Exploration Trends in South America*

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Abstract

The largest fields discovered during the last 10 years in Latin America were found in the deep offshore, with over 77 BBOE were added and with average field sizes of 550 MMBOE. By far most of these discoveries are located in the pre-salt of the Campos and Santos Basins in Brazil. Discoveries in the Shelf areas during the same period were also important, totaling about 6.8 BBoe, with average field sizes of 85 MMBOE. Of these, the most important was the Perla discovery in the Gulf of Venezuela. On land, the largest fields were found in the fold and thrust belts, with average field sizes of 58 MMBOE, but with small total volumes since only a few wells were drilled in this environment. About 7.5 BBOE were discovered in the onshore, in numerous small fields, being the Llanos basin of Colombia and the Neuquén Basin of Argentina the most prominent. However, the unconventional resources of the Vaca Muerta Fm. in the Neuquén basin include the largest resources to be developed in the onshore of the continent. Looking into the future, Latin America still maintains important conventional opportunities. Onshore, the most promising area are the heavy oil accumulations in the flanks of the sub Andean basins (Orinoco and Llanos), as well as the foothills areas which have been poorly explored in the last years. Offshore many off the Atlantic basins remain very poorly explored, and thus hold important potential as recently demonstrated by new discoveries in Guyana. The deep offshore Caribbean basins of Colombia and Mexico will be areas of major focus in the coming years.

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ACE 2017
ANNUAL CONVENTION & EXHIBITION

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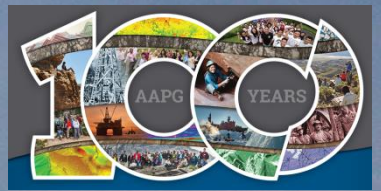
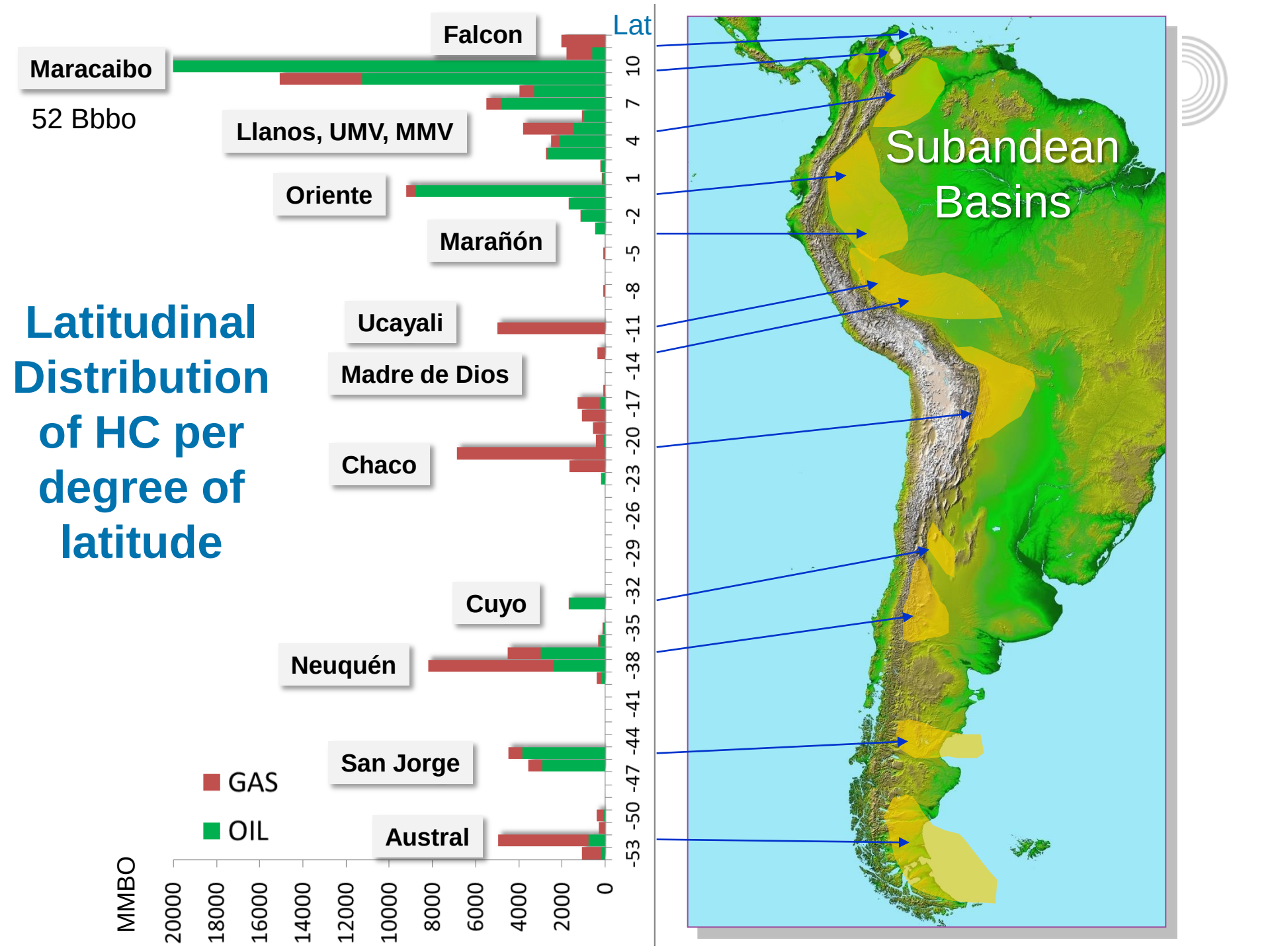
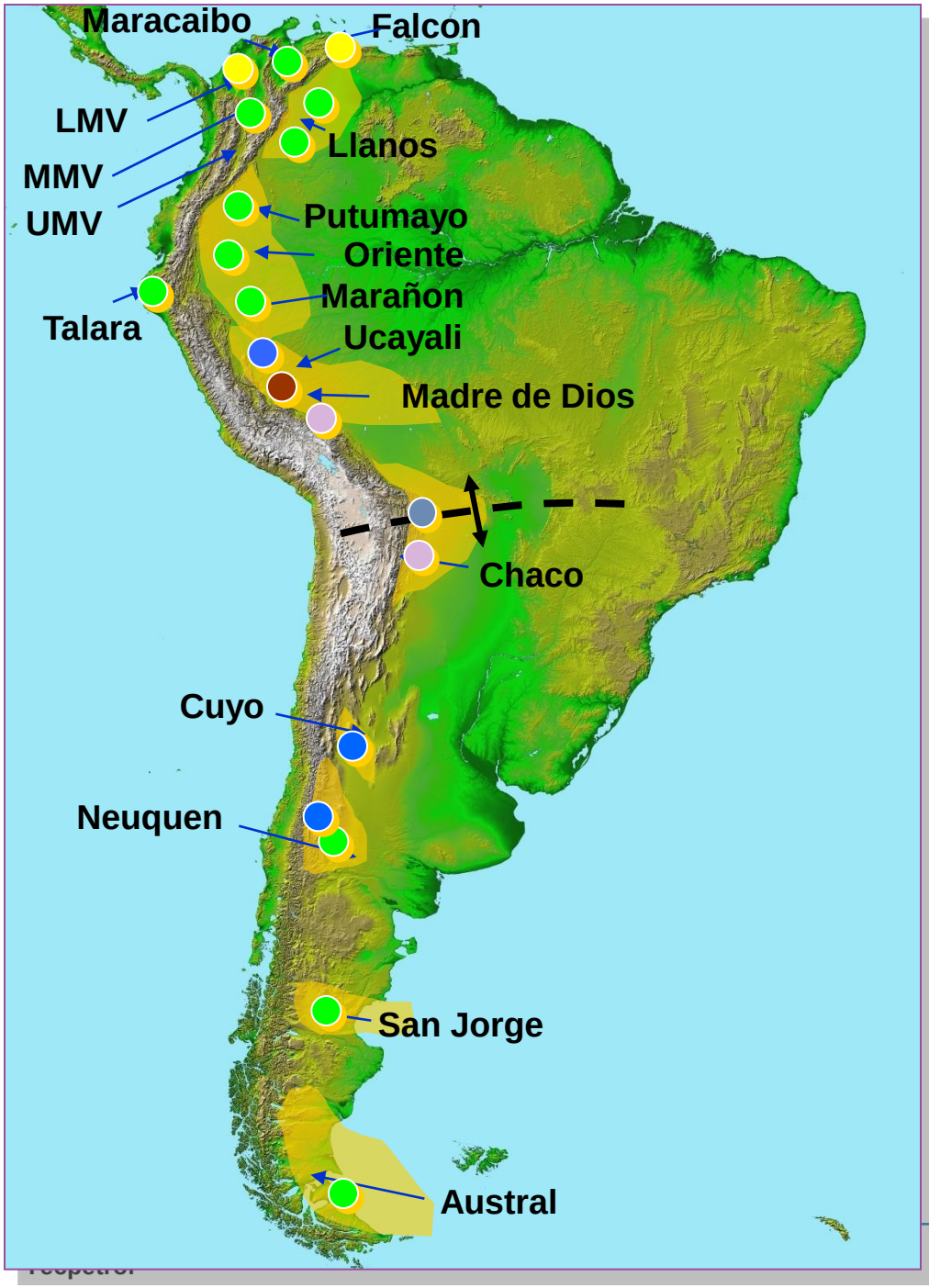


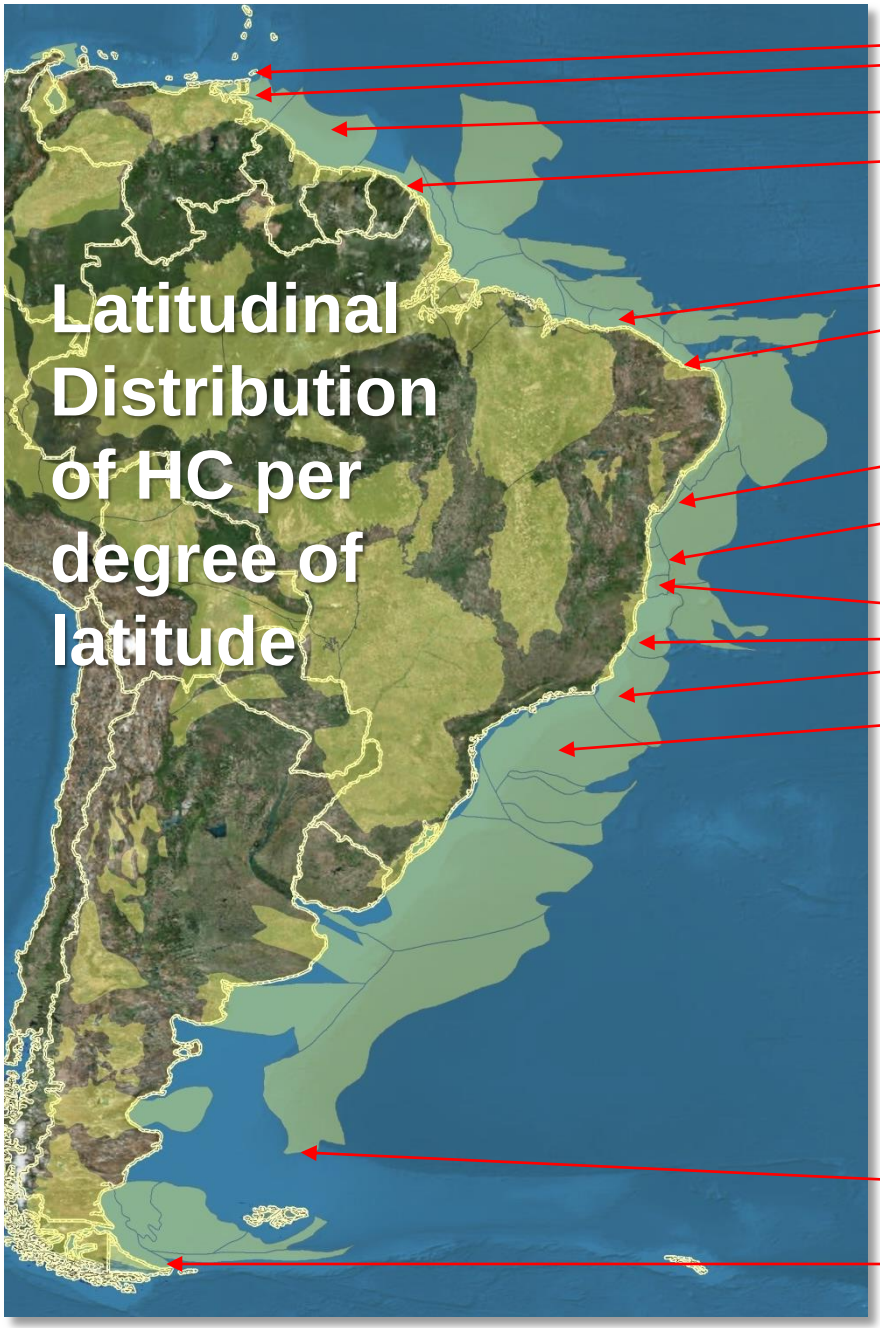
Areas of Exploration in Latin America

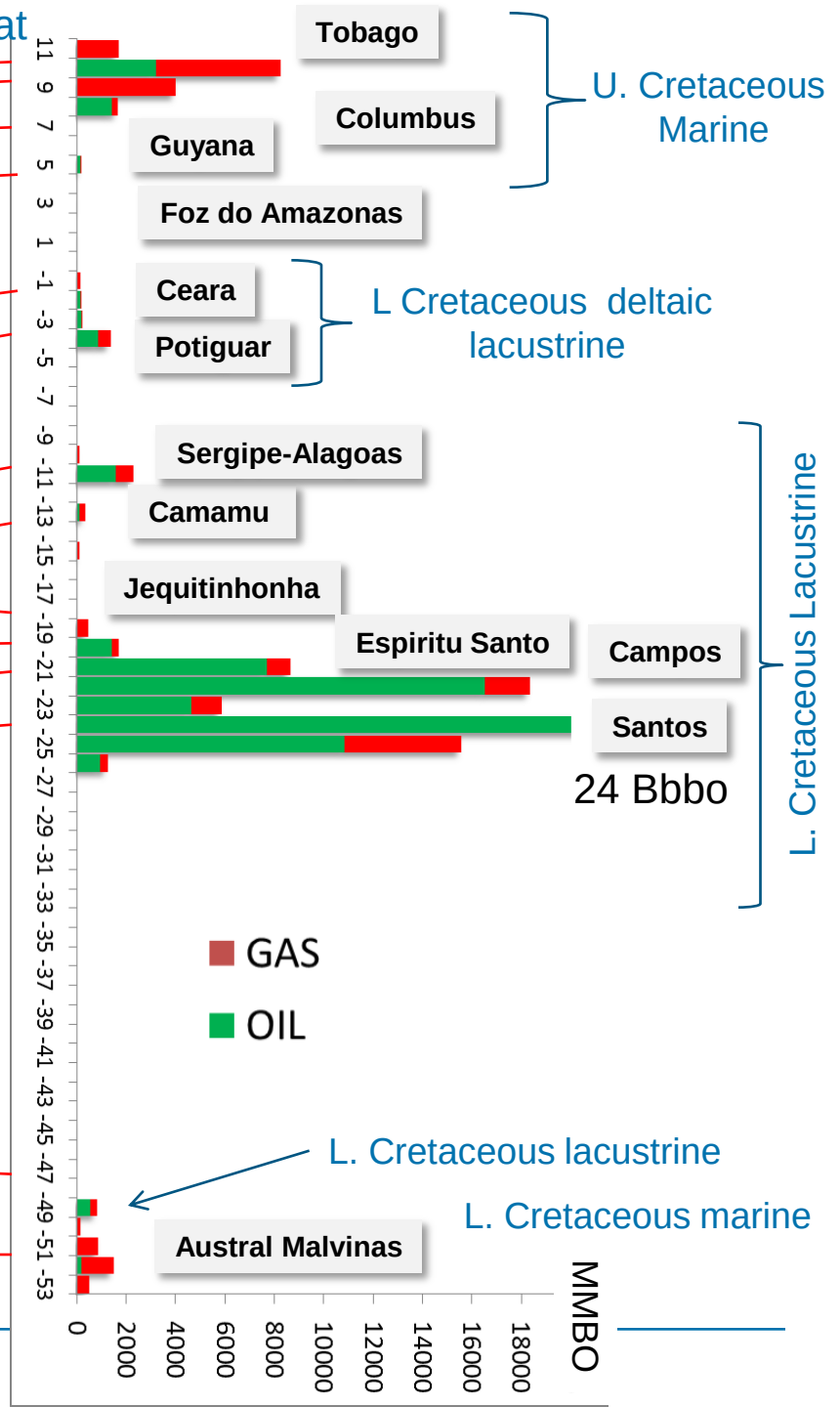

Latitudinal Distribution of HC per degree of latitude
Maracaibo
52 Bbbo
Falcon
Llanos, UMV, MMV
Oriente
Marañón
Ucayali
Madre de Dios
Chaco
Cuyo
Neuquén
San Jorge
Austral
GAS
OIL
MMBO
20000
18000
16000
14000
12000
10000
8000
6000
4000
2000
0
Lat
10
7
4
1
-2
-5
-8
-11
-14
-17
-20
-23
-26
-29
-32
-35
-38
-41
-44
-47
-50
-53
Subandean Basins

Age of main Source Rocks for the Subandean Basins

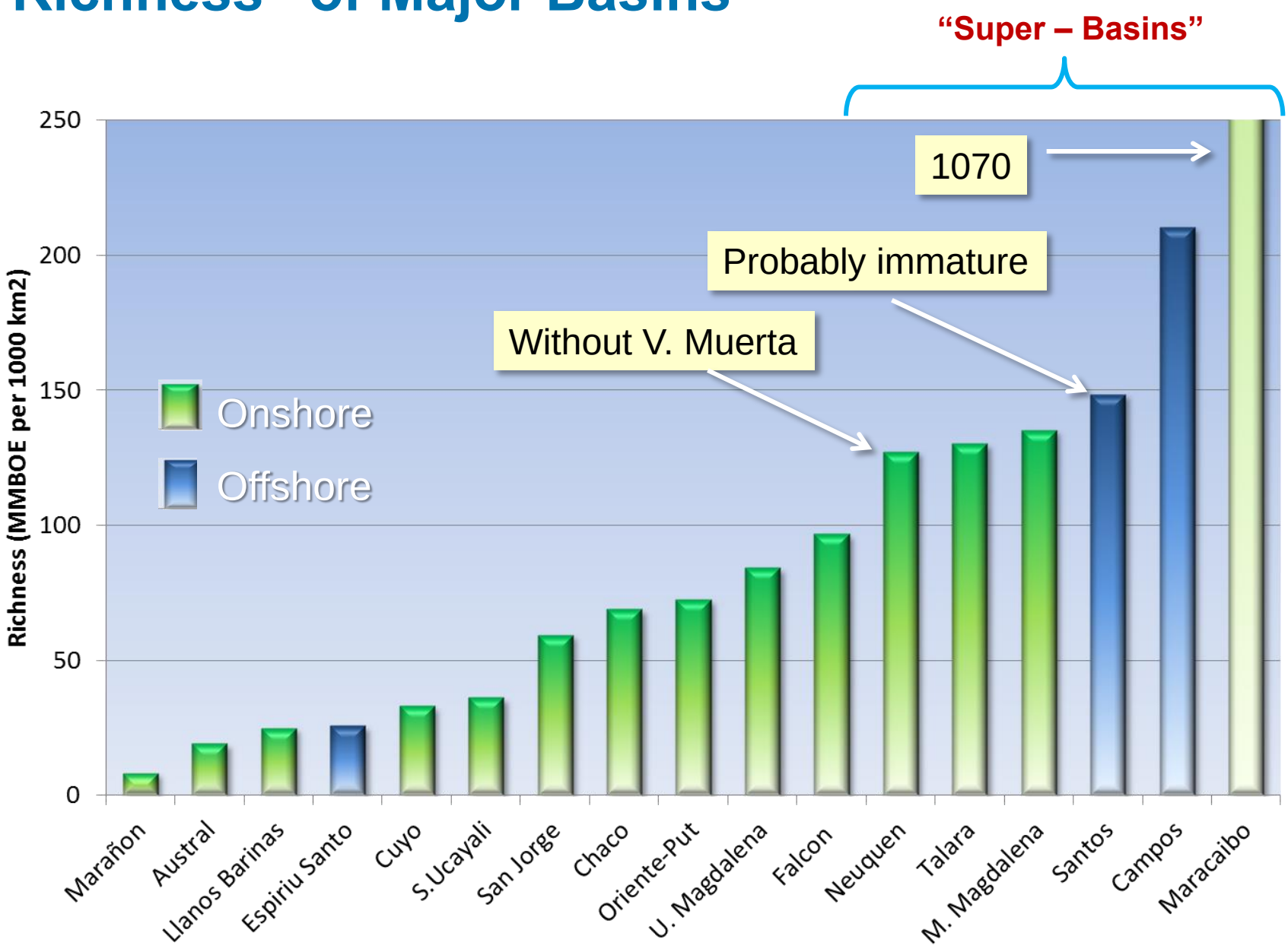


- Tertiary
- Cretaceous
- Tr-Jurassic
- Cb -Permian
- Devonian
- Silurian

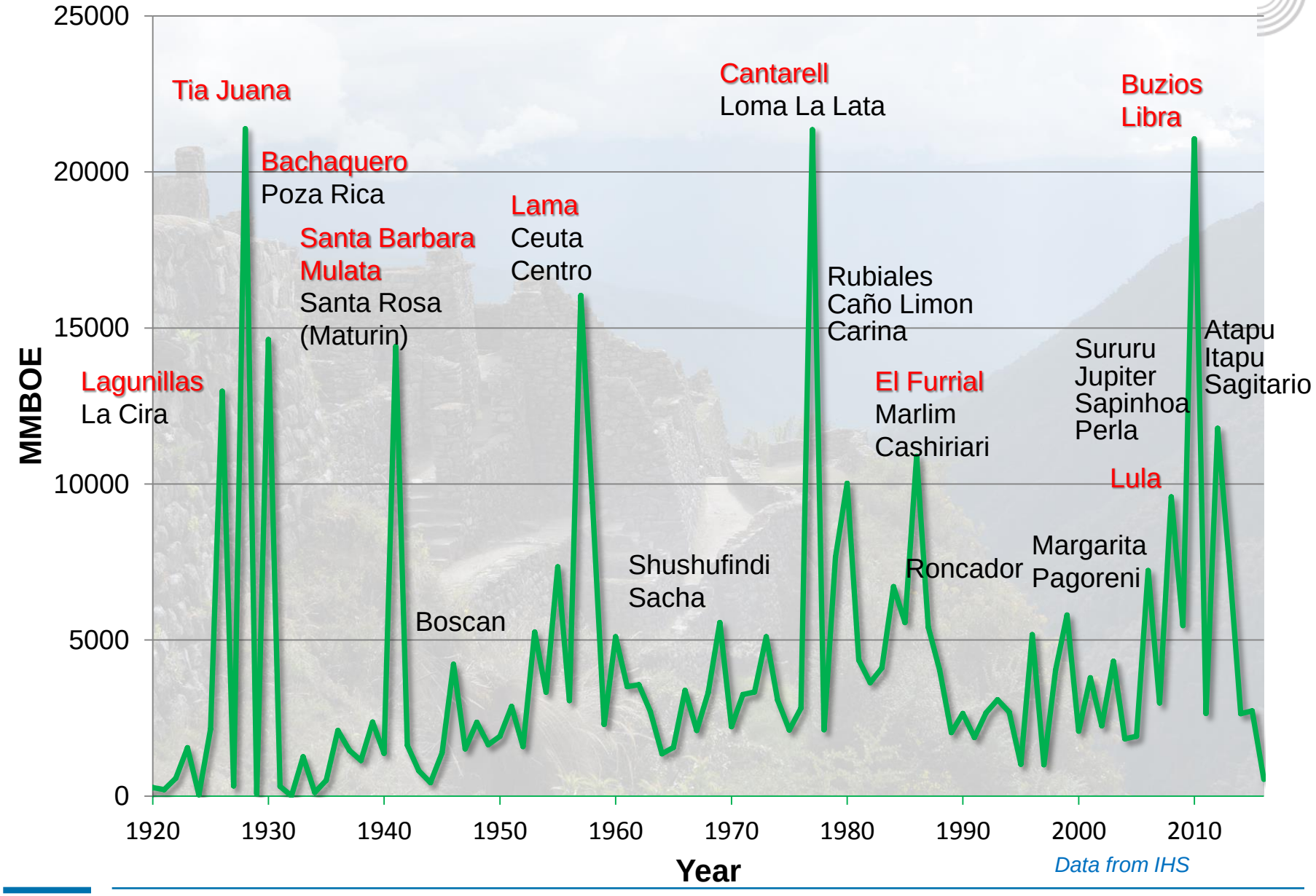

Latitudinal Distribution of HC per degree of latitude


Lat
11 9 7 5 3 1 -1 -3 -5 -7 -9 -11 -13 -15 -17 -19 -21 -23 -25 -27 -29 -31 -33 -35 -37 -39 -41 -43 -45 -47 -49 -51 -53
Tobago
Columbus
Guyana
Foz do Amazonas
Ceara
Potiguar
Sergipe-Alagoas
Camamu
Jequitinhonha
Espiritu Santo
Campos
Santos
24 Bbbo
Austral Malvinas
U. Cretaceous Marine
L Cretaceous deltaic lacustrine
L. Cretaceous Lacustrine
GAS
OIL
L. Cretaceous lacustrine
L. Cretaceous marine
0 2000 4000 6000 8000 10000 12000 14000 16000 18000
MMBO

“Richness” of Major Basins

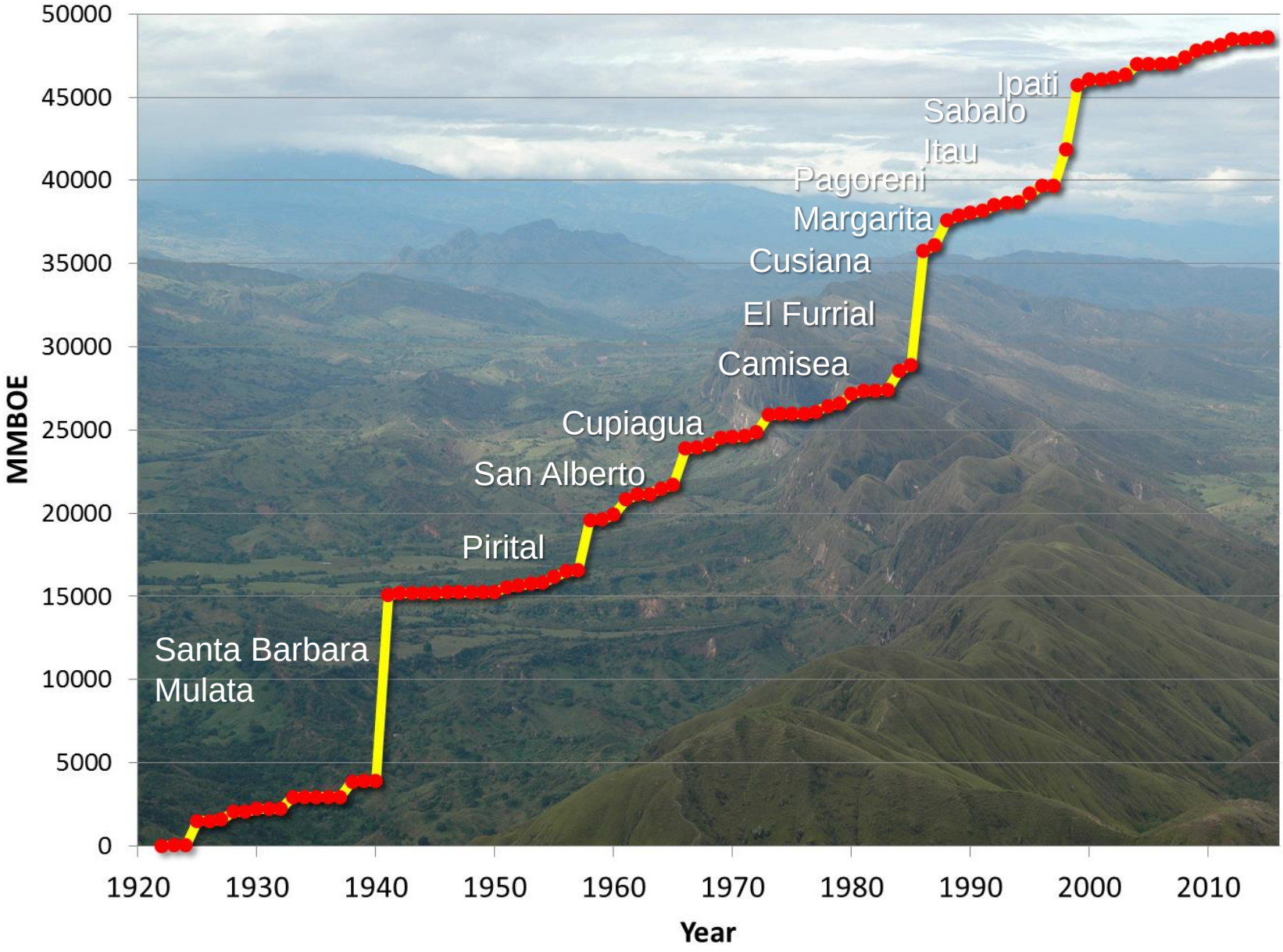


Latin American Discoveries – Last 100 years

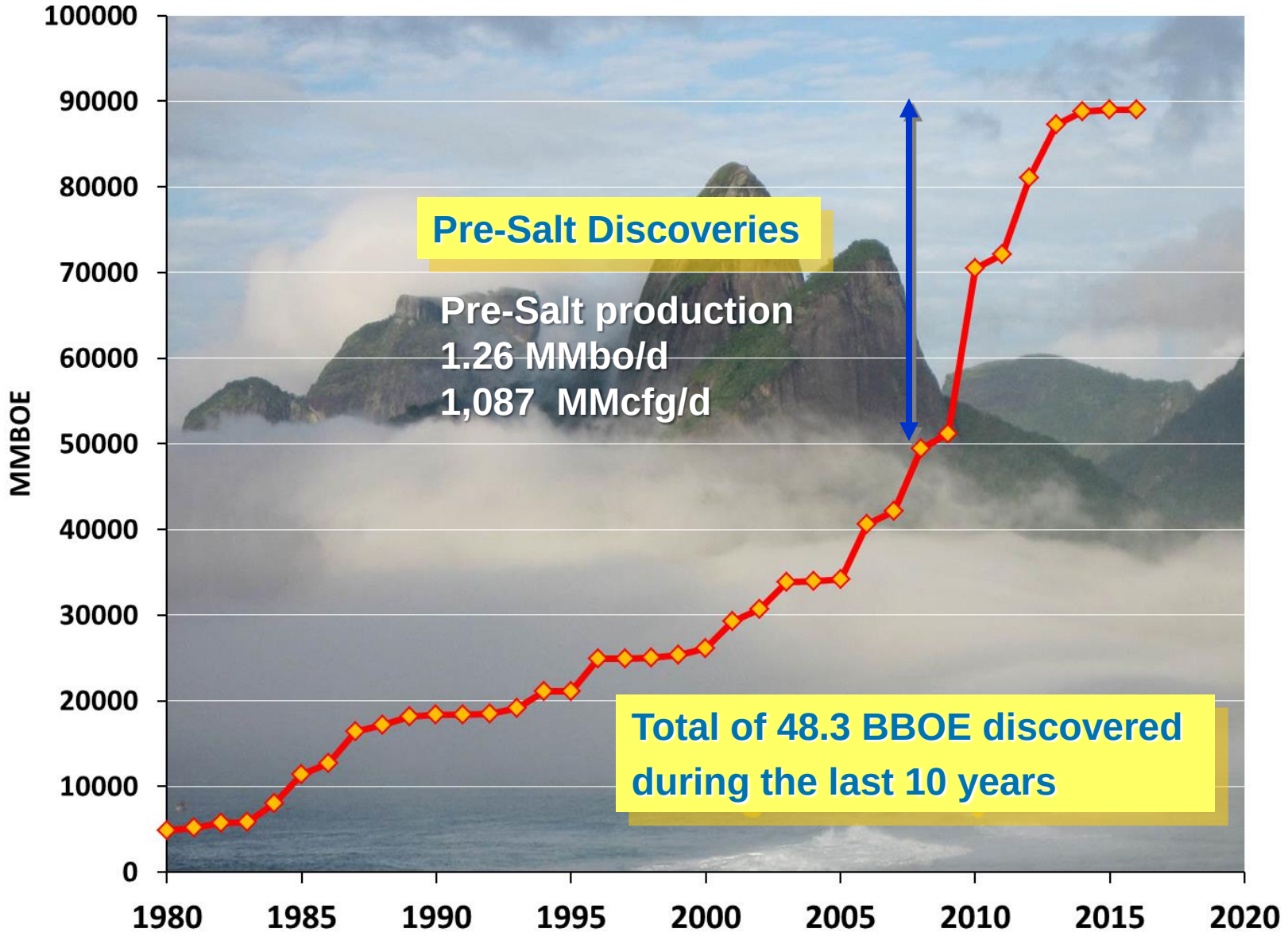


Orinoco Belt excluded

Discoveries in the Thrust Belt

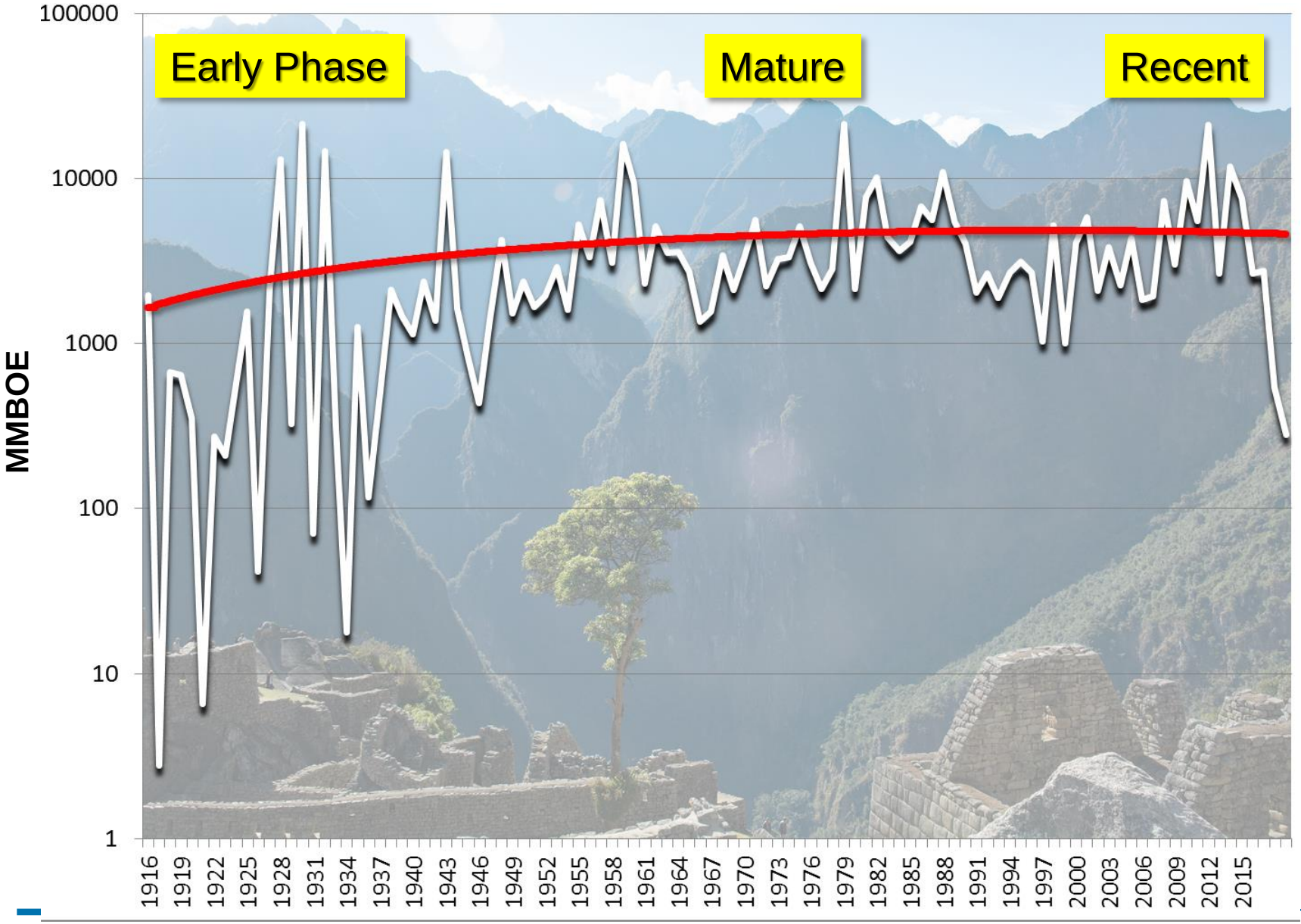


Creaming Curve Brazil Atlantic Basins

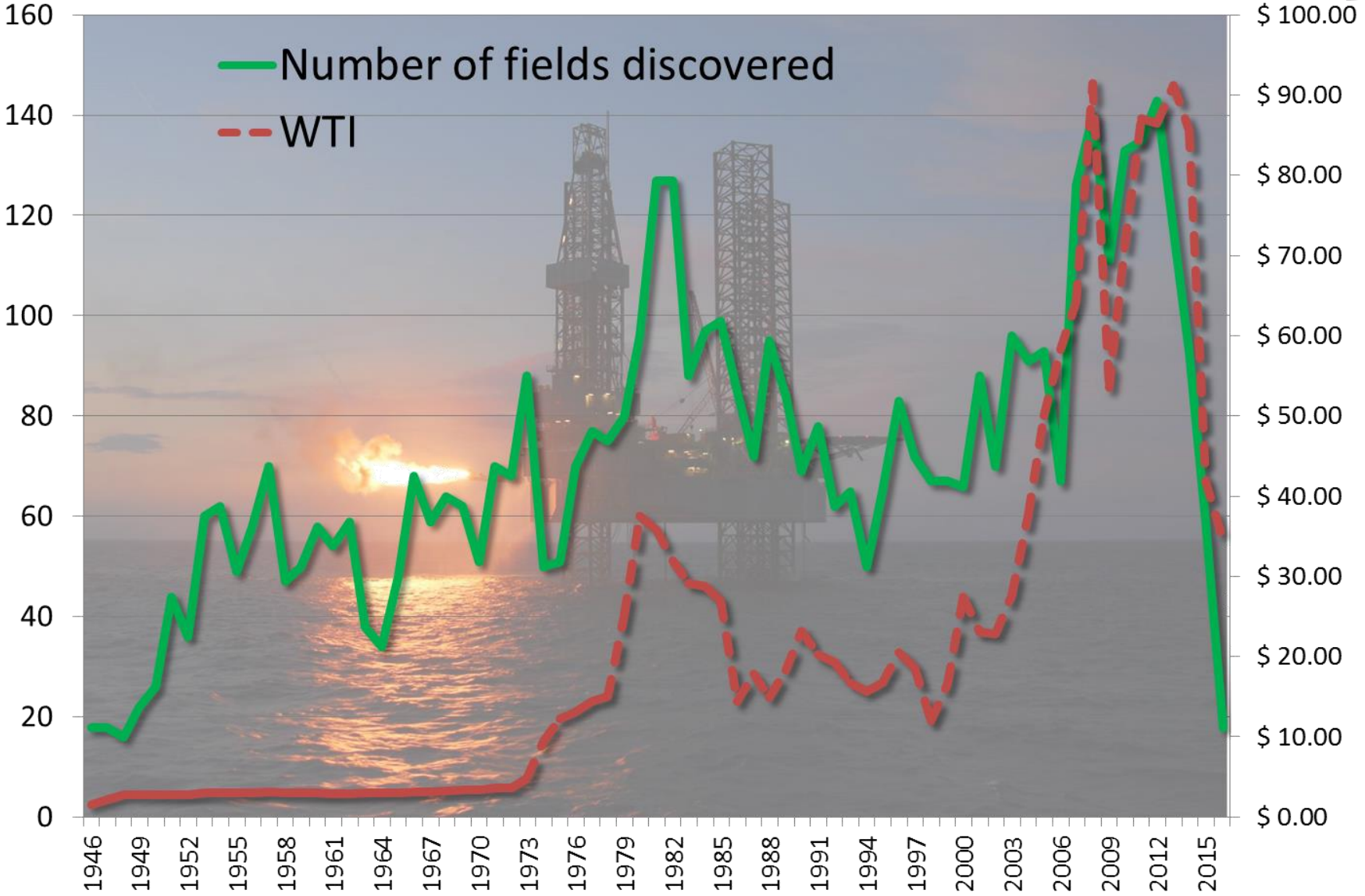


Data from IHS

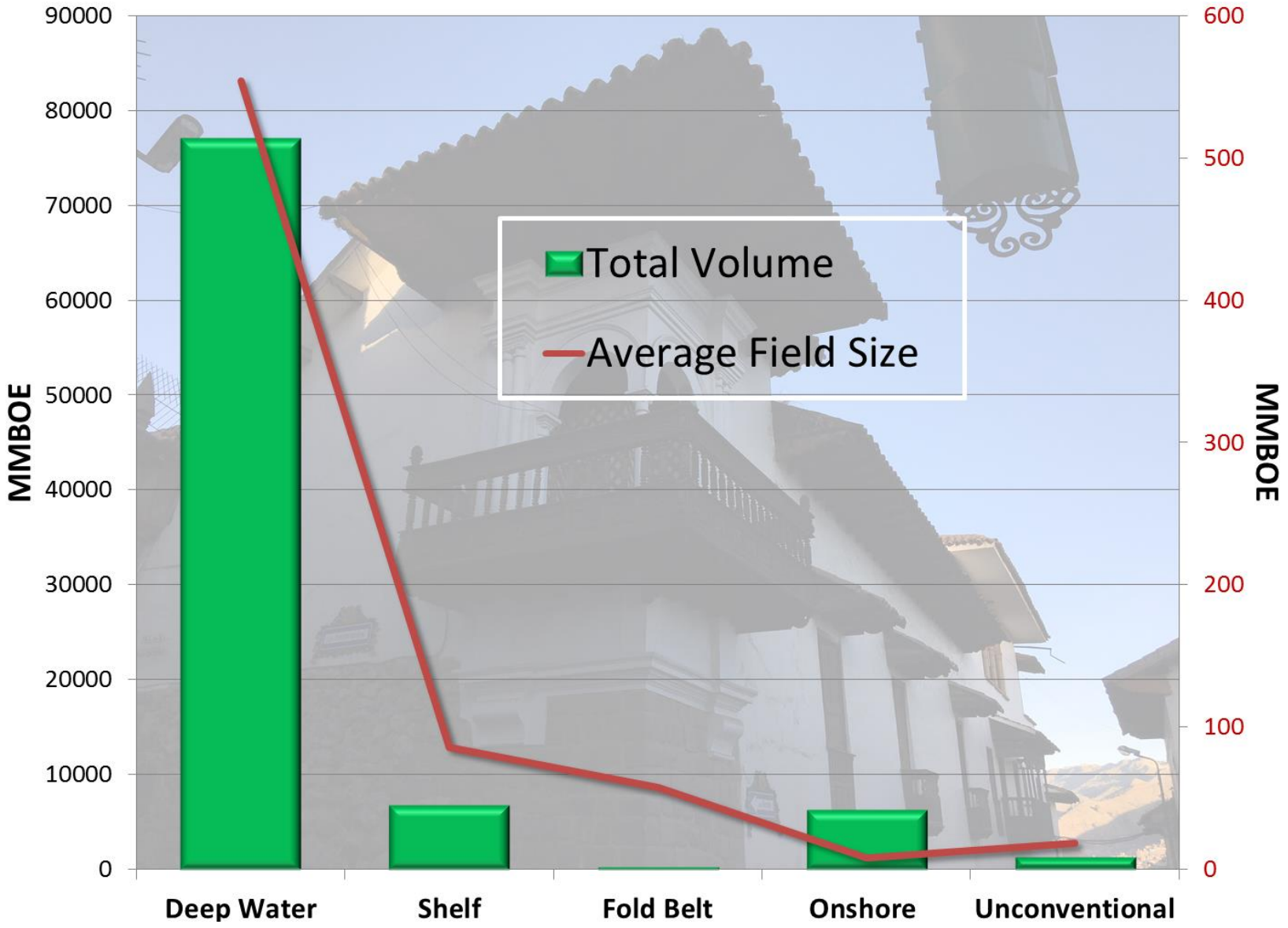
Latin American Discoveries – Last 100 years



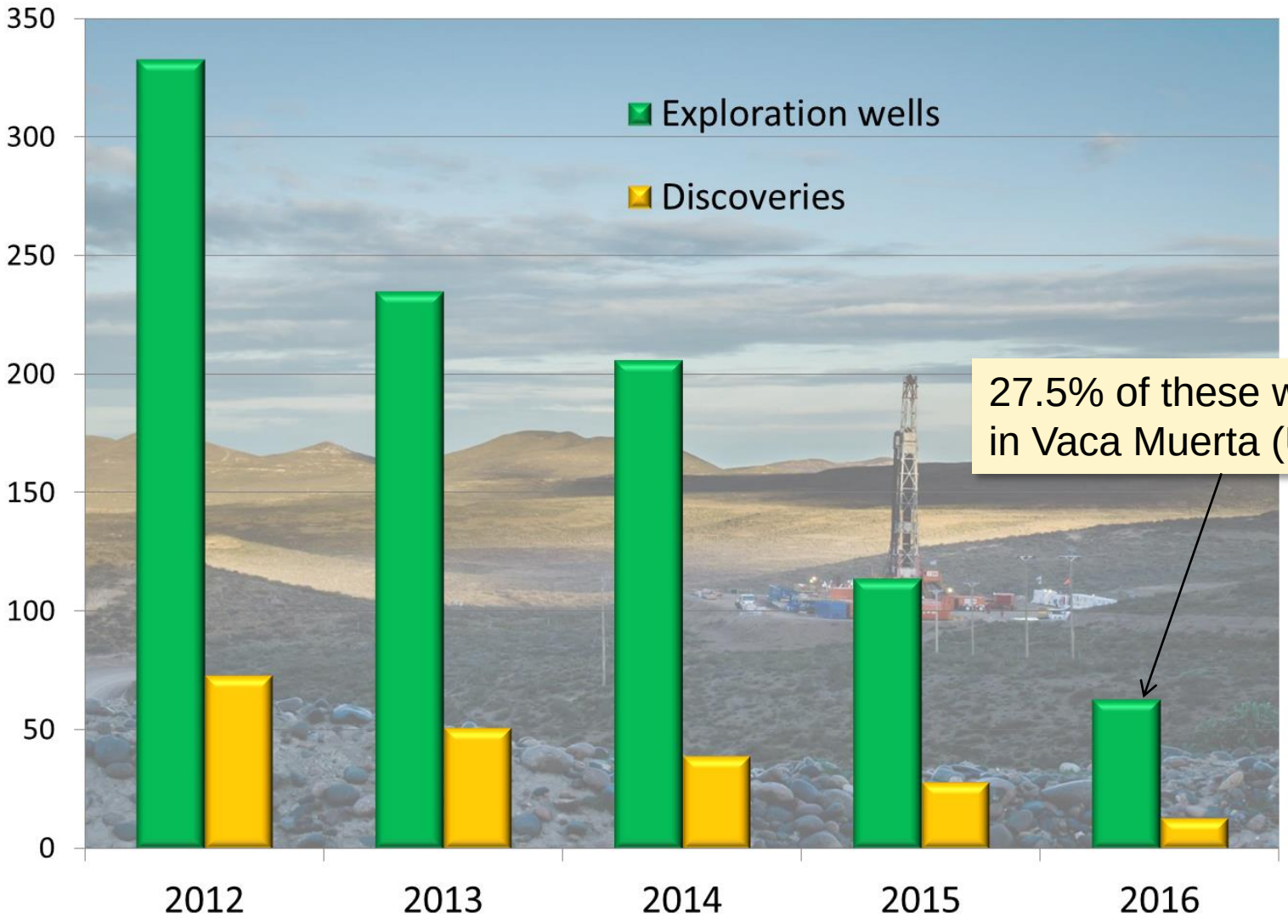
Number of Discoveries vs. WTI price



Discoveries during the last 10 years

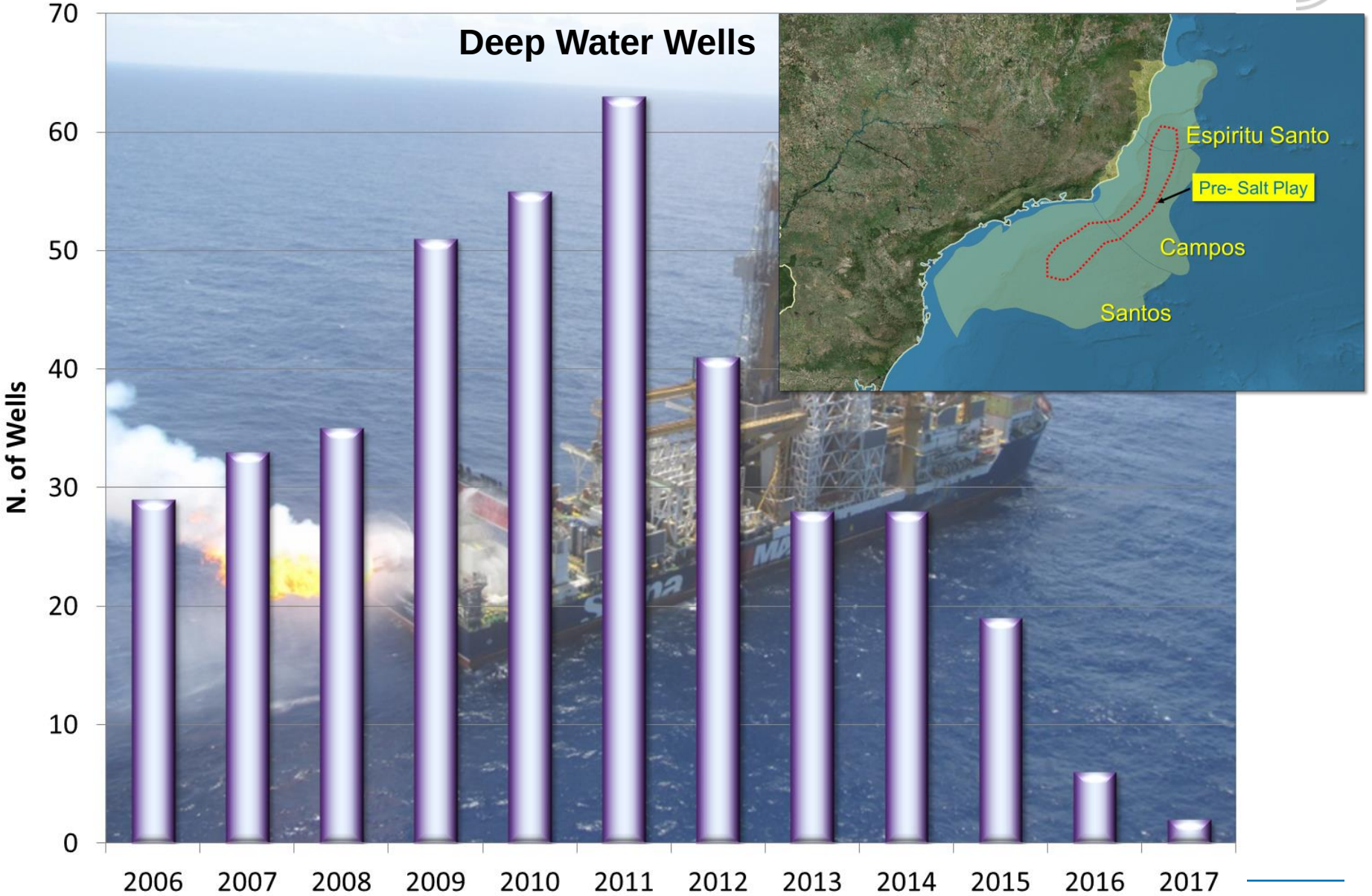


Recent Exploratory Activity in Latin America



Data from IHS

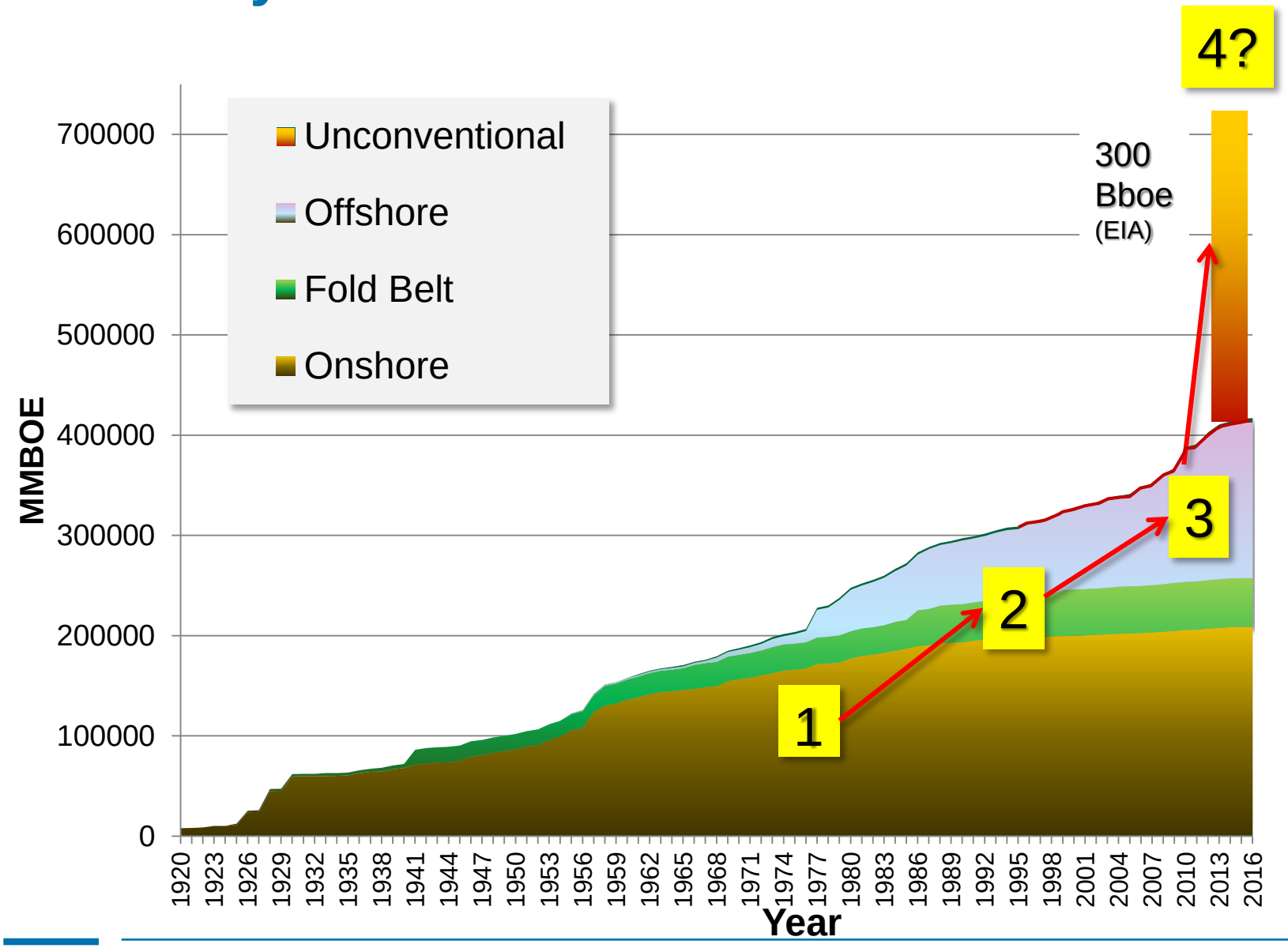
Recent Trends Brazil Atlantic Basins



Data from IHS

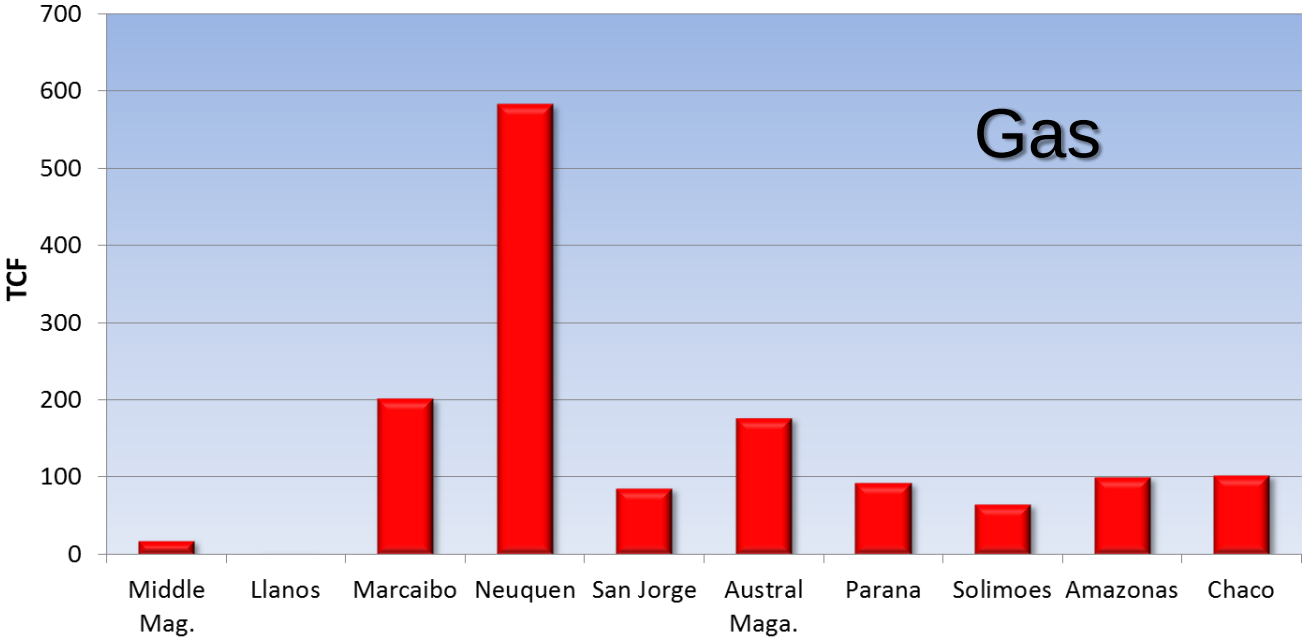
Trends Northern South America

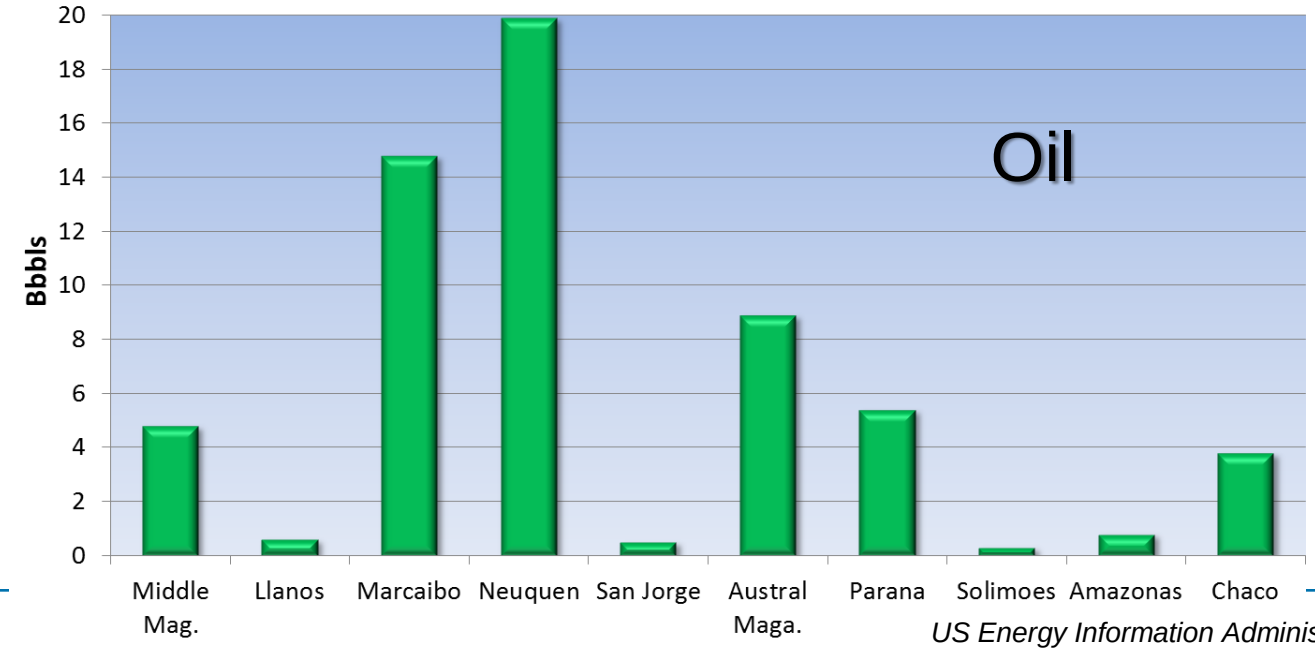
Cumulative Resources discovered during the last 100 years



Unconventional Potential Latin America

Technically Recoverable Unconventional Resources

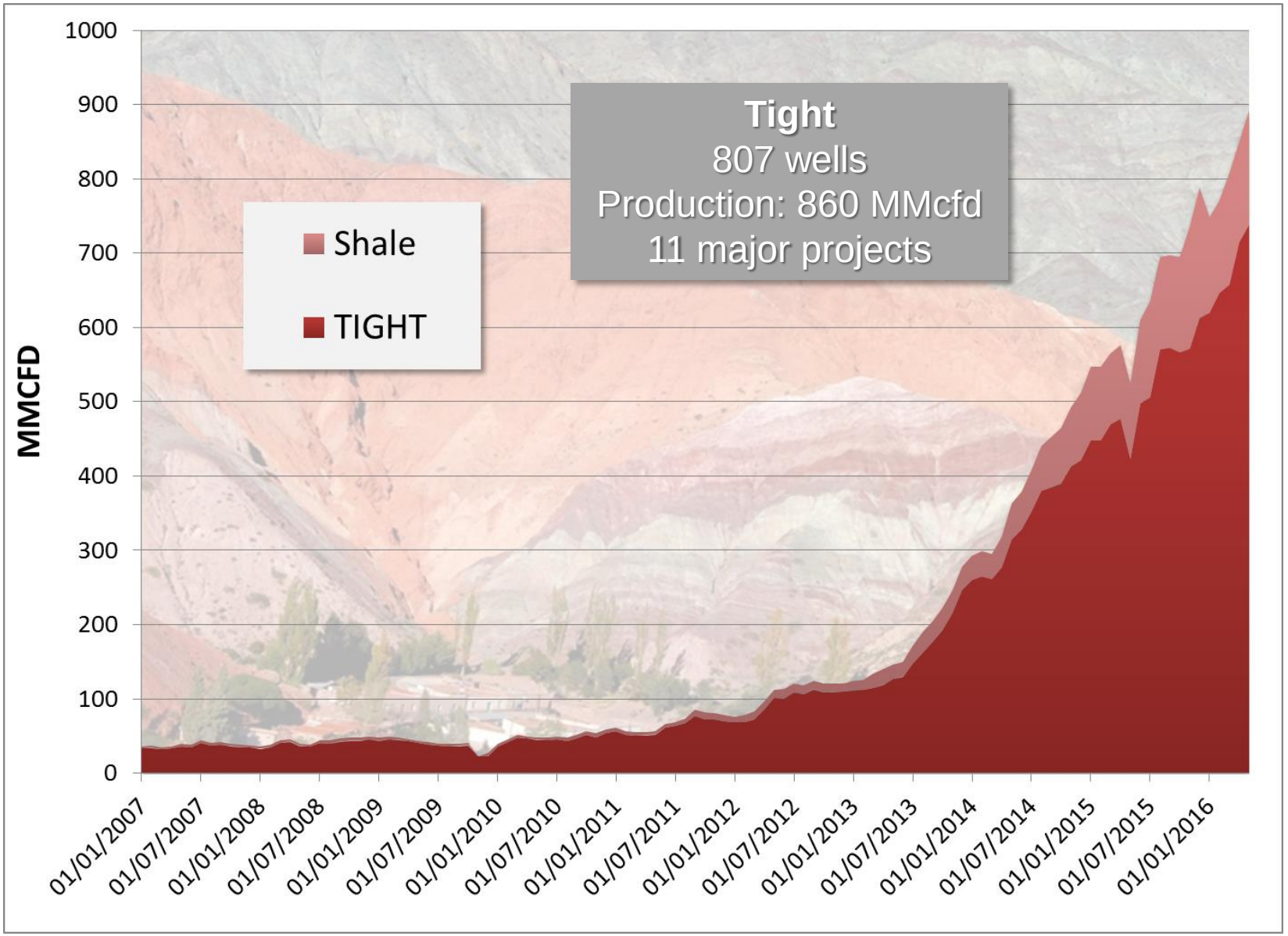




US Energy Information Administration , 2013

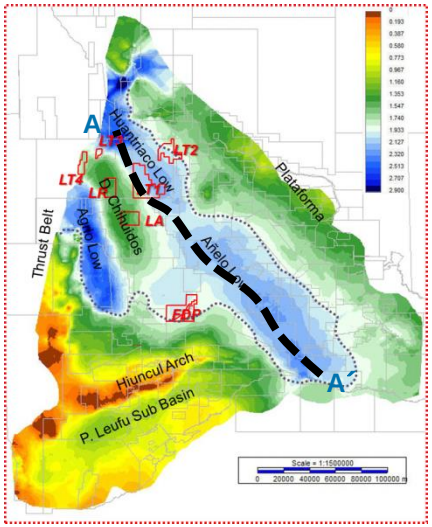
Unconventional Potential Neuquén Basin

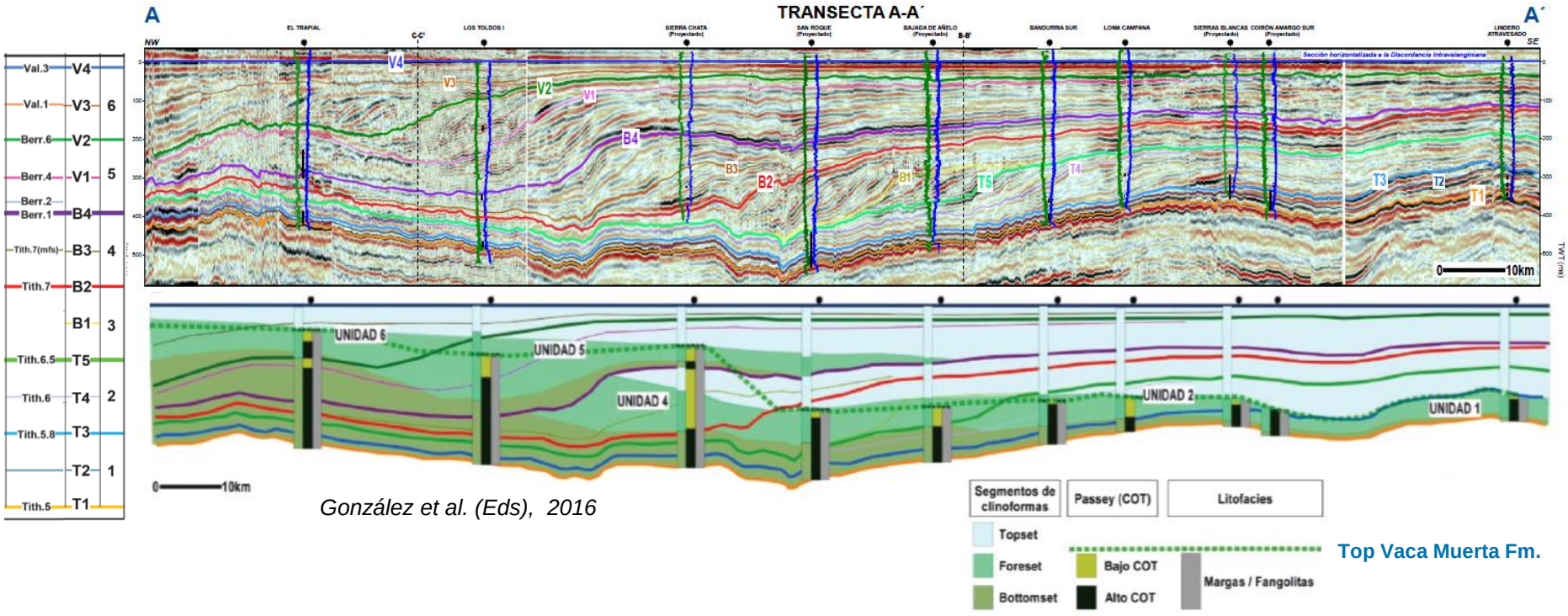
Tight and Shale Gas Production



Neuquén Basin – Vaca Muerta

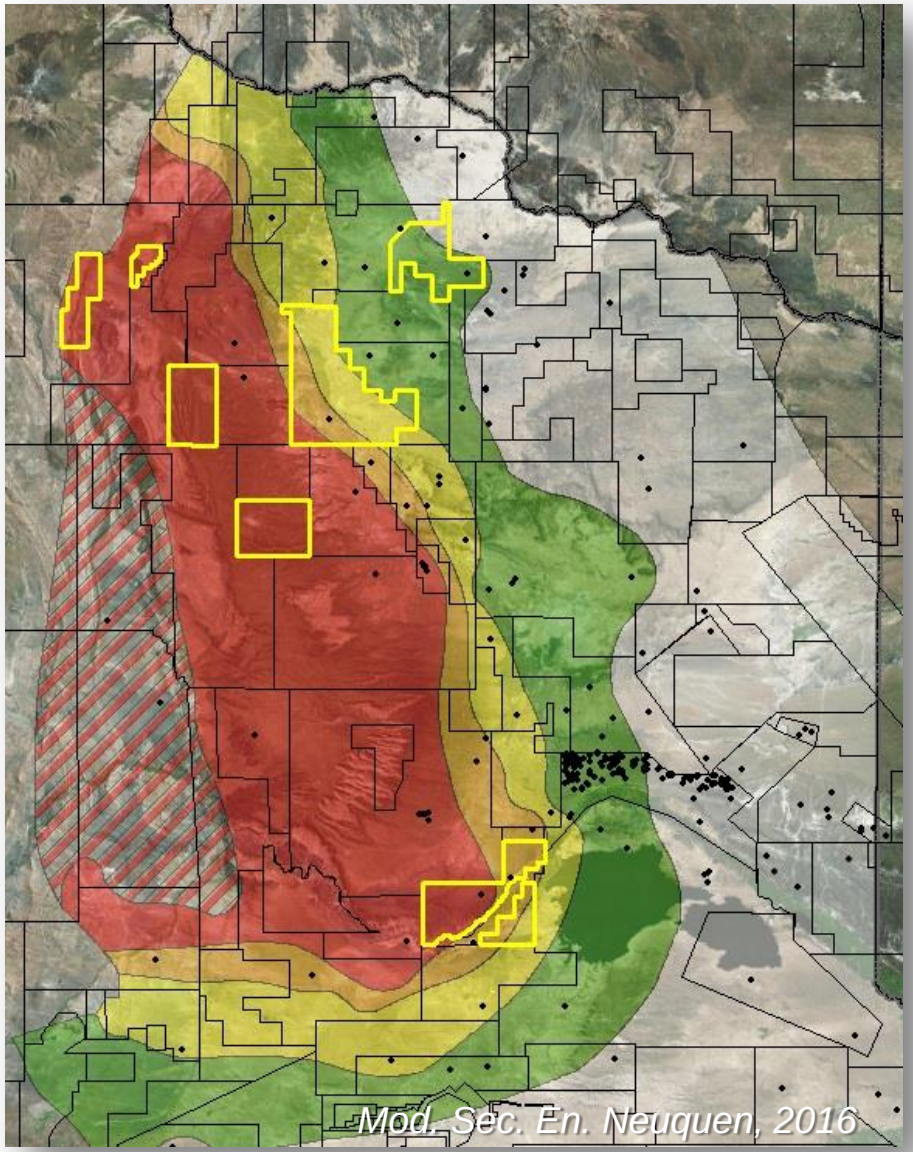
- Organic rich shales and marls
- Late Jurassic-Early Cretaceous (Tihonian-Berriasian)
- Deposited in a restricted marine platform



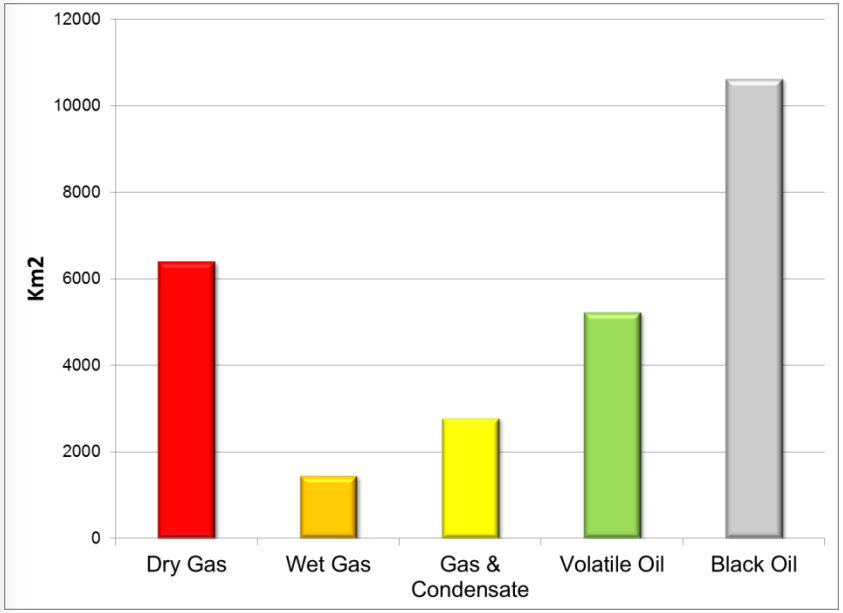


González et al. (Eds), 2016

Vaca Muerta Maturity Zones Map



- Dry Gas Window
- Wet Gas Window
- Gas & Condensate
- Volatile Oil Window
- Black Oil Window



Vaca Muerta Productivity

- Best oil well = 1000 bbls/d
- Best gas well = 15.4 mmcf/d
- Current Oil Production = 37,000 bbls/d
- Current Gas Production = 182 MMcf/d

According to IHS Markit, the Vaca Muerta Play could produce **560,000 bpd of oil** and **6 bcf** of gas by 2040 (more than the current total production of Argentina)

Vaca Muerta Aspects

Below Ground Factors

- Size of Potential Reserves ↑
- Productivity ↑
- Well optimization →

Above Ground Factors

- Fiscal Regime – Prices ↑
- Land Access / operability ↑
- Workforce ↑
- Service Sector →
- Distribution network ↓
- Market ↑

Conclusions

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- The collapse of the oil price has dramatically affected the exploration activity and hence the number of new discoveries during the last two years.
- Current “hot areas” are mostly located in the offshore: Pre-salt, Transform Margin, NW Colombia.
- Potential for heavy oil in stratigraphic traps in the Llanos Basin, but affected by low oil price. Important potential remains in the Thrust Belts.
- The unconventional resources could become the next source of value (“Fourth Wave”). However it still needs to be established if the Vaca Muerta potential can be replicated elsewhere in South America