KUALA LUMPUR 2012 WORLD GAS CONFERENCE

25th world gas conference

"Gas: Sustaining Future Global Growth"

Geochemical characterization of discovery new gas-condensates reservoir on Golfo de Venezuela Basin, Offshore, Venezuela

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Date: Thursday 7th June

Venue: Level 3 Room 302/3

Patron

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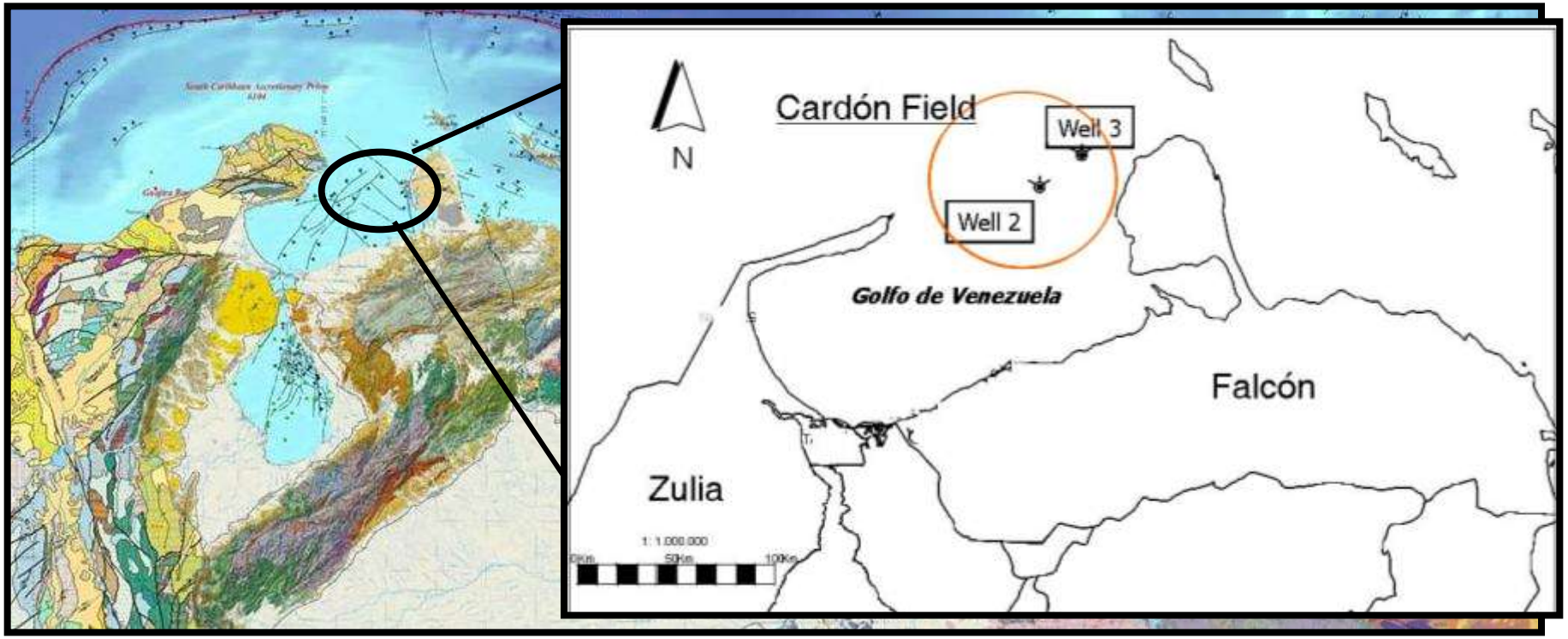
Presentation Squeme

- Background
- Aims
- Methods
- Results
  - Geochemical gas characterization
  - Geochemical condensates characterization
- Conclusions

Background

- PDVSA Offshore exploration studies ⟶ (East, Nor-east, Center and west)



- Golfo de Venezuela ⟶ > 10 TCF Gas and light oil (Tertiary carbonate facies)

Objectives

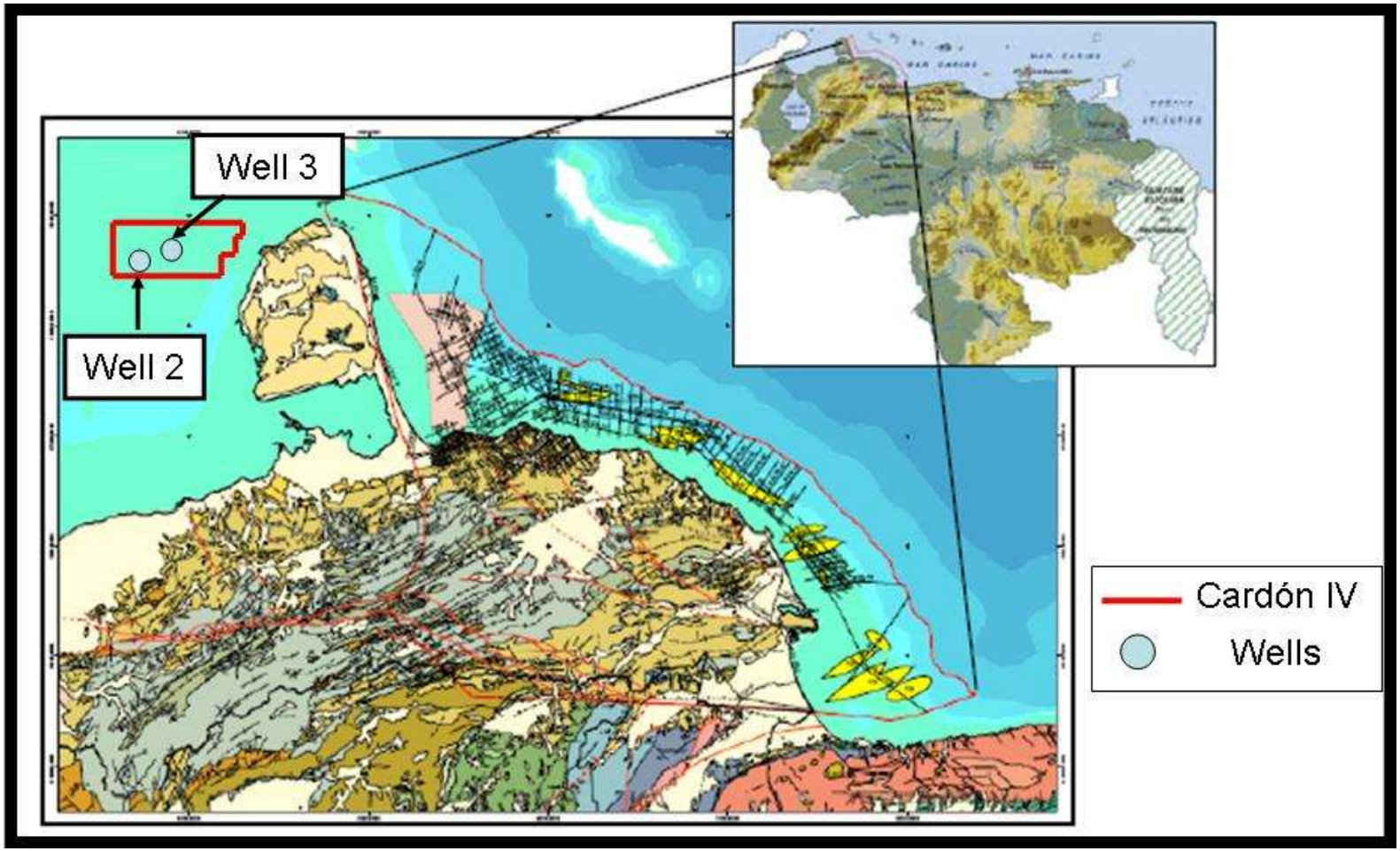
- Northeast Golfo de Venezuela (gas and condensates)
  - Origin gas and condensates
  - Studying and understanding of petroleum system.

- Main objectives

  Carrying out the geochemical characterization of fluids and to establishing oil-oil correlations to determine if there is more than one oil family

Methods

- Gas and condensates samples → Well 2 and Well 3
  - Calcareous Sequence (Cauderalito Member; Pinto et al., 2011) → 750 ft (thickness)

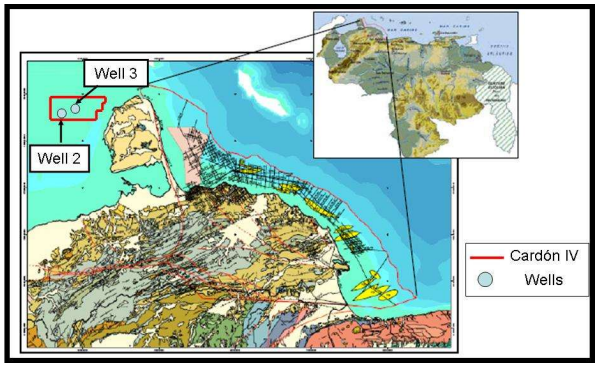


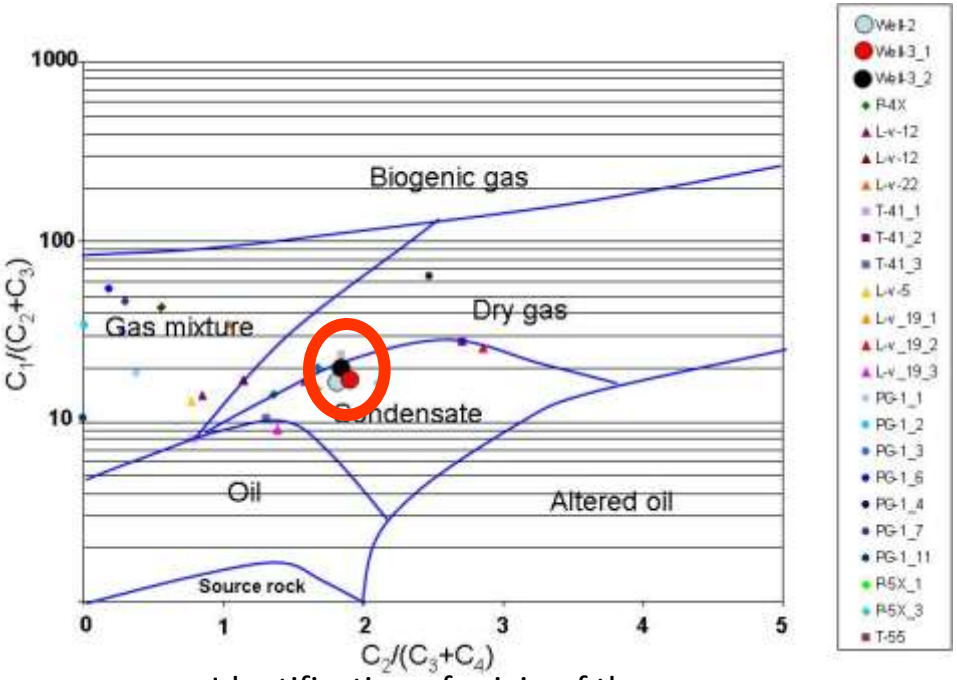
Results

- Geochemical gas characterization

Gases	Well 2	Well 3 (sample 1)	Well 3 (sample 2)
	% mol		
CH_4	90.08	89.79	89.84
C_2H_6	4.18	3.22	3.22
C_3H_8	1.69	1.25	1.25
i-butane	0.30	0.25	0.25
n-butane	0.55	0.42	0.42
i-pentane	0.177	0.153	0.151
n-pentane	0.143	0.124	0.121
Hexanes	0.108	0.113	0.106
Heptanes	0.094	0.124	0.111
Octanes	0.028	0.048	0.047
Nonanes	0.003	0.01	0.007
Decanes	0.001	0.000	0.000
Undecanes	0.001	0.000	0.000
N_2	0.43	0.59	0.56
CO_2	2.20	3.91	3.92

Wet gas
(Schoell, 1983)

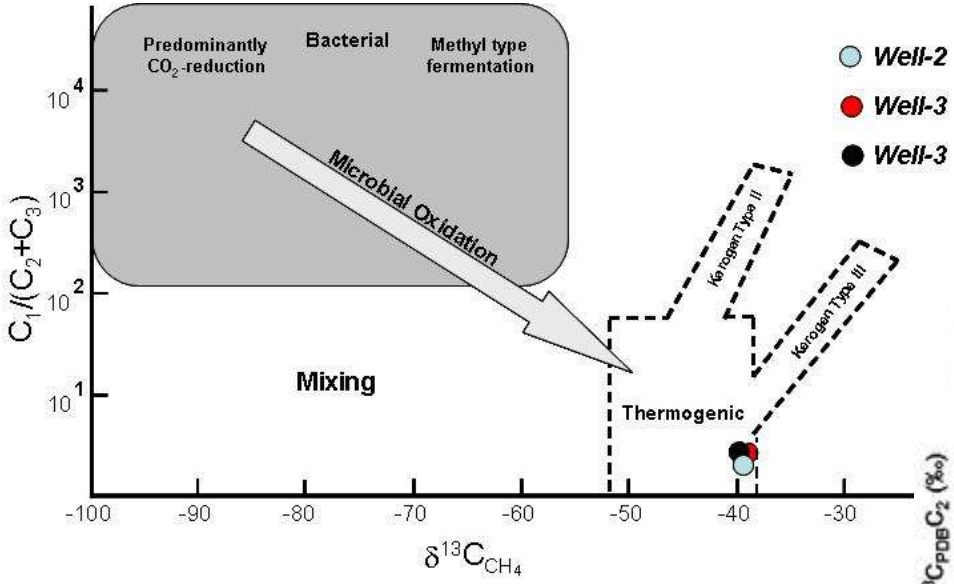




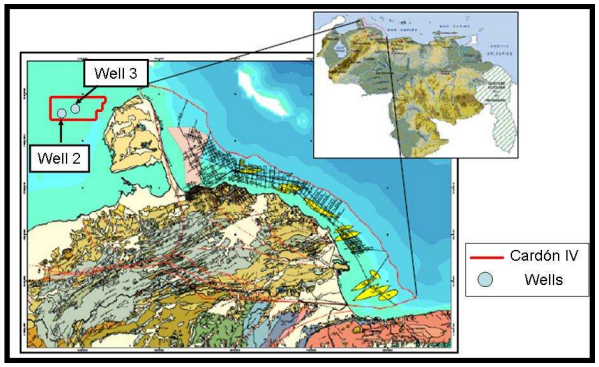
Identification of origin of the gases
(Von Der Dick et al., 1994)

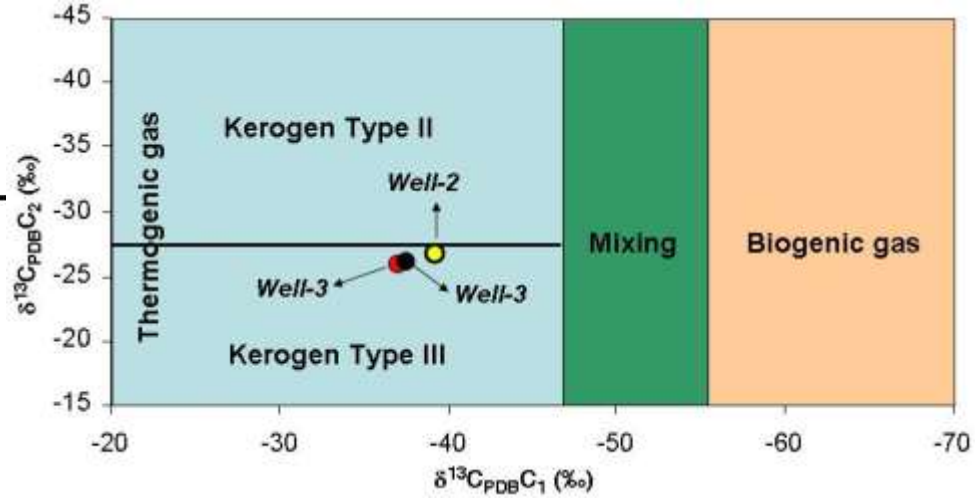
Results

- Geochemical gas characterization



Bernard Diagram
(Whiticar, 1994)



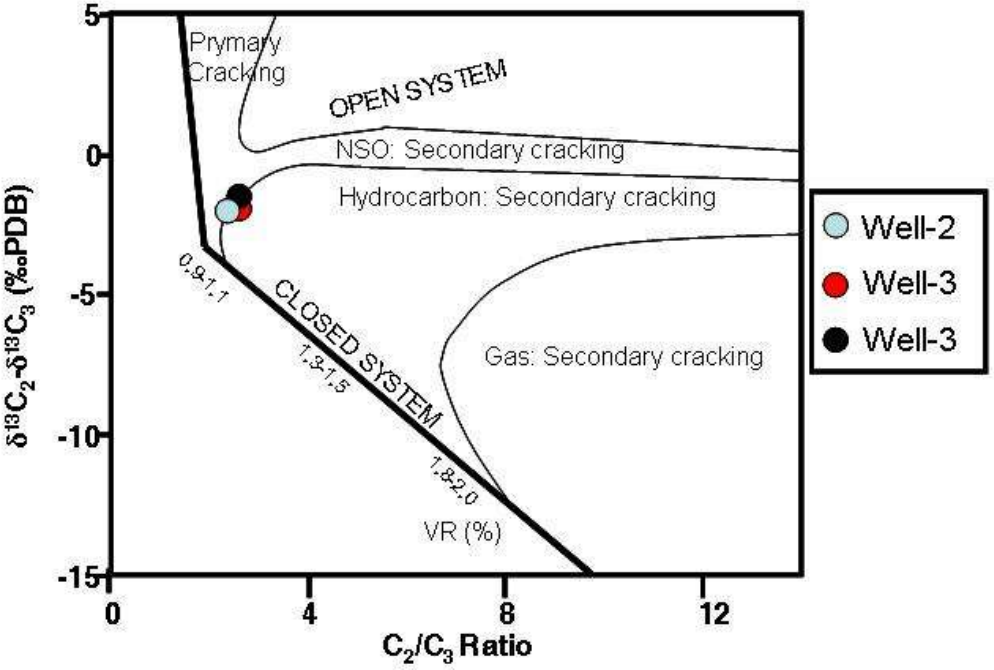


- Thermogenic source
- $\delta^{13}C_{CH4}$ ⟶ -39‰ to -37 ‰ (Hunt, 1996)

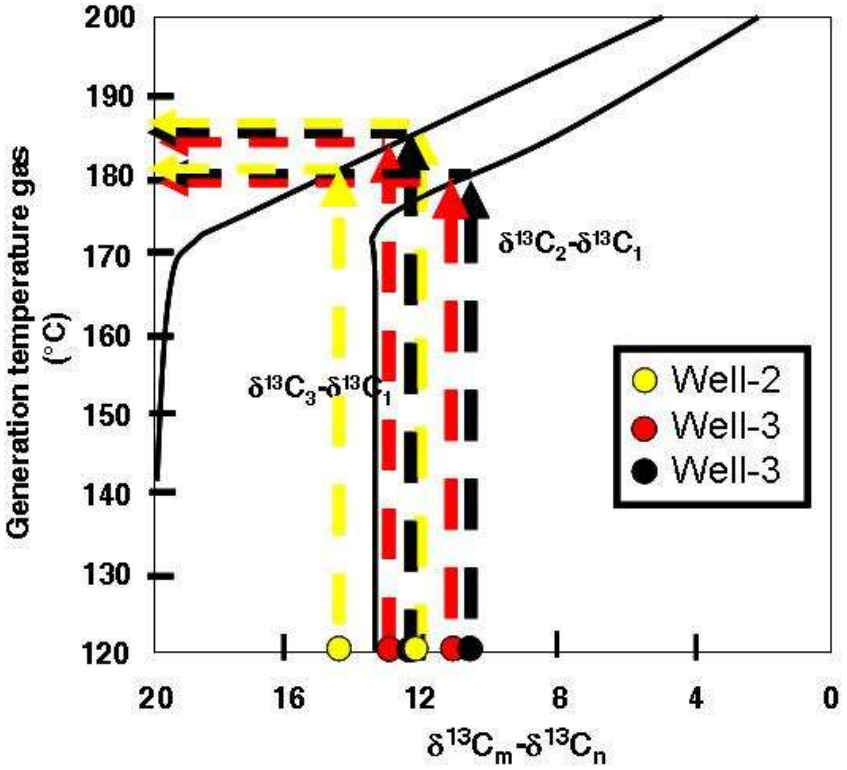
- Thermogenic source
- Type III-II Kerogen
  (terrestrial and marine o.m.) (Huang et al., 2003)

Results

- Geochemical gas characterization



Maturity of natural gases
(Gürgey et al., 2005)



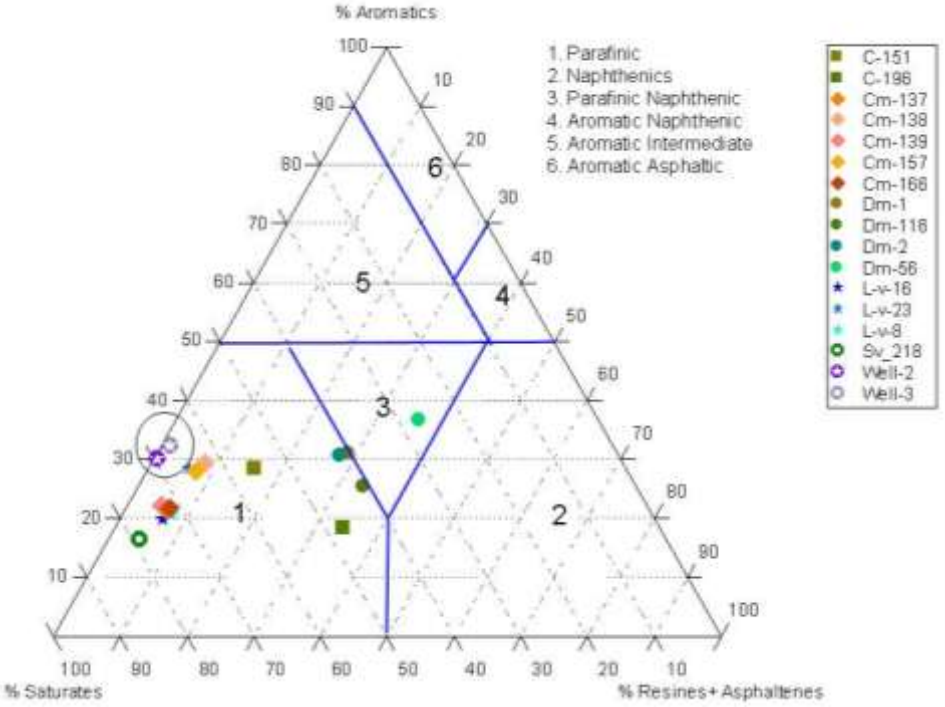
Temperature vs isotopic differences
(Rooney et al., 1995)

- Primary and secondary cracking
- %Ro ≈ 1.1 (mature area, cathagenesis)

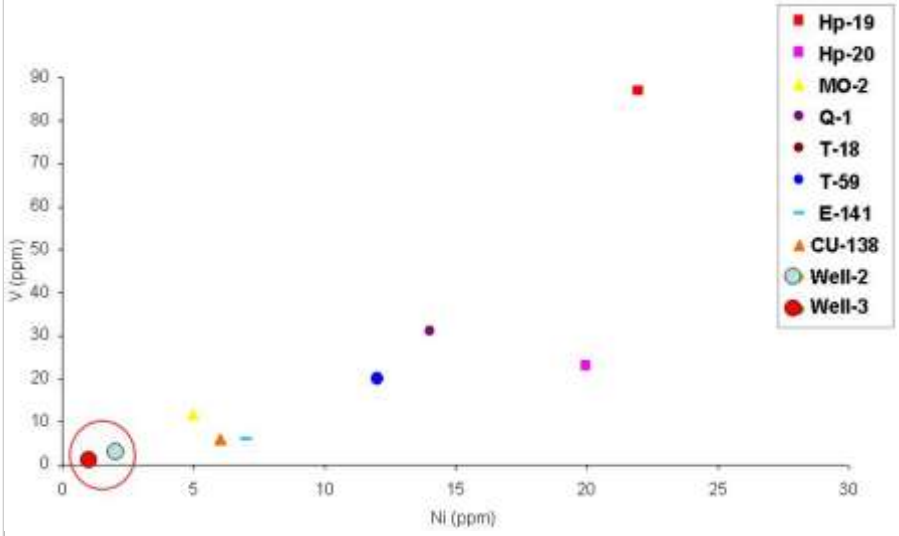
- Generation temperature ≈ 180°C
- Type III-II Kerogen
  (terrestrial and marine o.m.) (Huang et al., 2003)

Results

- Geochemical condensates characterization



SARA composition



V and Ni correlation

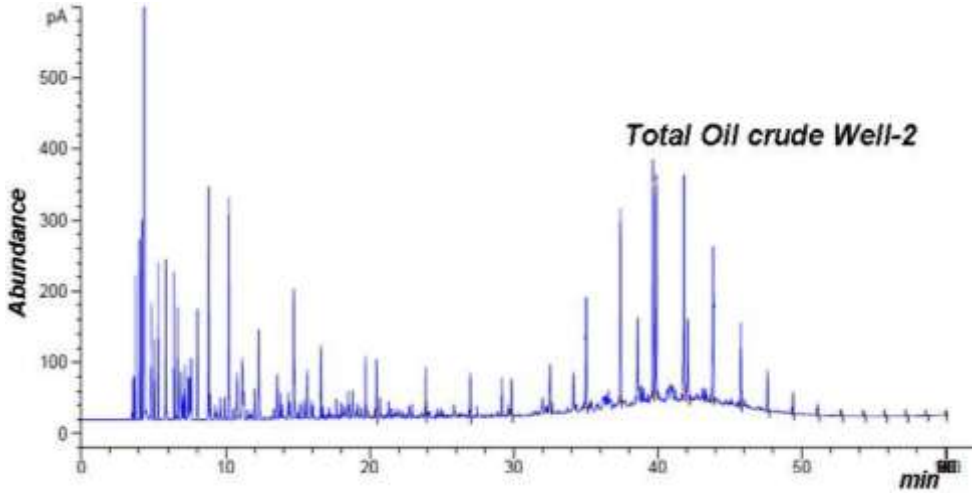
- °API ≈ 49 ⟶ Condensates
- 70% Saturated and 30% Aromatics HC's
- Type crude oil parafinn

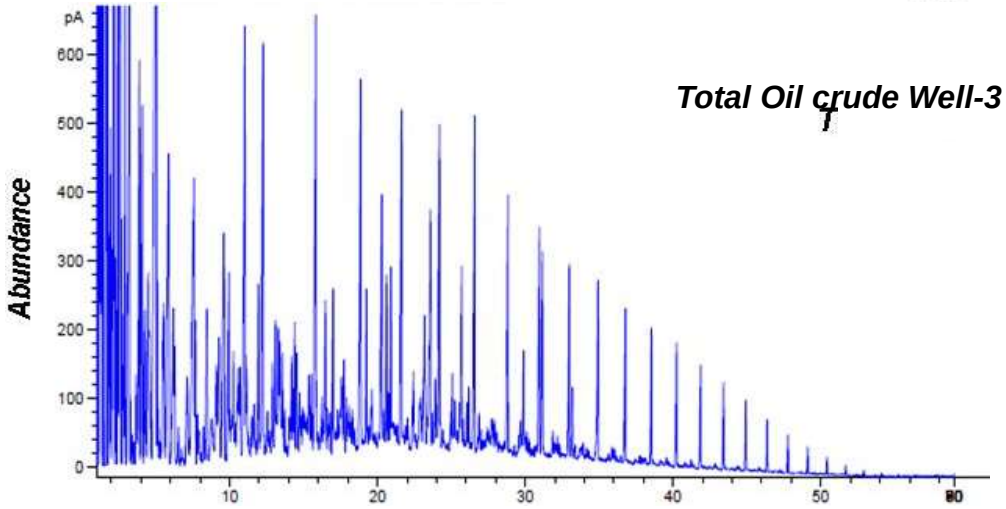
- Low Sulfur (349 ppm)
- Siliciclastic source rock
- Positive correlation

Hombre Pintado, Tiguaje and Cumarebo fields

Results

- Geochemical condensates characterization



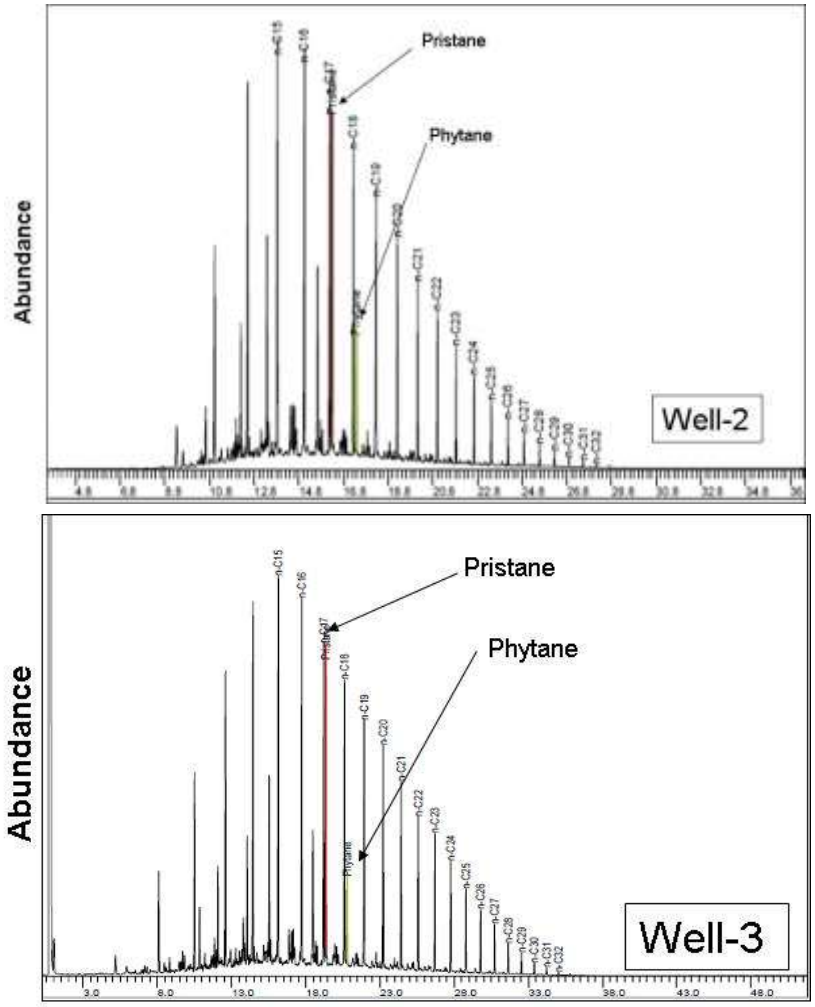


- Lower molecular weight compounds (<C_{15}).
- High level of maturity.
- Paraffin (0.44) and aromaticity (2.18) values suggest evaporative fractionation process.

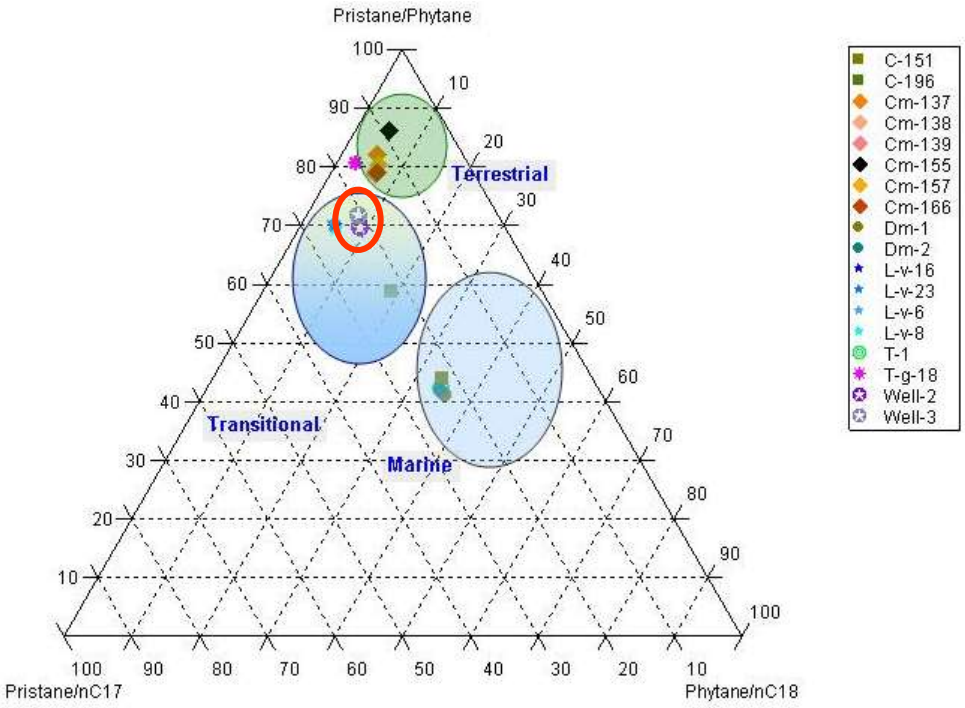
Heptane isomers ratios (C_{15}-) ⟶ slightly altered by biodegradation

Results

- Geochemical condensates characterization
  - GC of saturated fraction (C_{15}^{+})



- Unimodal distribution pattern.
- Marine organic matter.
- Pristane/Phytane ratio (3.36)
  - * Terrestrial o.m.
  - * Oxic conditions (available of O_2).



Results

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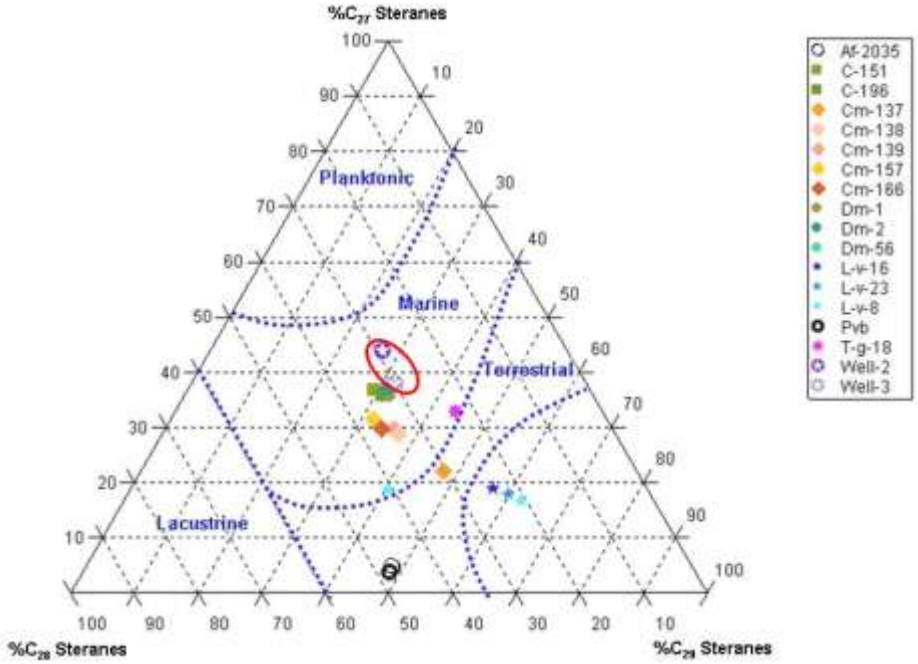
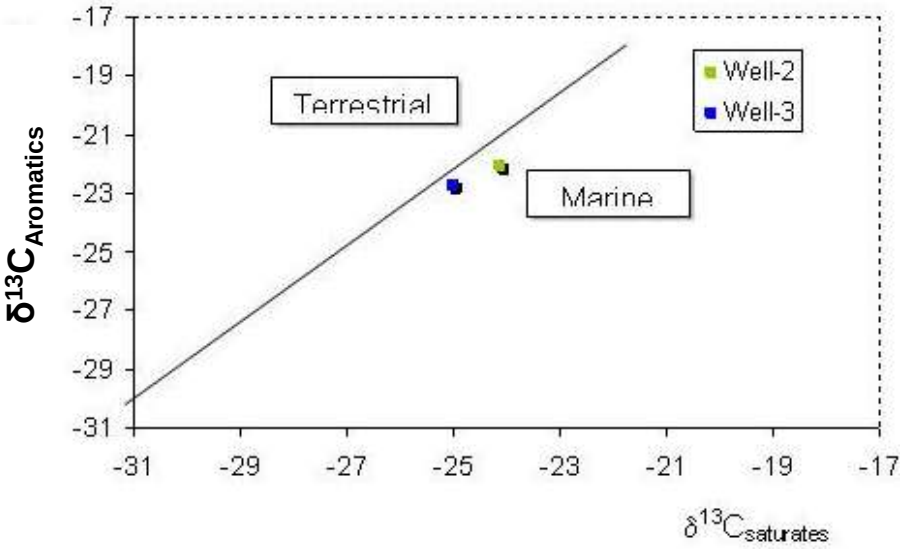


Steranes diagram

- Marine origin for crude oil ?
- Positive correlation → Cumarebo field.
- Lithology associated is siliciclastic.



Isotopic correlations

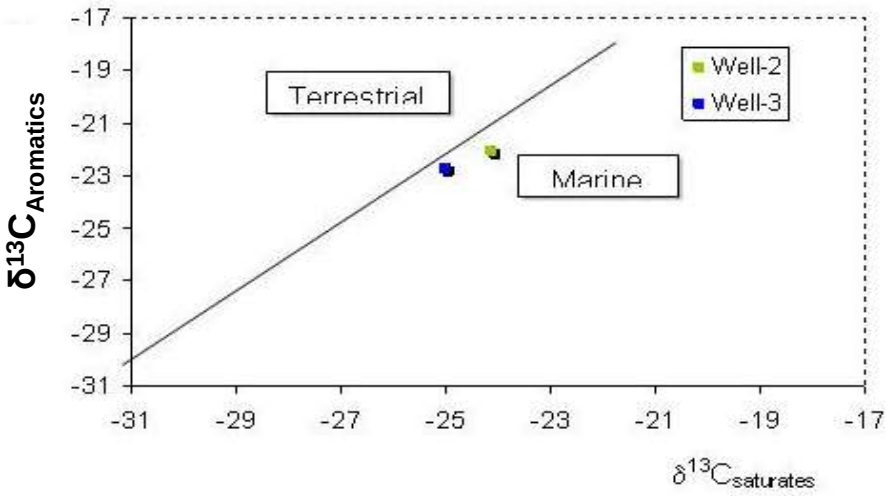
Results

- Geochemical condensates characterization
  - Diamondoids

- Methyl Adamantane Index (AMI) ⟶ %Ro 1.3 – 1.6 (mature area, wet gas window)
  Consistent with generation region obtained for gas samples (%Ro≈ 1.1)

  - Isotopic data

- Marine origin for o.m.
- Total oil ^{13}C = -23 ± 0.3‰ ⟶ Age source rock Miocene



Conclusions

- Geochemical characterization made to fluids found in Well 2 and Well 3, shows similar characteristics, suggesting that these fluids are genetically correlated and correspond to the same family.

- Thermogenic origin for gas correlated with origin found for liquid fraction in reservoir; besides suggest that both have been generated at higher maturity levels in the oil window, and slightly above 1% reflectance of vitrinite.

- The maturity showed two different tendencies. However, considering the range of maturity values δ or obtained for the parameters evaluated, the level of thermal evolution of these hydrocarbons should be located in a range of maturity of $0.9\% \leq Ro \geq 1.3$. Another hypothesis that could be representing these varying levels of maturity is a possible mixture of hydrocarbons with different degrees of thermal evolution, but further studies are required to give further support to this hypothesis.

- The thermal evolution level determined in the liquid fraction show no clear definition as parameters suggest that these hydrocarbons have a high level of thermal evolution (diamondoids, relations of the isoprenoids and n-paraffins) not clearly show the level of maturity (n-heptane and iso-heptane index values). Considering the average maturity values or ranges obtained for the parameters evaluated, the level of thermal evolution of these hydrocarbons should be located in a range between $0.9\% \leq Ro \geq 1.3$.

Conclusions

- The origin of hydrocarbons, evaluated from the liquid fraction, it shows a trend associated with a mixed source rock, deposited in transitional environments, where organic matter was deposited in suboxic conditions. The associated lithology type is siliciclastic (shale).

- Well-3 and Well 2 hydrocarbons showed good correlation between them, which suggests that these hydrocarbons are genetically correlated and should be associated with the same rock. These hydrocarbons showed a positive correlation with the Campo Cumarebo, specifically in the depositional environments of source rocks.