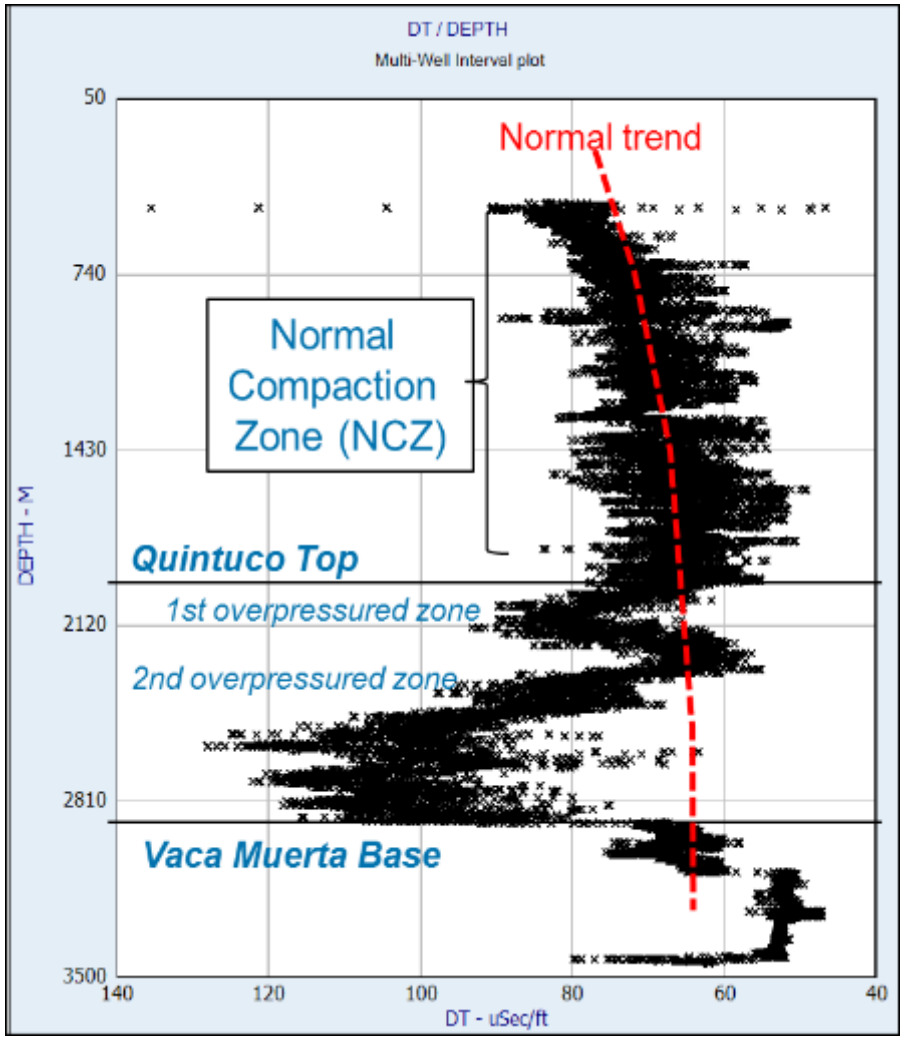


Gonzalez et al., 2016

Vaca Muerta - Geopressure

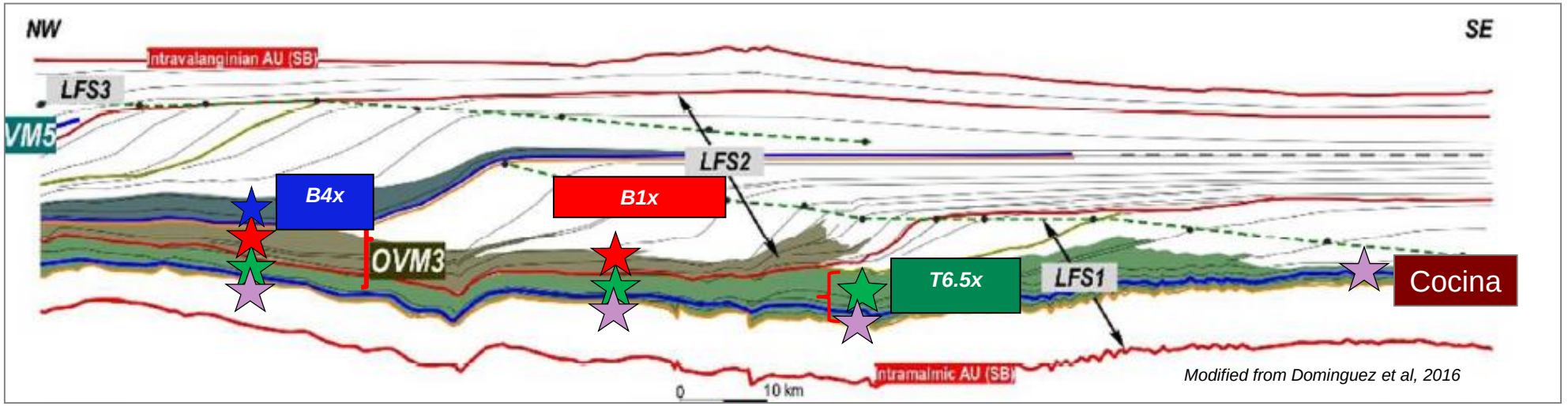


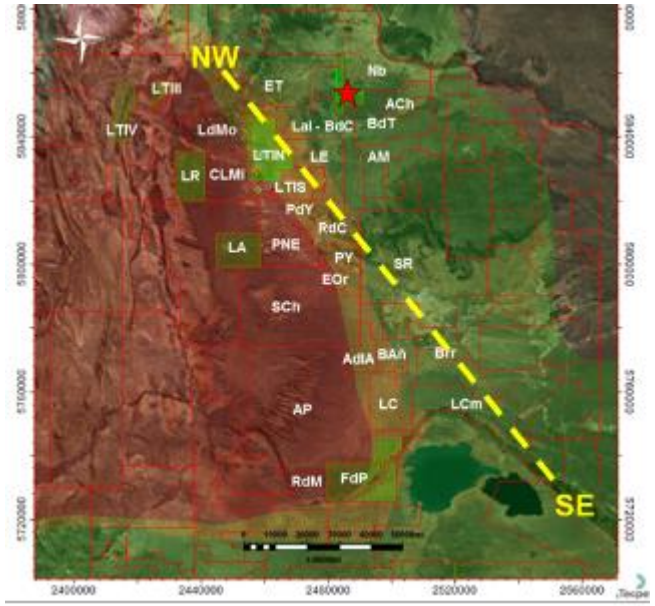
Varela, in prep.



Overpressure barrier in Quintuco probably helped to retain hydrocarbons within Vaca Muerta

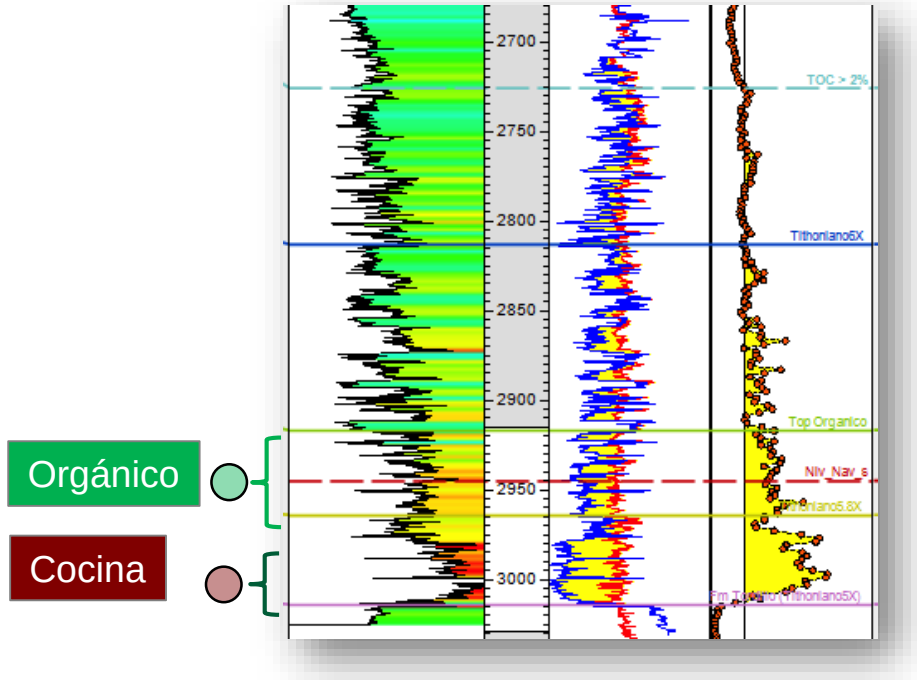
Vaca Muerta – Quintuco System – Landing Zones



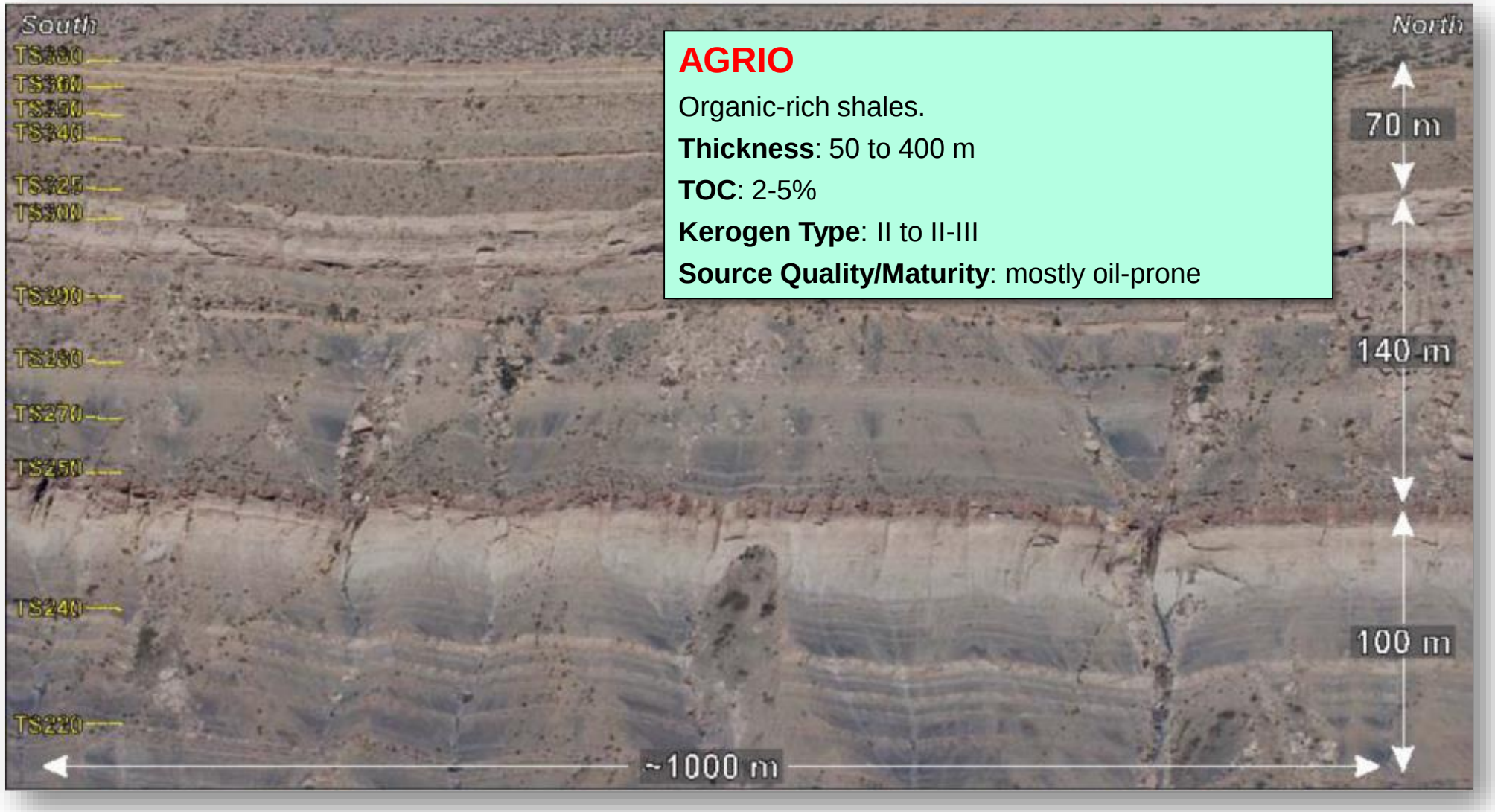


Main Landing Zones

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

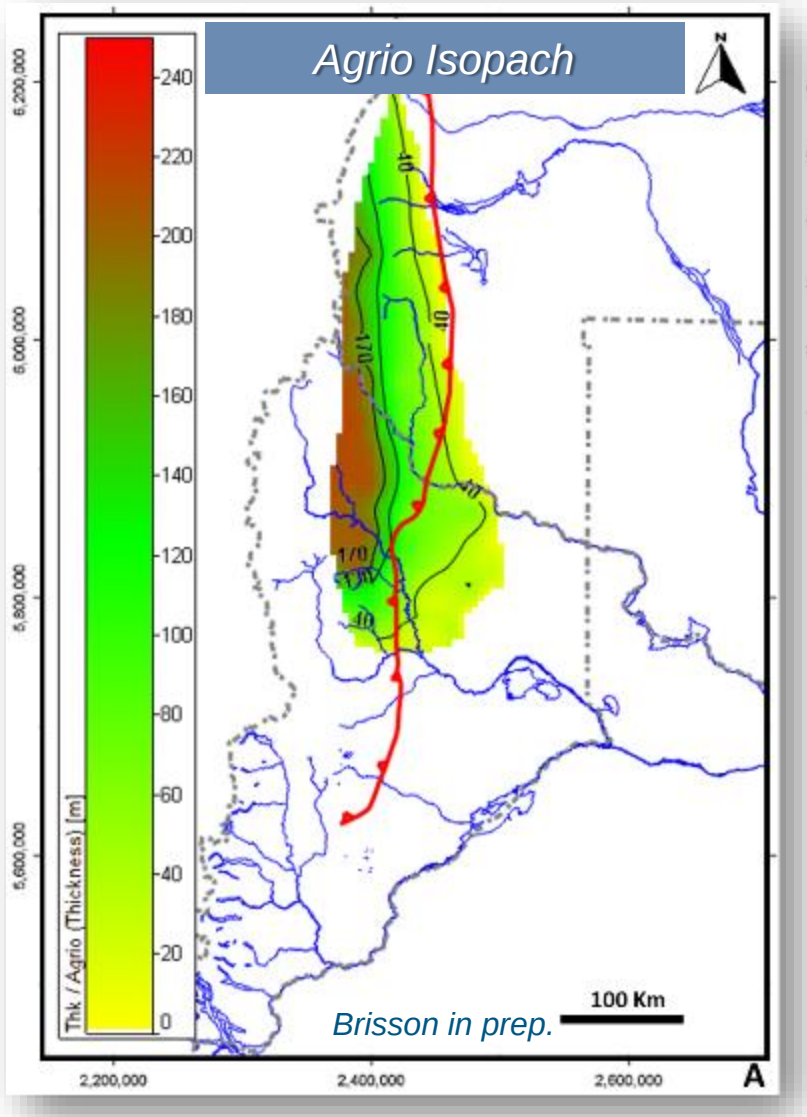


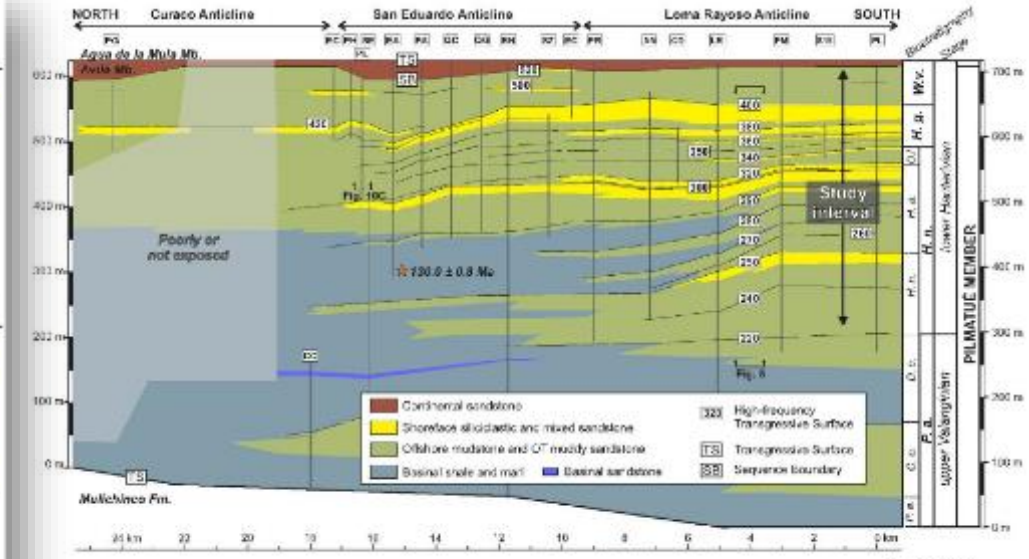
Agrio

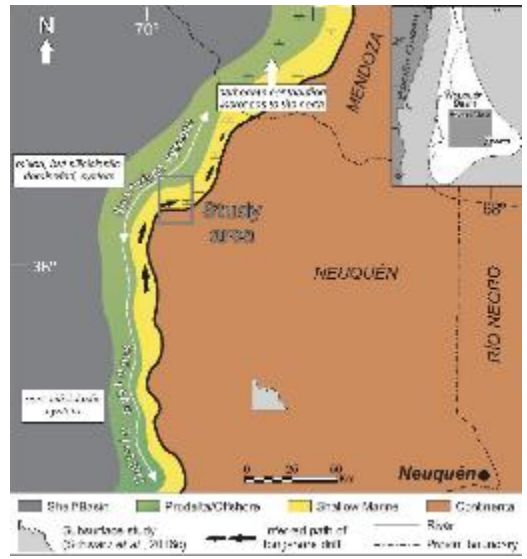


Schwarz 2019

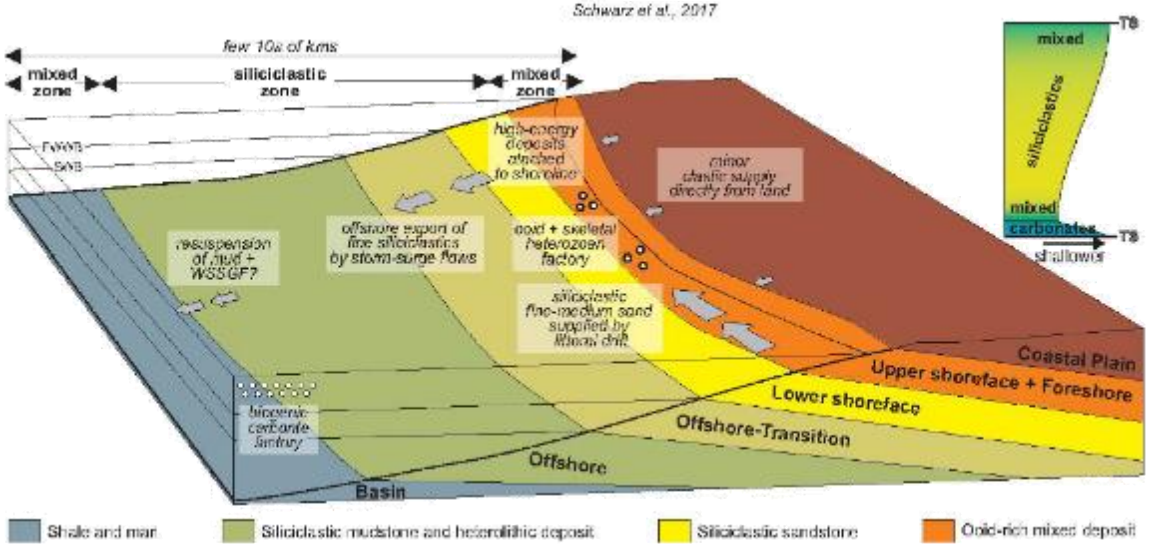
Agrio





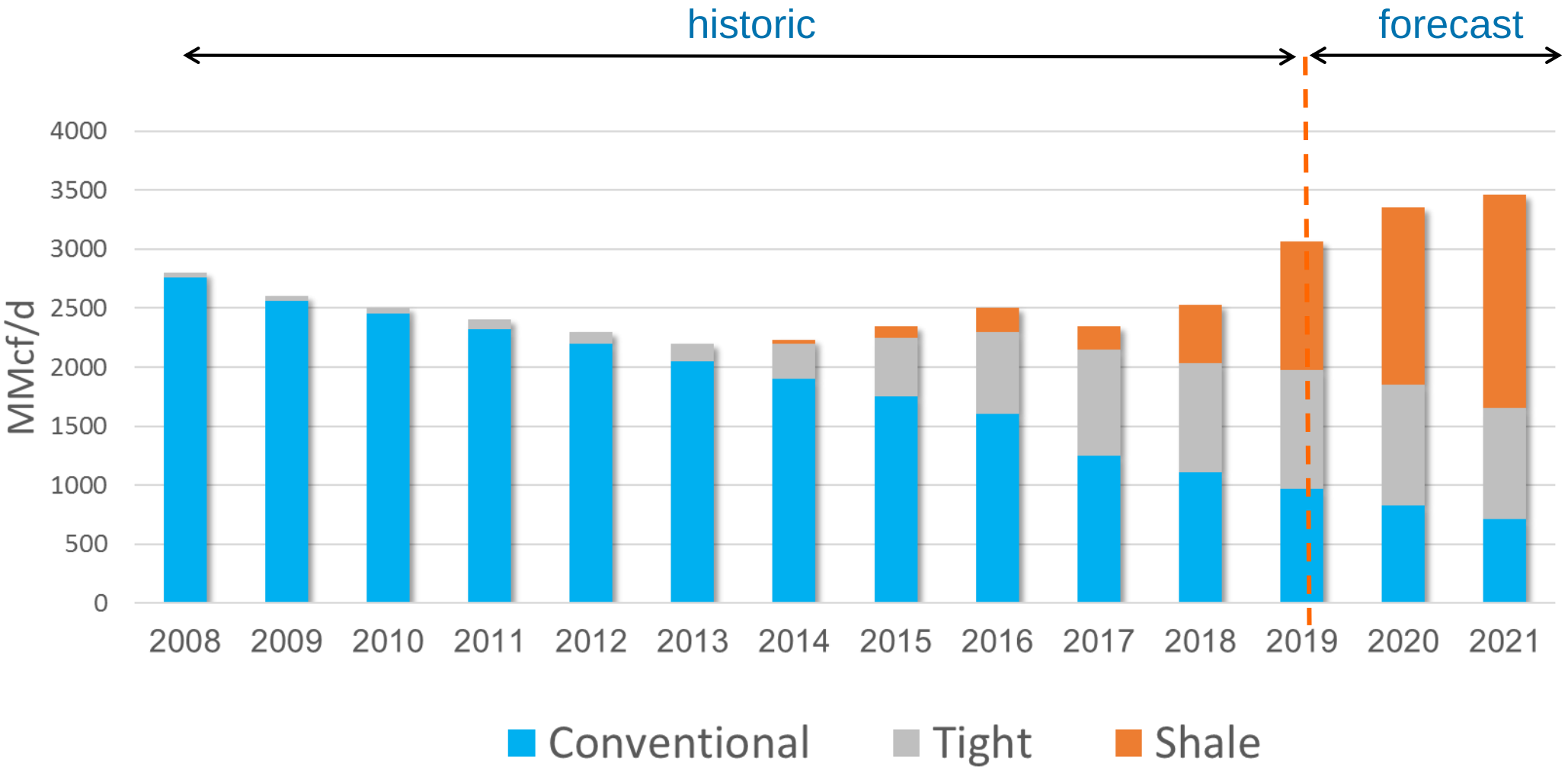


Schwarz et al., 2017

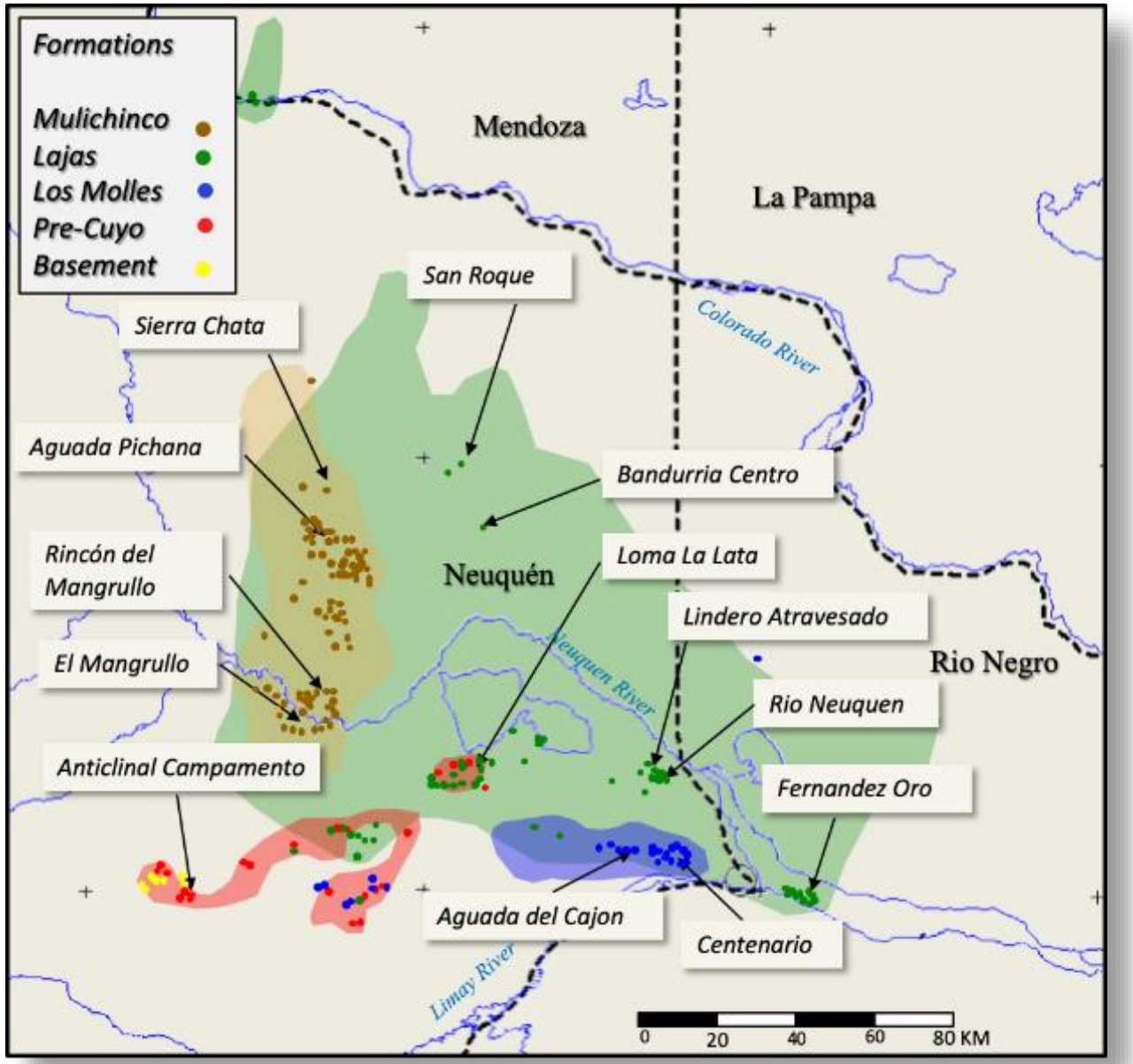


Schwarz 2019

Neuquén Basin Gas Production

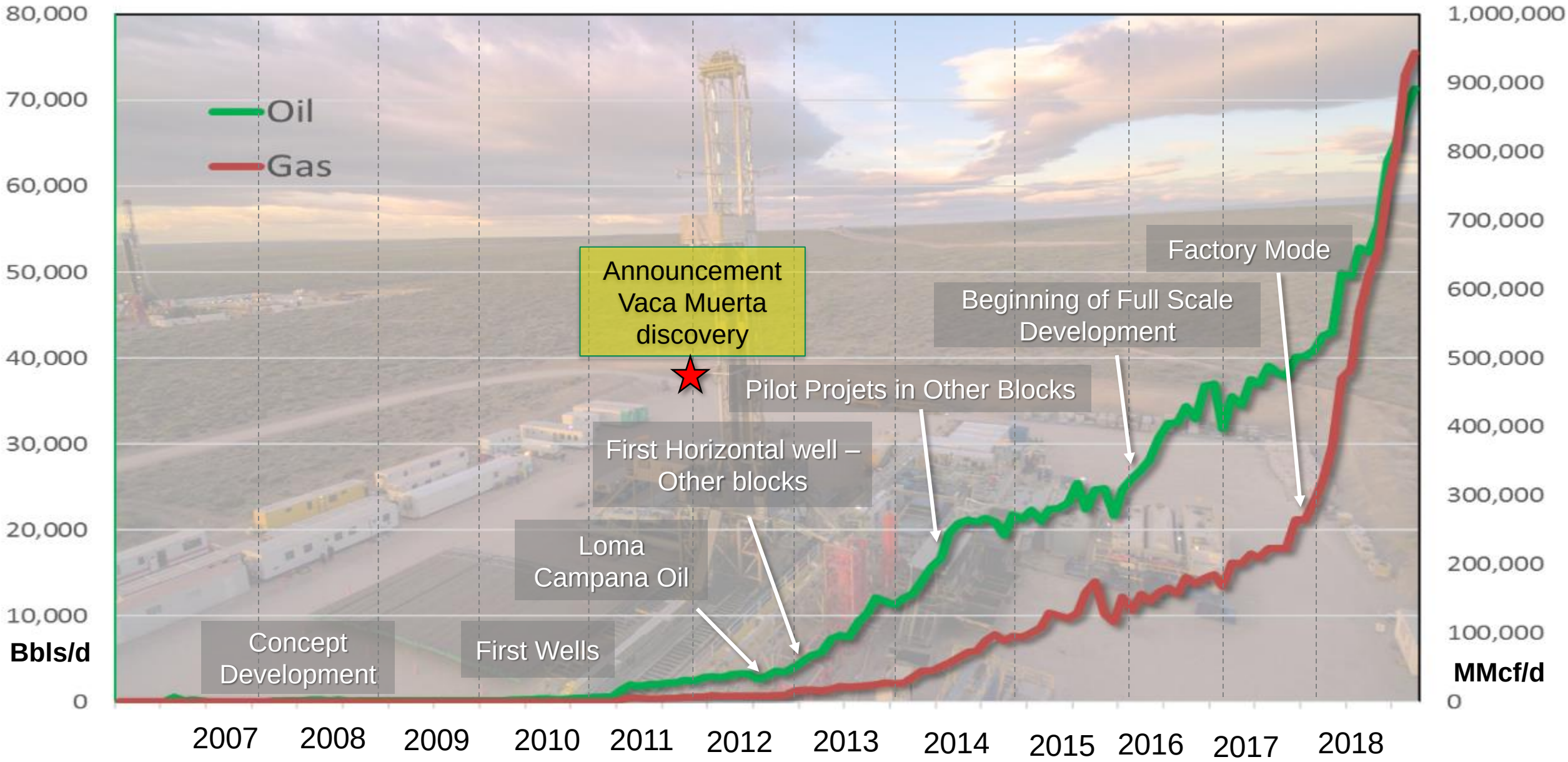


Tight Reservoirs Development



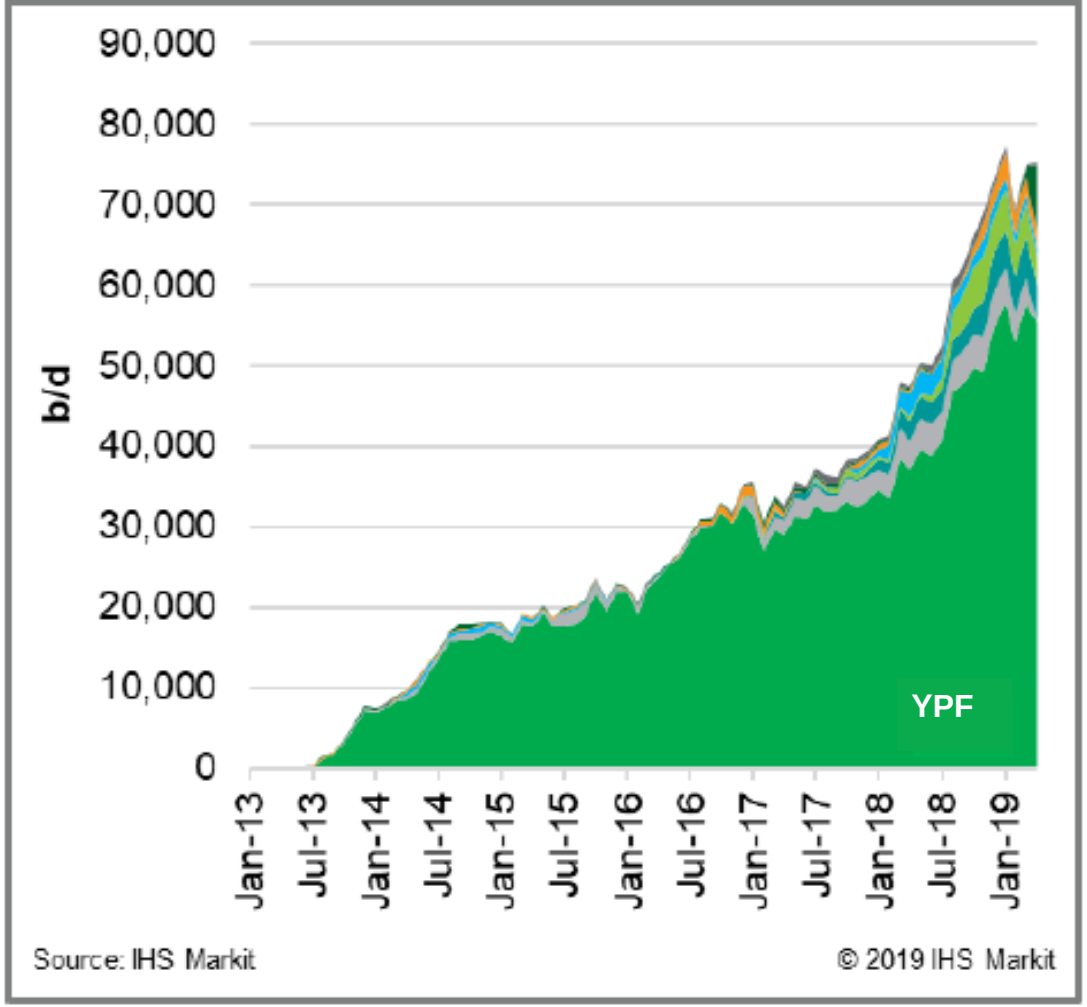
Modified from GiGa Consulting

Vaca Muerta Production and Landmarks

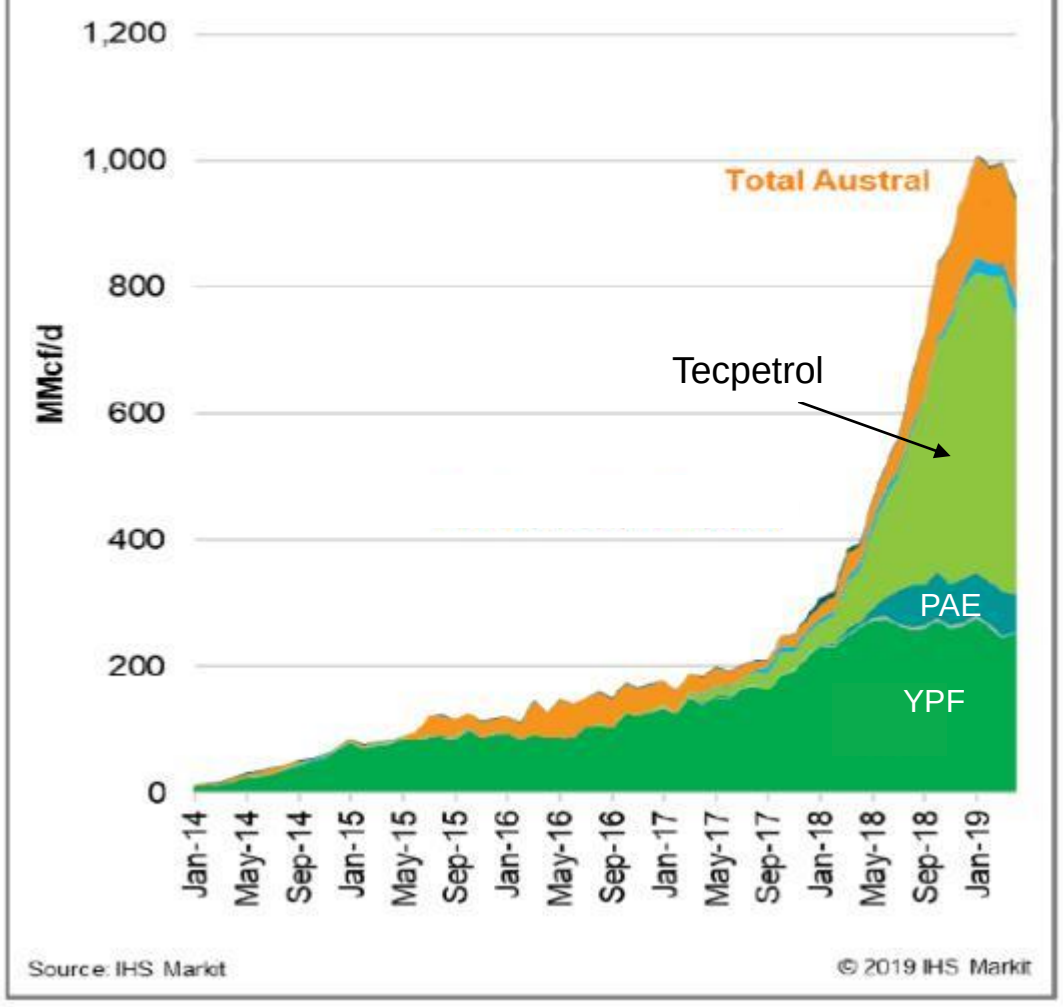


Vaca Muerta Production by Operator

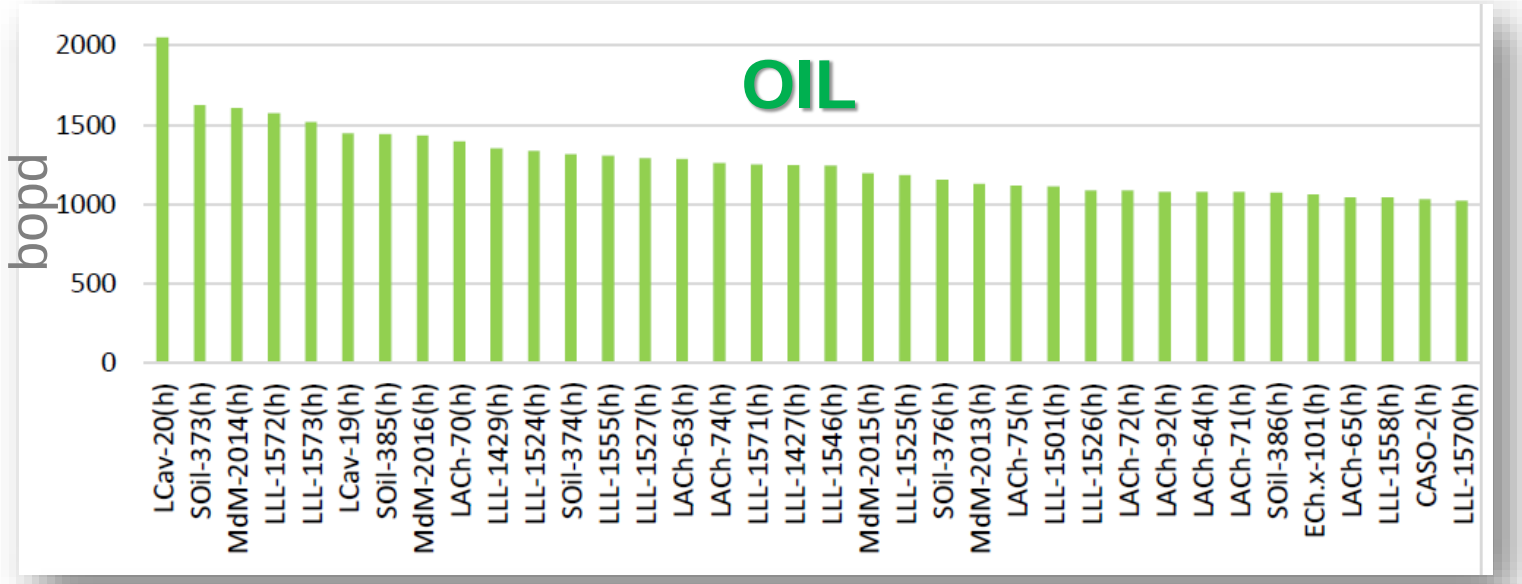
Oil production by operator

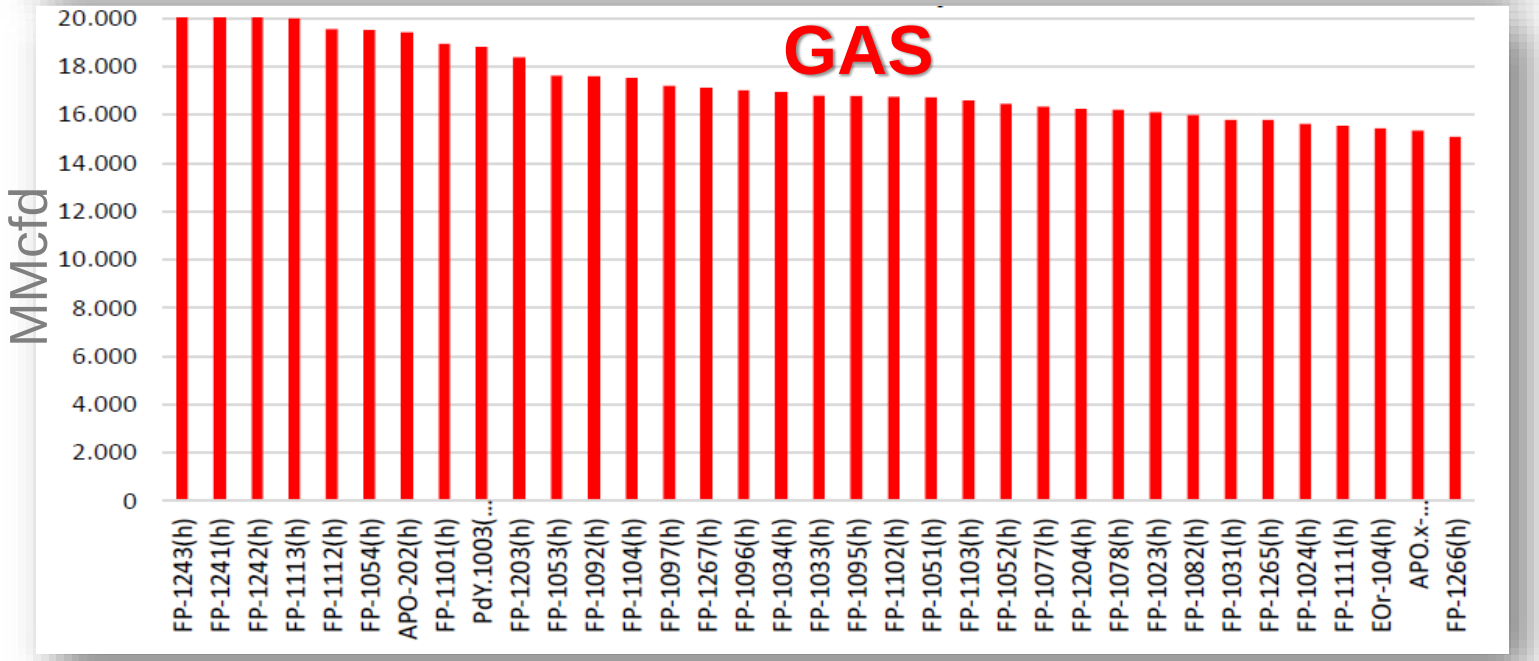


Natural gas production by operator



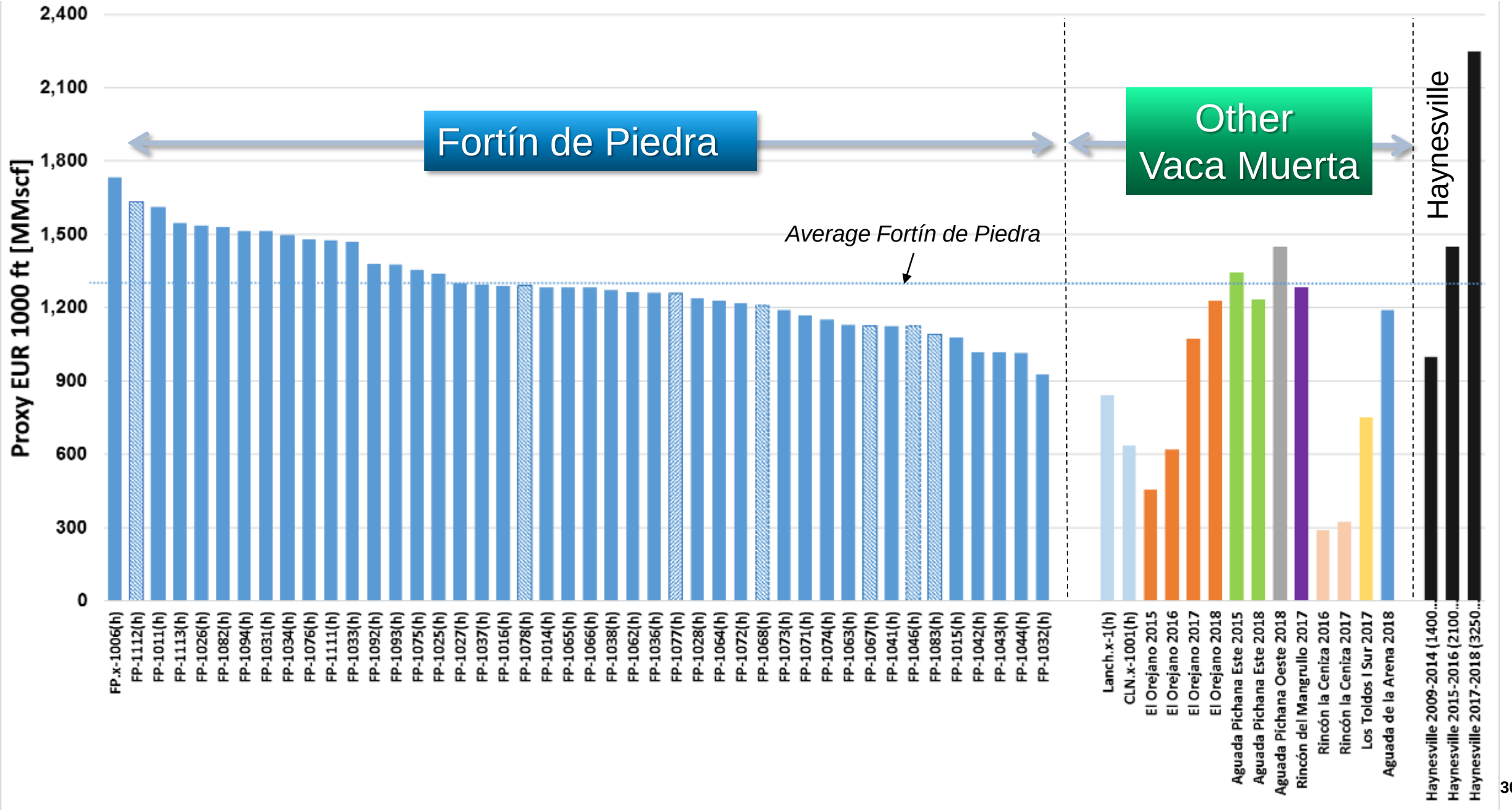
Vaca Muerta Well Performance – Initial Production Rate



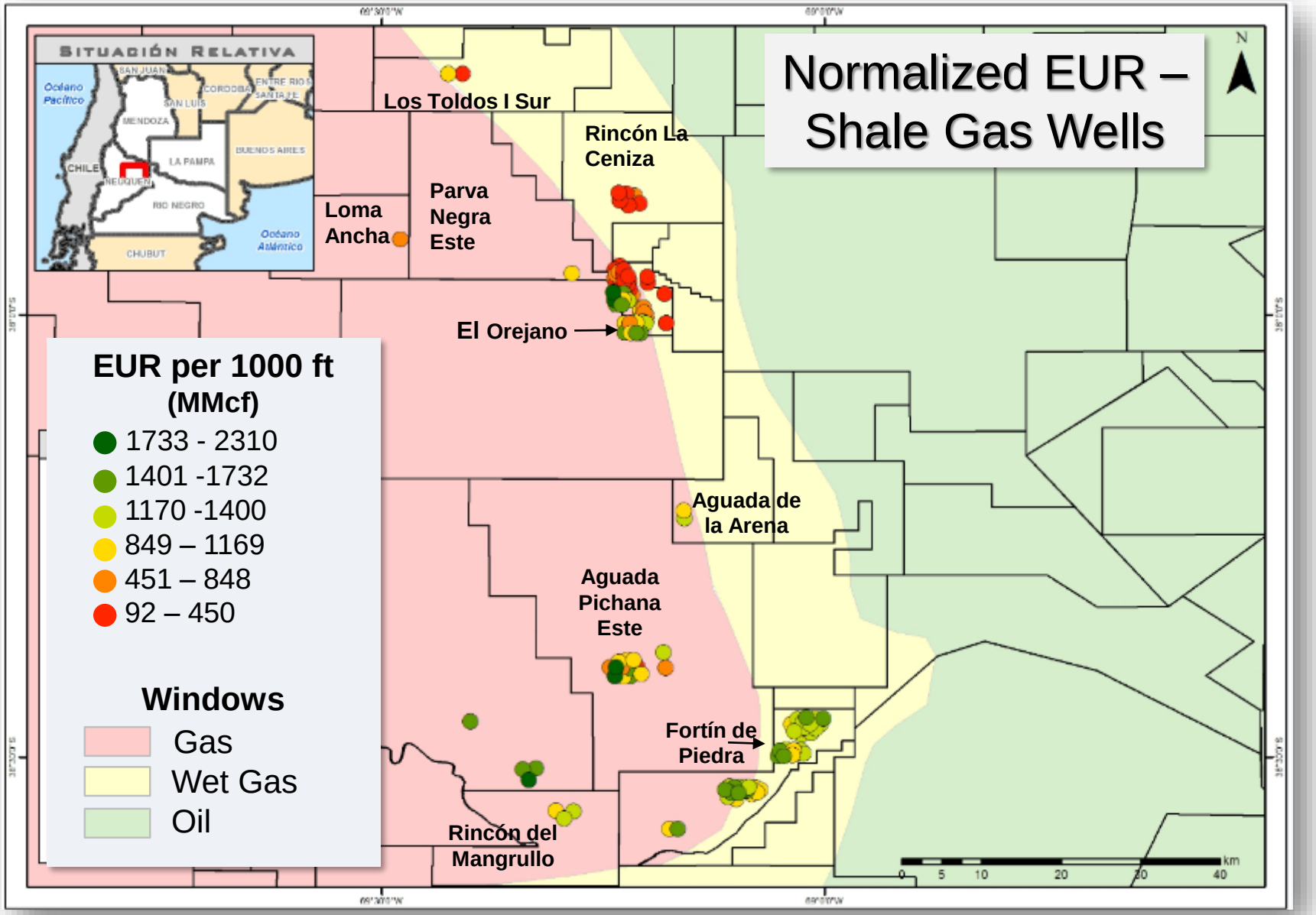


From GiGa Consulting 2019

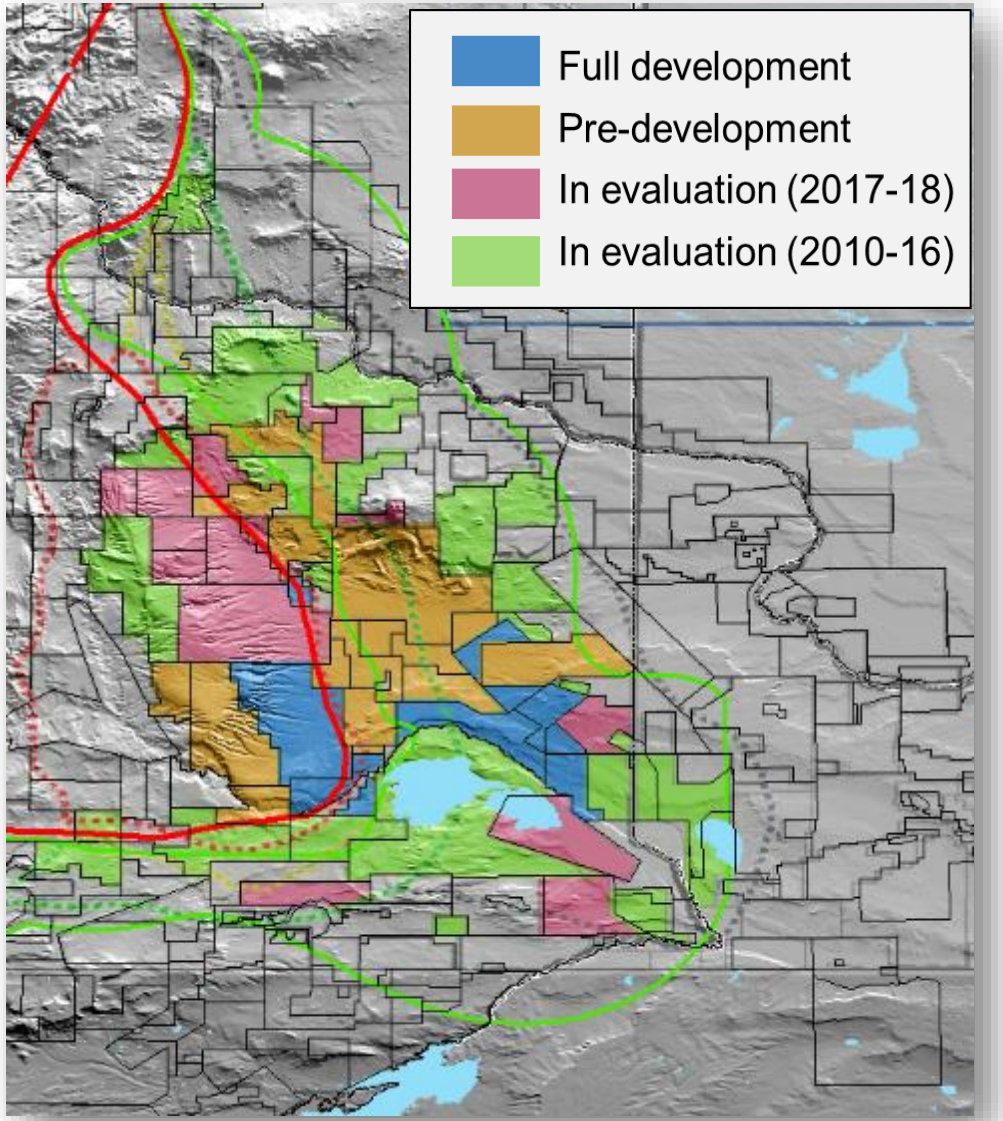
Normalized EUR – Shale Gas Wells



Early Regional Trends in Vaca Muerta



Projects in Vaca Muerta



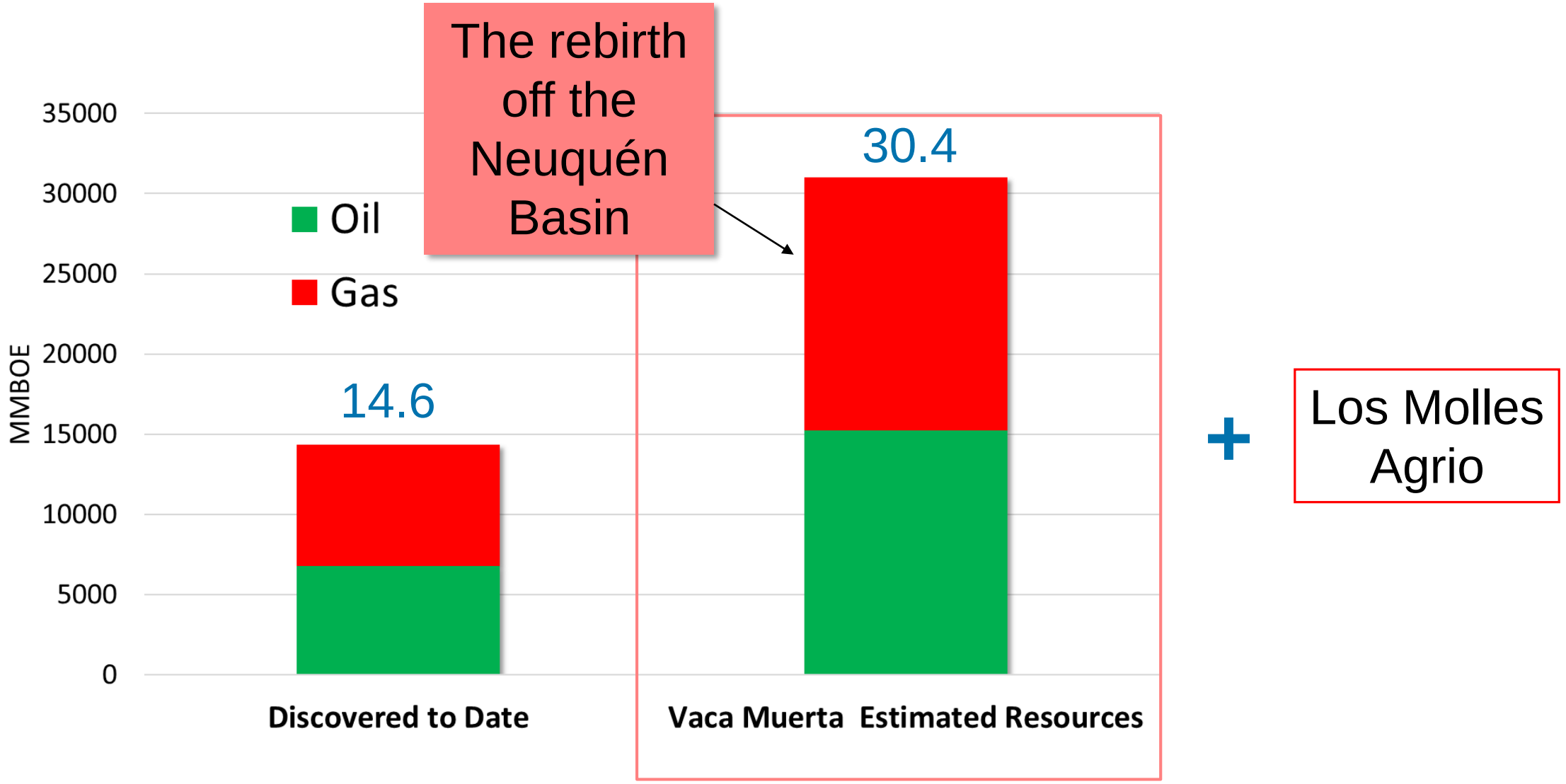
One Zone

Fluid Zone	Area (Km2)		Oil Recoverable (MMBO)	Gas Recoverable (BCF)	Total Hydrocarbons (MMBOE)
	Total	Net	Mean	Mean	Mean
Dry Gas	6400	4160	454	29155	5313
Wet Gas	1100	715	244	4269	956
Gas & Cond	1400	910	788	5411	1690
Volatile Oil	3900	2535	2018	4395	2751
Black Oil	7400	4810	4113	2445	4521
TOTALS	**20,200**	**13,130**	**7,617**	**45,675**	**15,230**

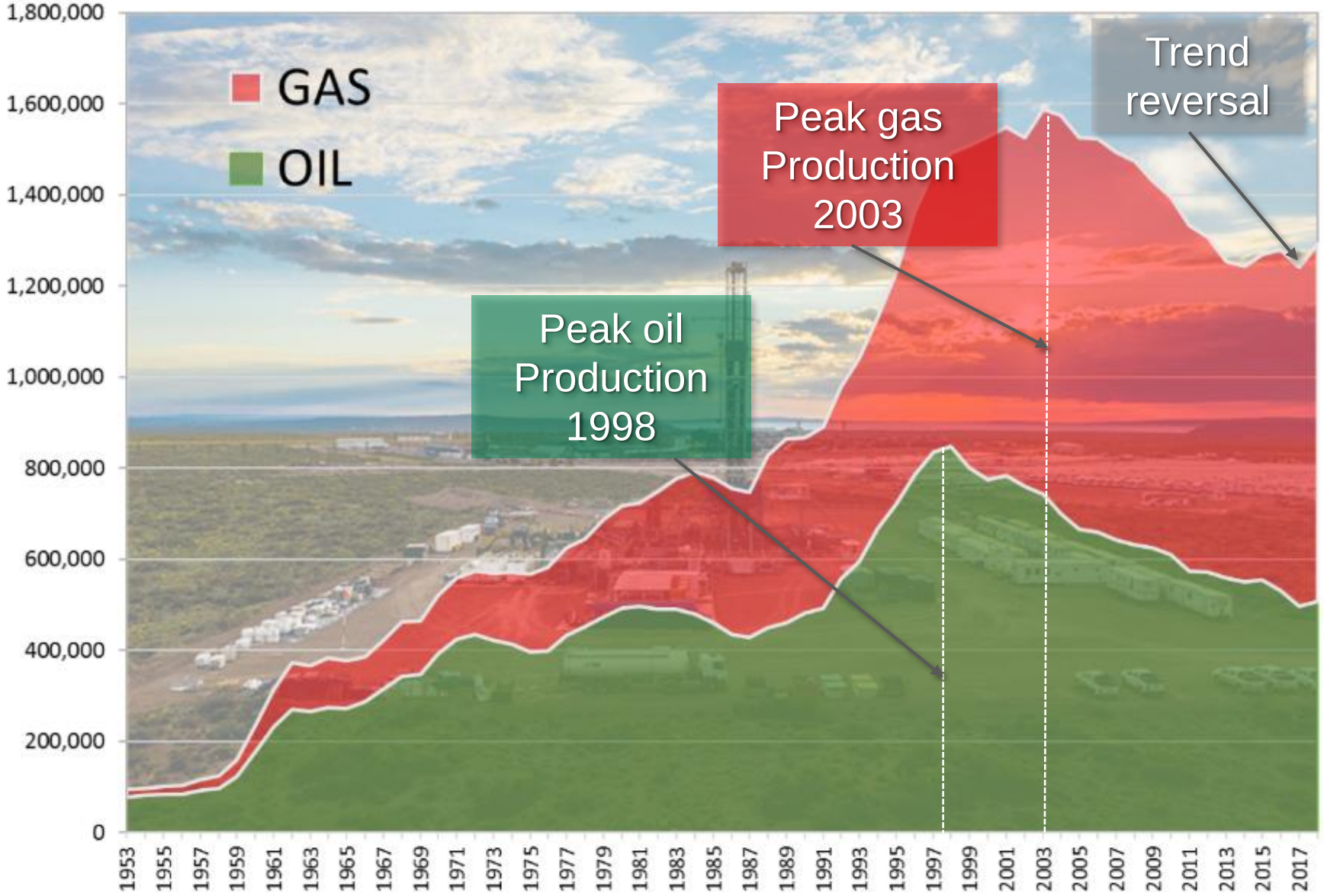
Two Zones

OIL (MMBO)	GAS (BCF)	TOTAL (MMBOE)
15,234	**91,350**	**30,459**

Neuquén Basin Resources

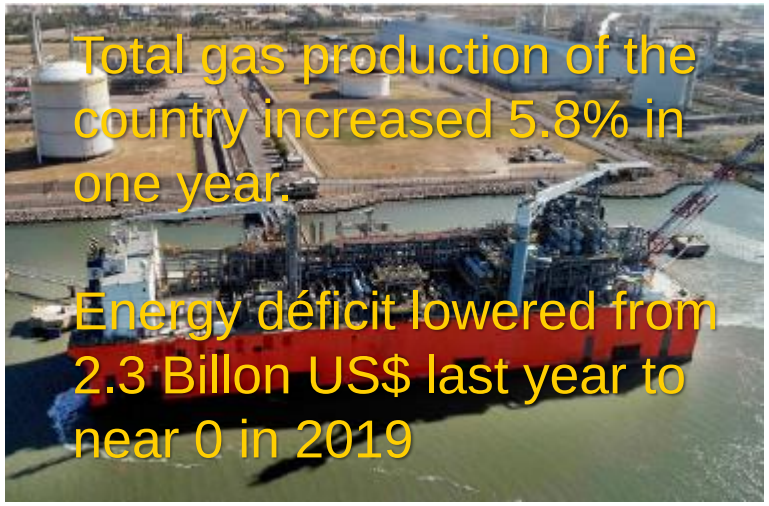


Historic Production - Argentina



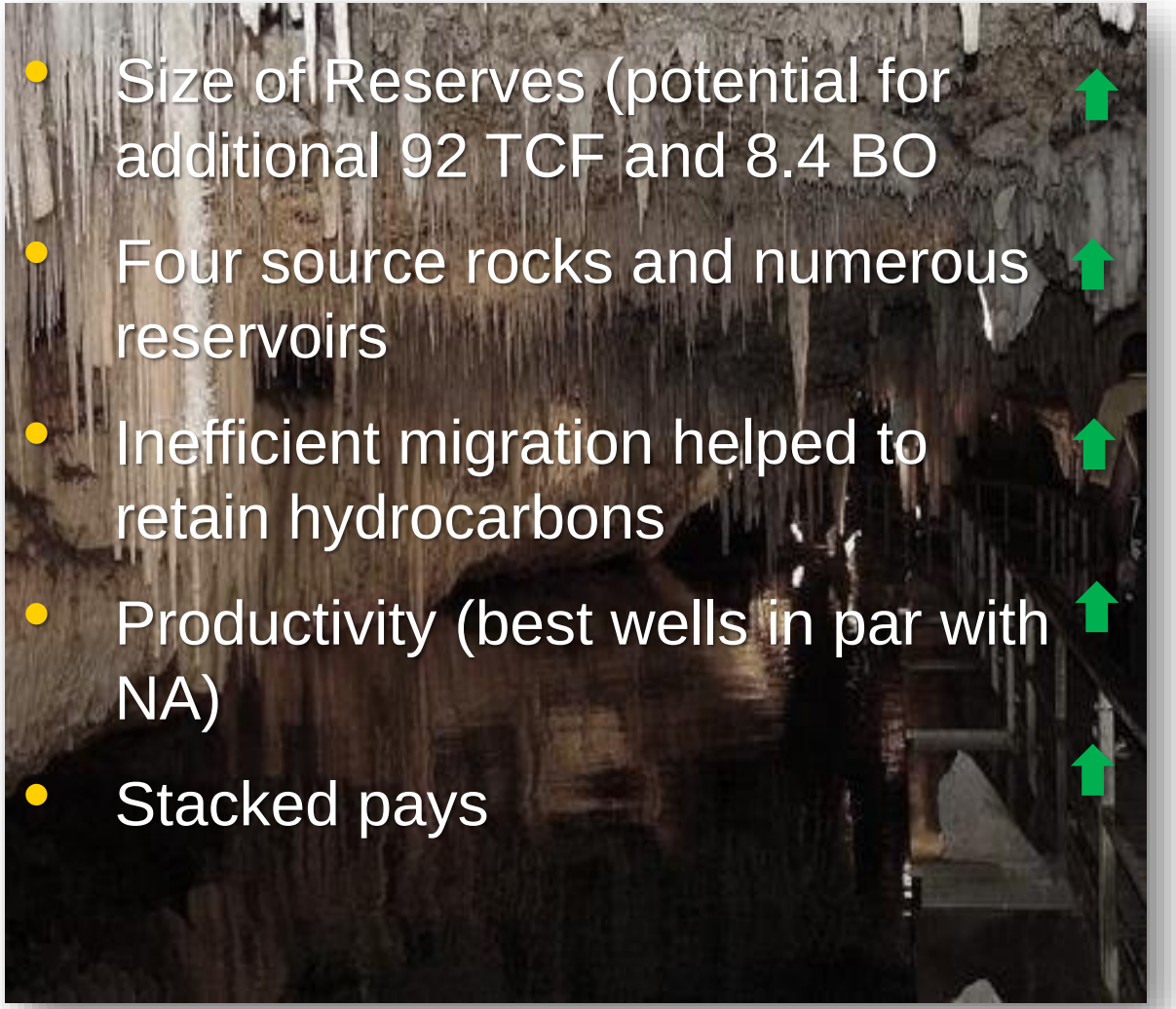
Current Vaca Muerta Production

- 82,000 bopd (increased 64% in one year)
- 1.16 Bcf/d (increased 111% in one year)



Neuquén Superbasin

Below Ground Factors



- Size of Reserves (potential for additional 92 TCF and 8.4 BO ↑
- Four source rocks and numerous reservoirs ↑
- Inefficient migration helped to retain hydrocarbons ↑
- Productivity (best wells in par with NA) ↑
- Stacked pays ↑

Above Ground Factors

- Large tracks of land (average block size 218 Km2). ↑
- Land Access / operability ↑
- Fiscal Regime – Prices ↑
- Indigenous groups ↑
- Workforce/Service Sector ↑
- Supply chain and evacuating infrastructure ↑
- Market ↑
- Political Stability ↑