KUALA LUMPUR 2012 WORLD GAS CONFERENCE

25th world gas conference

"Gas: Sustaining Future Global Growth"

ISOTOPIC TECHNIQUES TO MONITOR GAS RELEASES AT DIADEMA UGS – ARGENTINA

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SCOPE OF THE PRESENTATION

PART 1

- LOCATION AND PURPOSES OF DIADEMA UGS
- GEOLOGY
- OPERATION
- MONITORING PROCESS

PART 2

- GEOCHEMICAL AND ISOTOPIC MONITORING
- SAMPLING POINTS
- ANALYSIS RESULTS
- APPLICABILITY OF THE TECHNIQUE

CONCLUSIONS

LOCATION


Diadema UGS
Manantiales Behr
Compression Plant
To Buenos Aires
N
Camuzzi Pipeline -12”
DIADEMA UGS
General San Martin
pipeline- 30”
Comodoro
Rivadavia City
Rada Tilly City
10km

INTRODUCTION

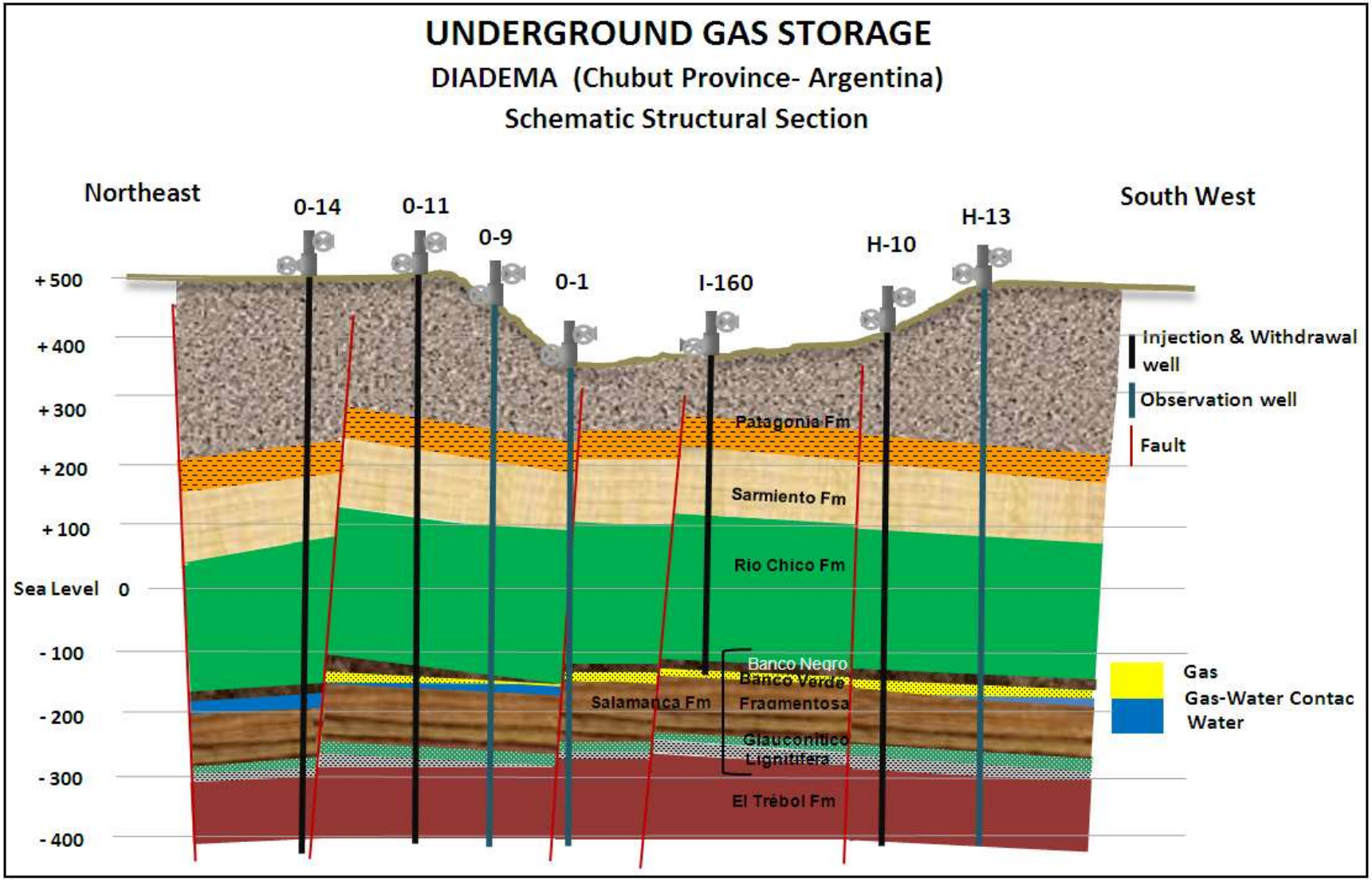
- For operating and environmental reasons, different types of monitoring are being carried out at Diadema UGS (wellhead pressure, casing leakings, etc.)

- In order to improve the monitoring process, another type of controls and analysis has been performed in the last 7 years, determining the **isotopic and geochemical compositions** of the:
  - injected gas
  - native gas remaining at the reservoir
  - monitoring developments in the mixture of native gas and stored gas.
  - detecting any anomalies regarding UGS wells and wells from neighboring companies.
  - gas presence in the upper aquifers

- The results of this work , demonstrate that Diadema UGS has an efficient methodology for monitoring the gas bubble into the reservoir , which is operated in a safe manner.

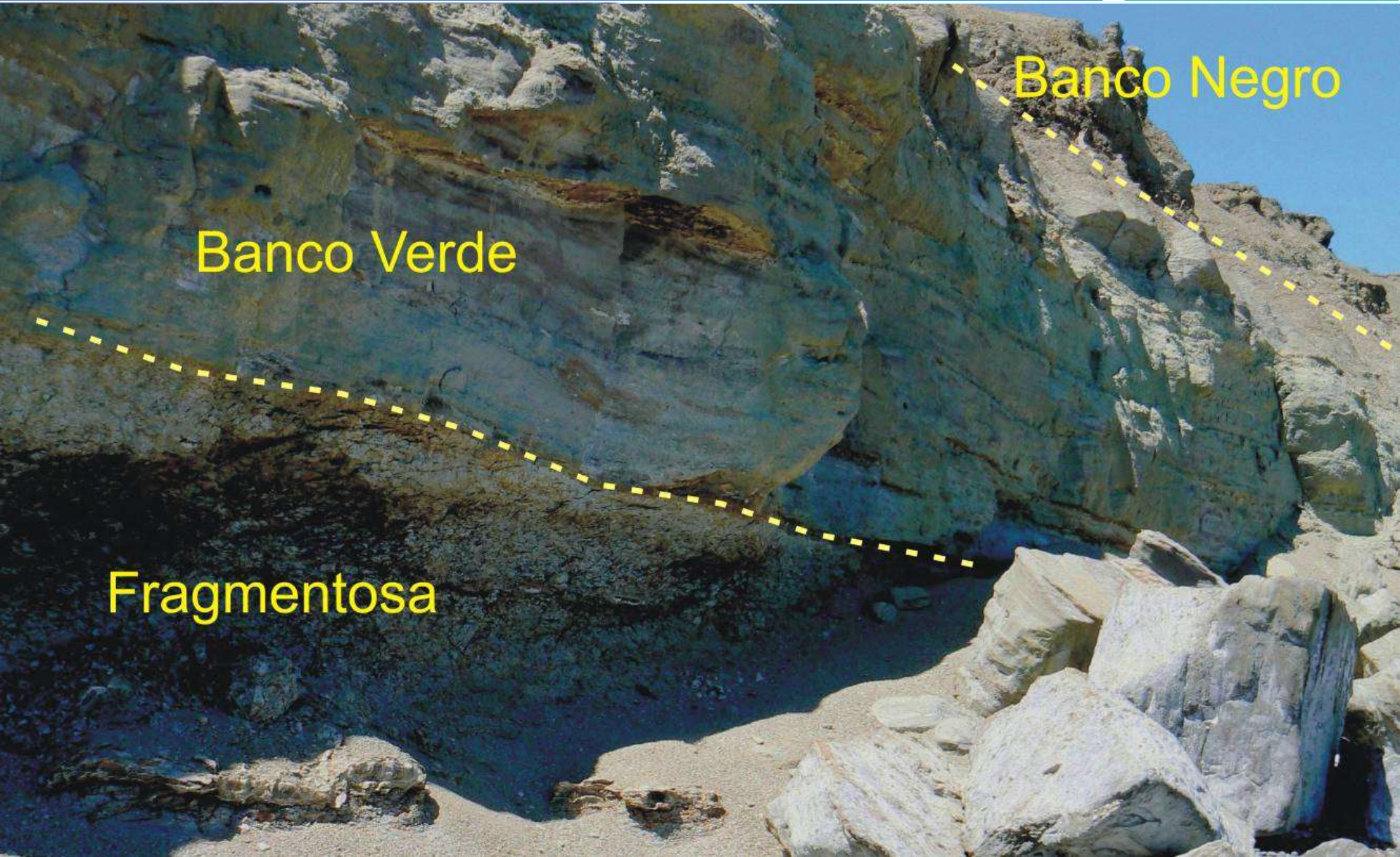
GEOLOGY

Structural Cross-Section



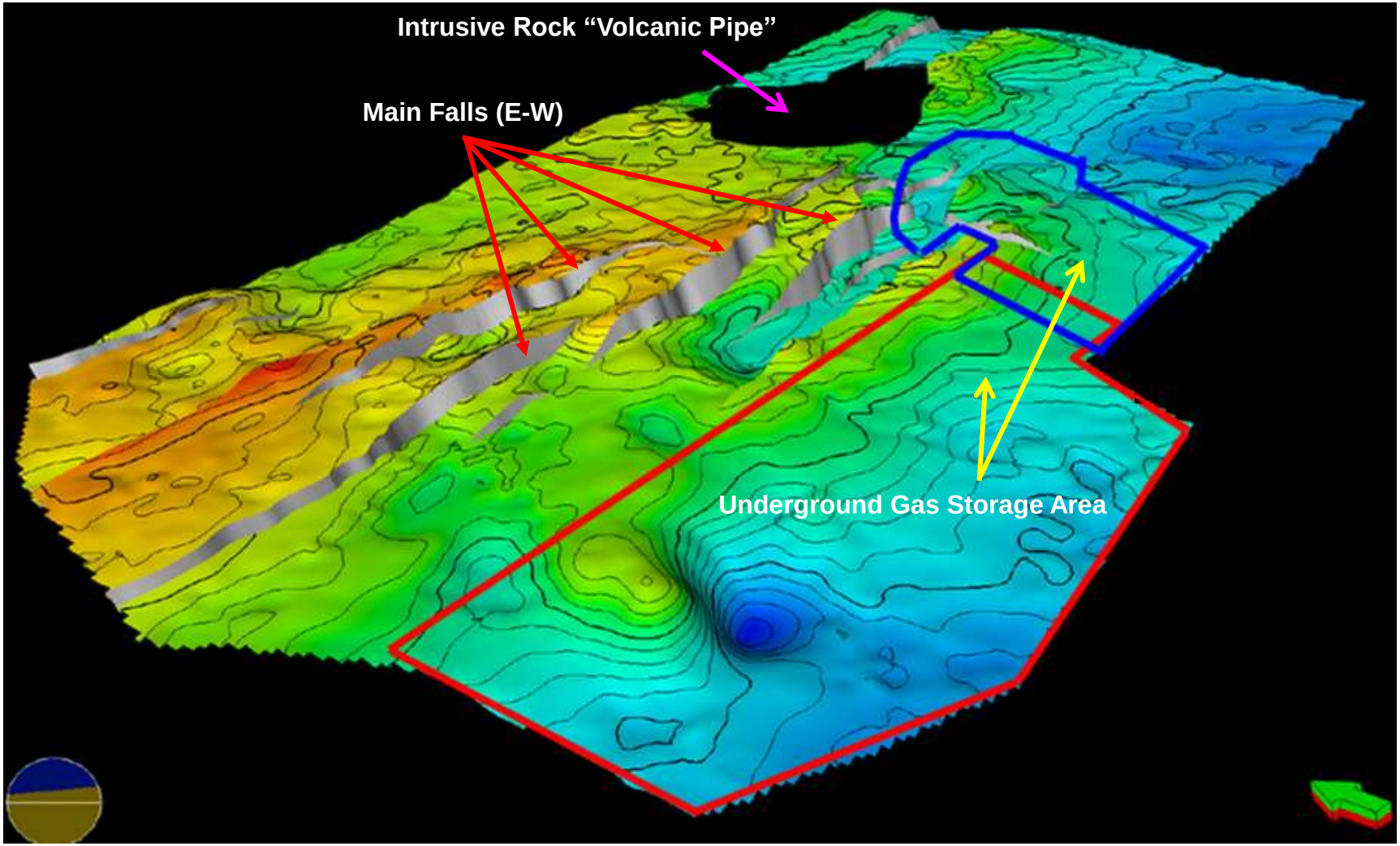
GEOLOGY

Banco Verde Outcrops

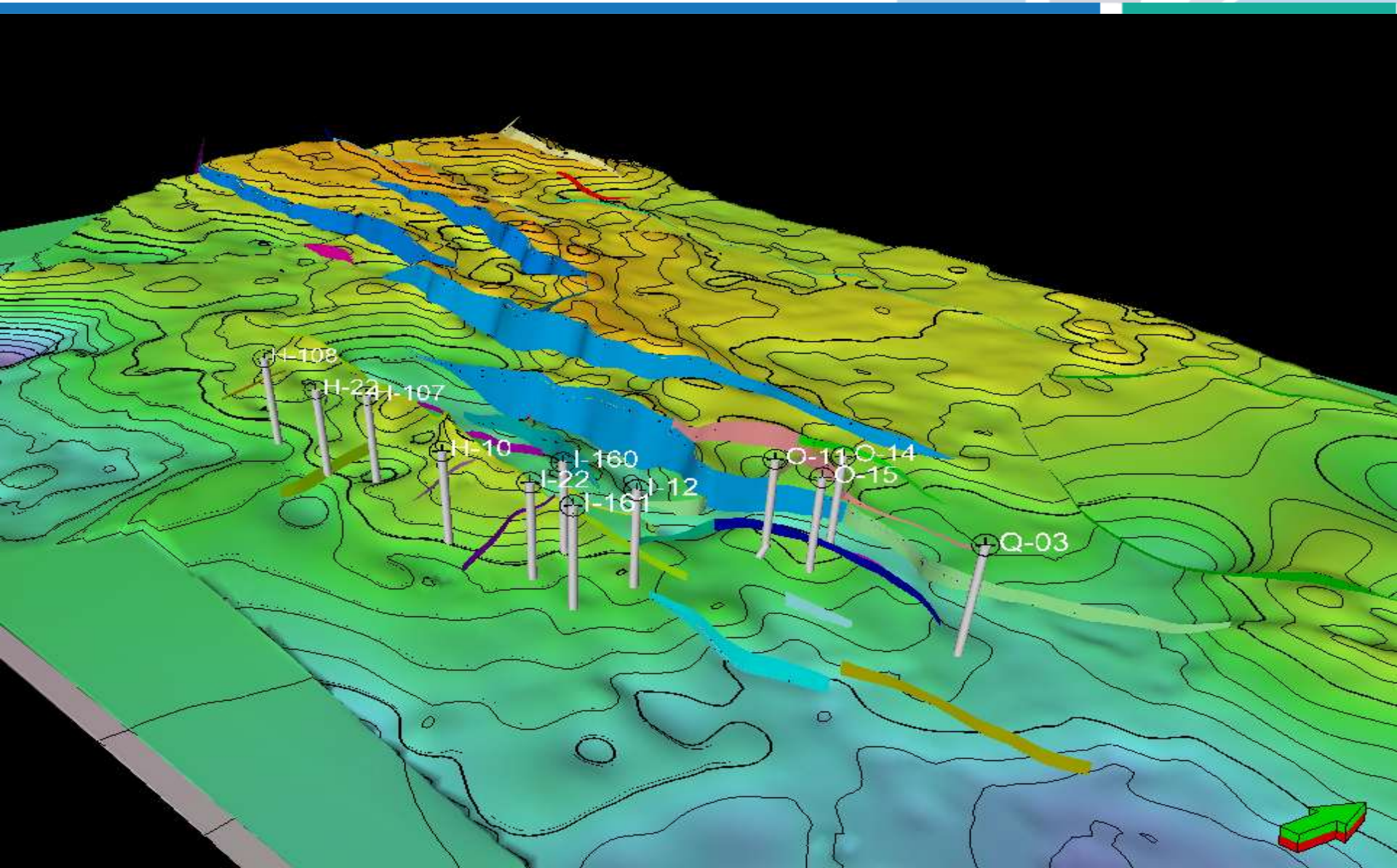


GEOLOGY

Structural Map

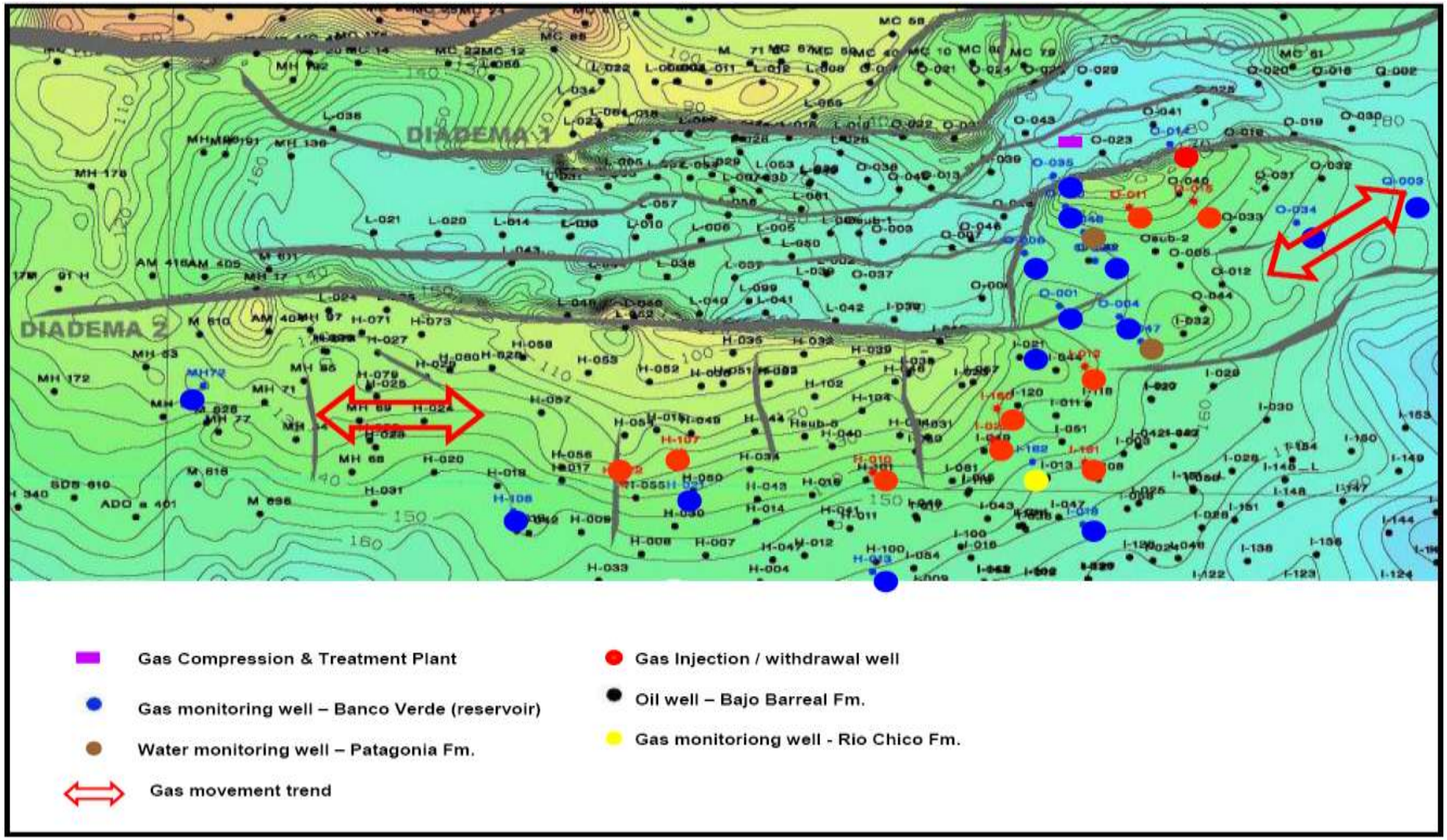


GEOLOGY
Storage & Monitoring wells



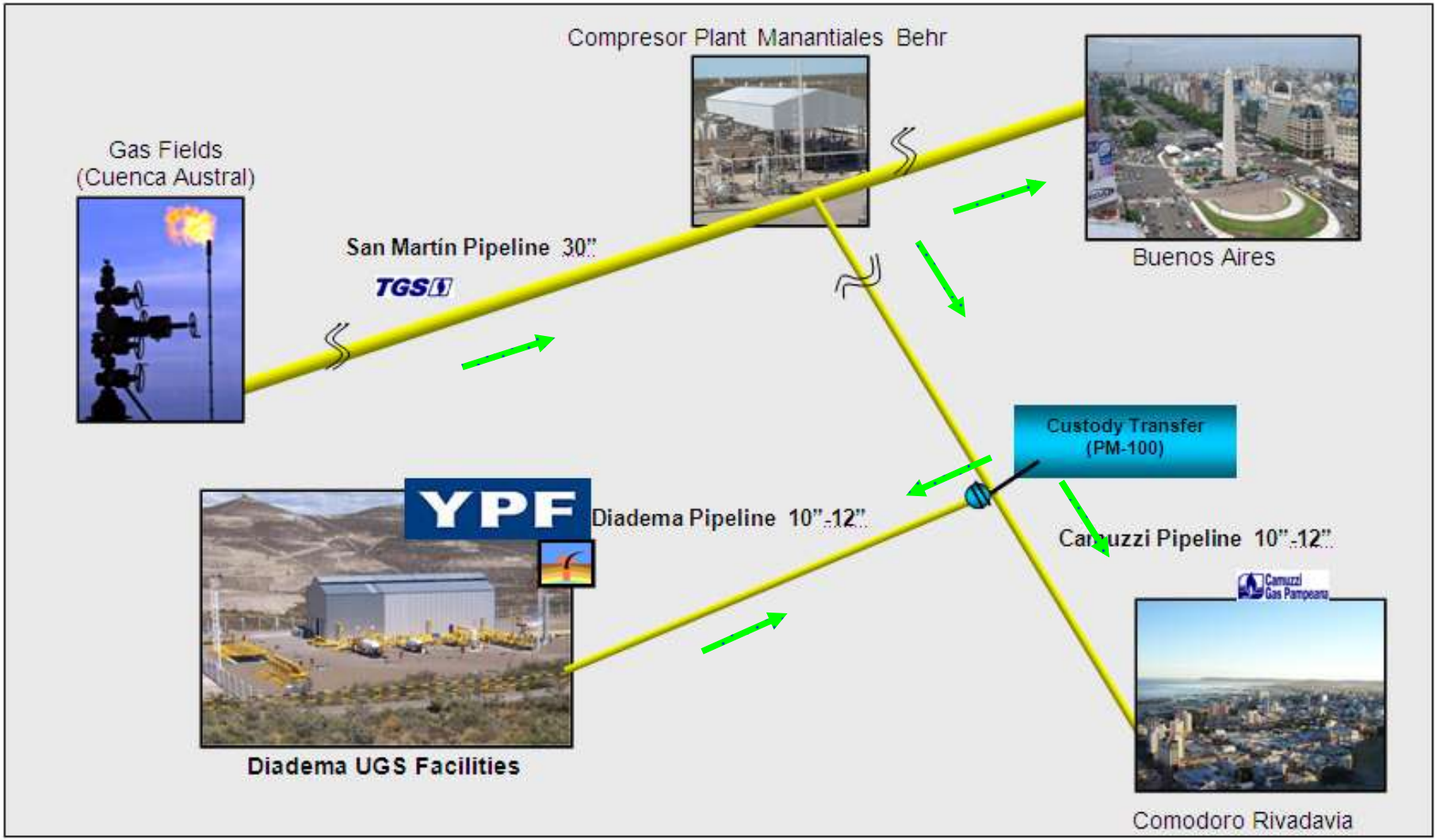
WELLS LOCATION MAP

Gas Movements In The Reservoir



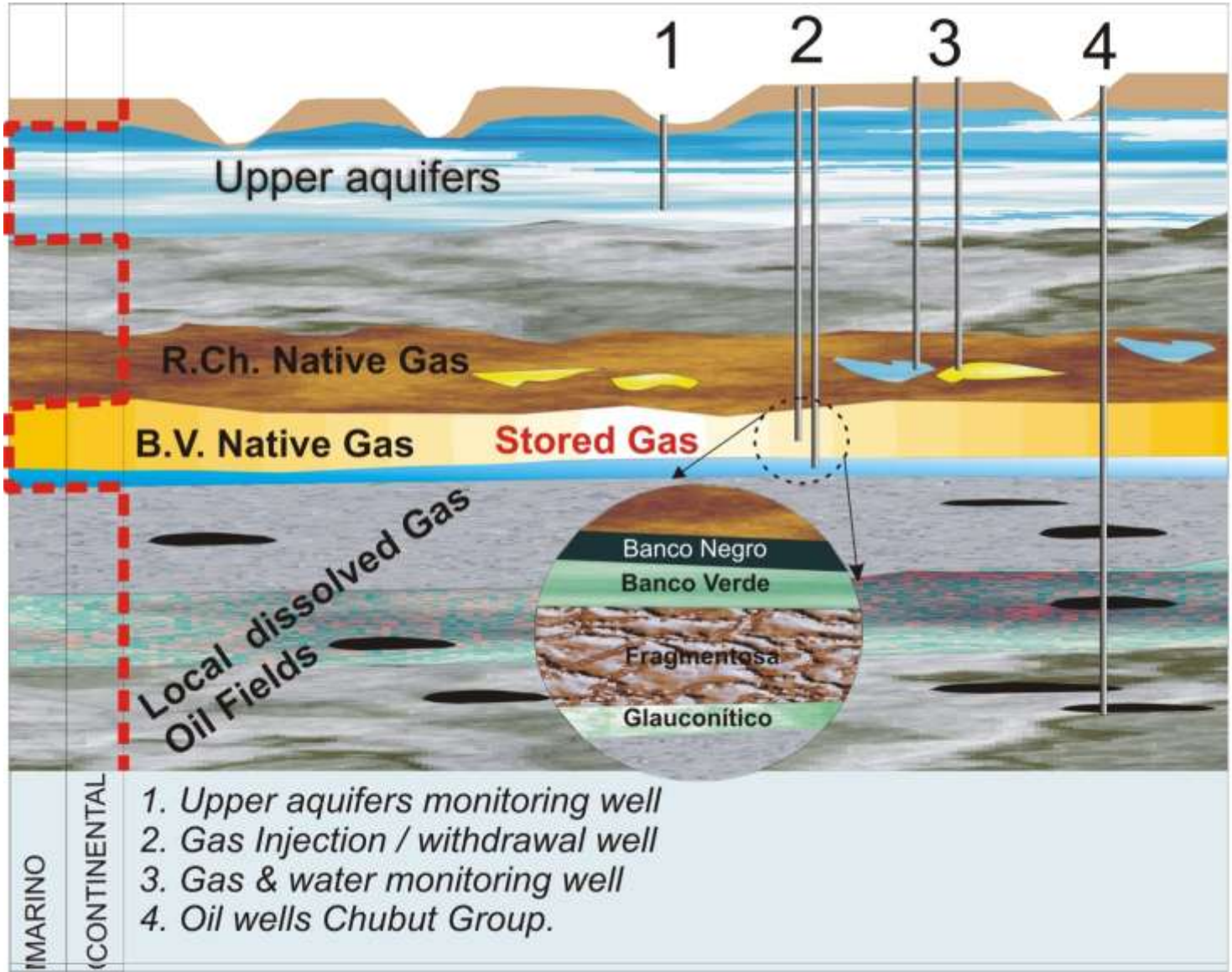
OPERATION

Gas Pipeline System

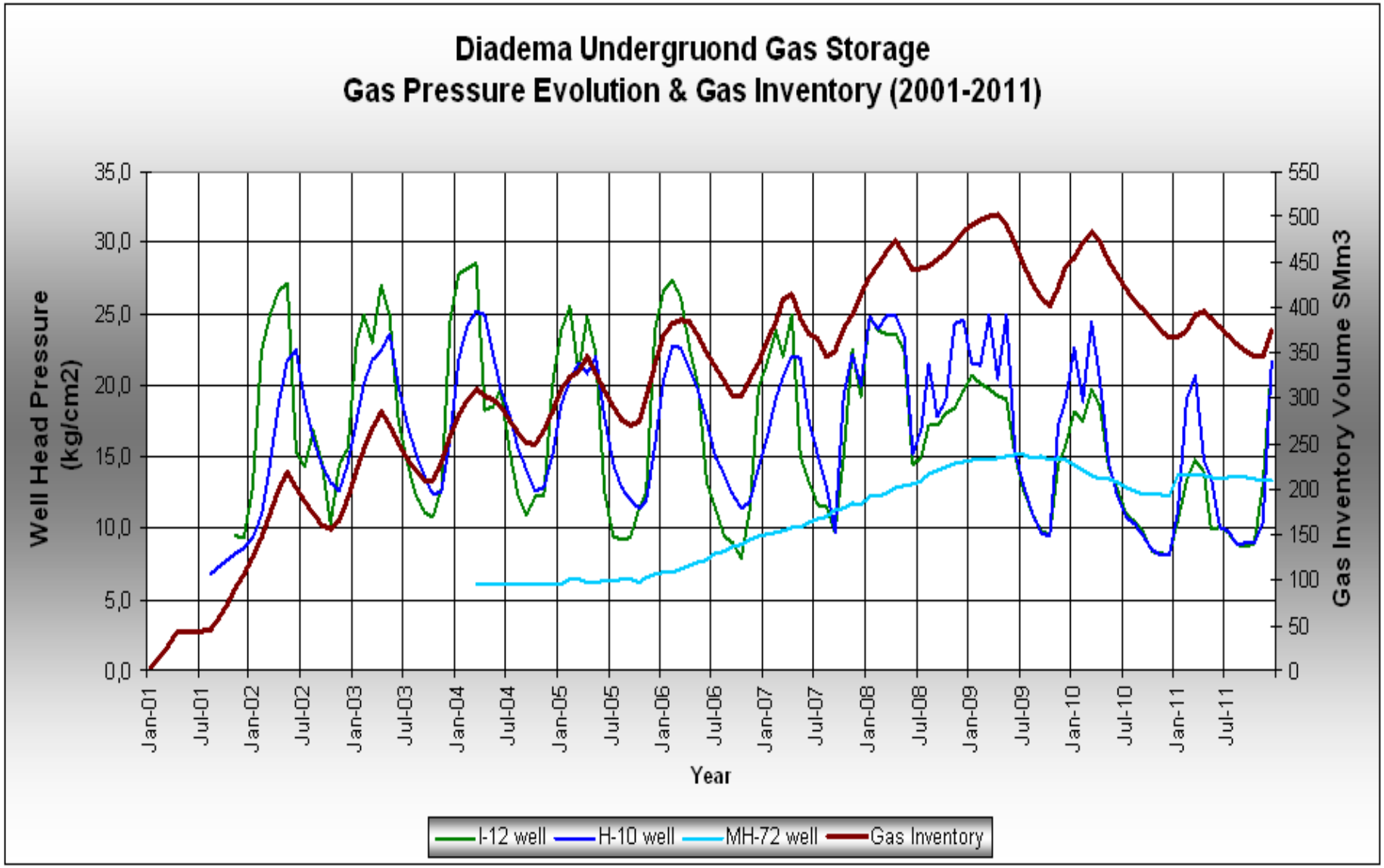


MONITORING PROCESS

Types Of Wells



MONITORING PROCESS
Pressure and inventoried gas evolution



PART 2

- GEOCHEMICAL AND ISOTOPIC MONITORING
- SAMPLING POINTS
- ANALYSIS RESULTS
- APPLICABILITY OF THE TECHNIQUE

GEOCHEMICAL AND ISOTOPIC MONITORING

- The sampling is done on operating wells, in order to ensure the representative condition of the gas obtained and to avoid any samples from the casing or with abnormal residence times.

- The most usual analysis is molecular composition (chromatography).

GEOCHEMICAL AND ISOTOPIC MONITORING

Molecular Composition

COMPONENT	SYMBOL	STORED GAS		LOCAL GAS = NATIVE GAS		
		Injection	Withdrawal	Banco Verde	Río Chico Fm.	B. Barreal Fm. (from Oil Field)
		% Molar	% Molar	% Molar	% Molar	% Molar
Nitrogen	N_2	1,56	1,70	3,45	3,44	2,14
Oxygen	O_2	0,00	0,00	0,28	0,05	0,10
Carbon dioxide	CO_2	0,93	0,78	0,03	0,33	5,92
Methane	CH_2	91,13	91,06	96,06	95,36	86,45
Ethane	C_2H_6	4,57	4,45	0,08	0,50	1,75
Propane	C_3H_8	1,05	1,15	0,02	0,10	1,16
i-Butane	IC_4H_{10}	0,26	0,30	0,00	0,04	0,38
n-Butane	nC_4H_{10}	0,30	0,33	0,02	0,03	0,66
i-Pentane	IC_5H_{12}	0,08	0,09	0,01	0,02	0,31
n-Pentane	nC_5H_{12}	0,07	0,08	0,01	0,01	0,34
Hexane	C_6H_{14}	0,04	0,05	0,01	0,03	0,30
Heptane	C_7H_{16}	0,01	0,02	0,01	0,03	0,27
Octane	C_8H_{18}	0,01	0,01	0,01	0,04	0,17
Nonane	C_9H_{20}	0,00	0,00	0,01	0,02	0,05
TOTAL		**100,00**	**100,00**	**100,00**	**100,00**	**100,00**

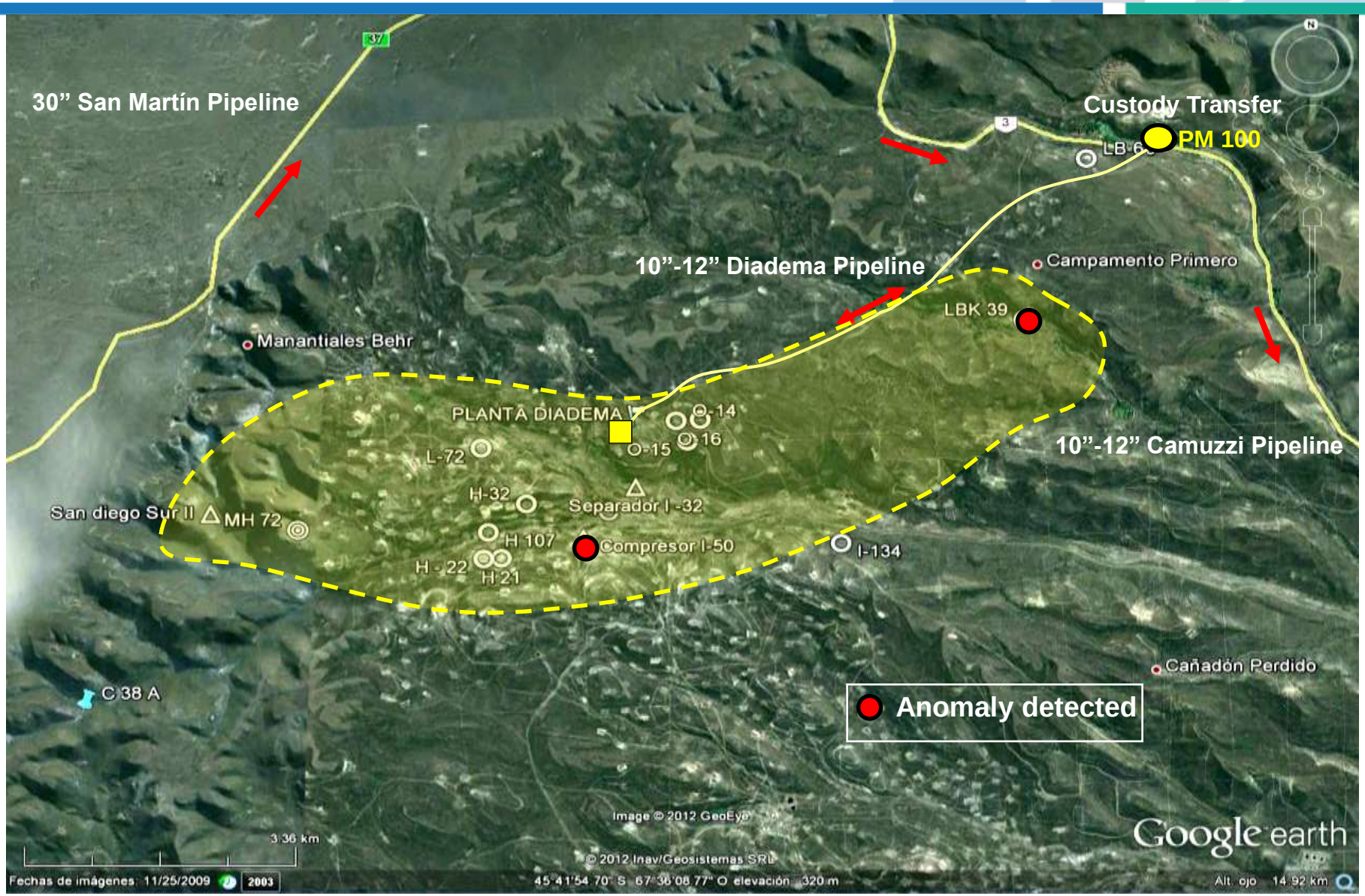
GEOCHEMICAL AND ISOTOPIC MONITORING

- **Main constituents** usually measured are C_1, C_2, iC_3, nC_3, iC_4, nC_4, N_2, CO_2, H_2S.

- The **tracer constituents** are the hydrocarbons with highest molecular weight, iC_5, nC_5 and C_6+, accompanied by O_2, Ar, He and H_2. In many cases the tracer constituents are below the detection limits.

- The second type of analysis is **isotopic composition of C and H** which can be measured in hydrocarbons, usually up to C_4 , and C in CO_2.

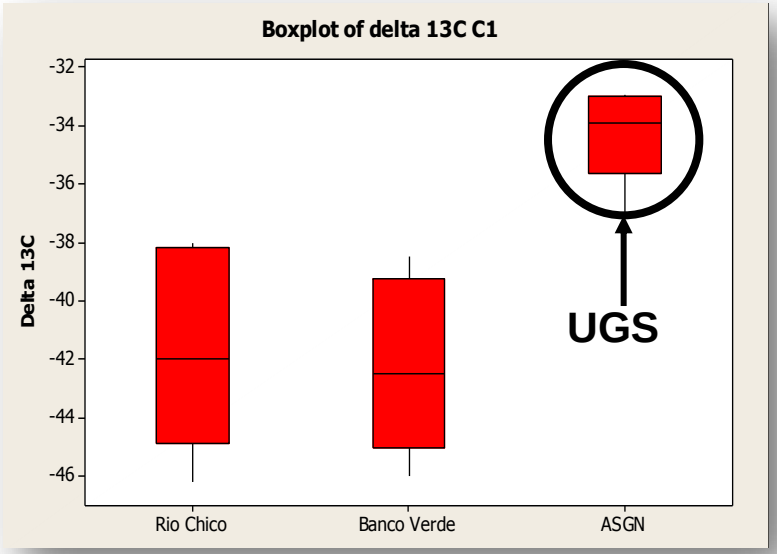
SAMPLING POINTS



SAMPLING ACTIVITIES

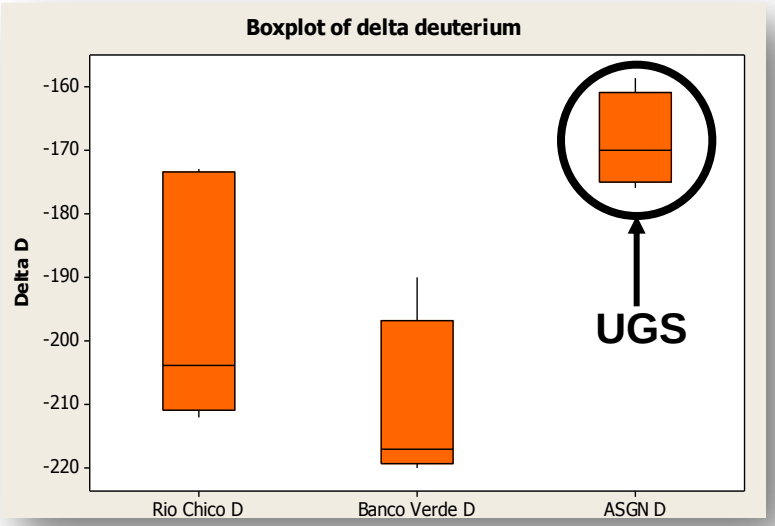
ANALYSIS RESULTS

Isotopic Compositions



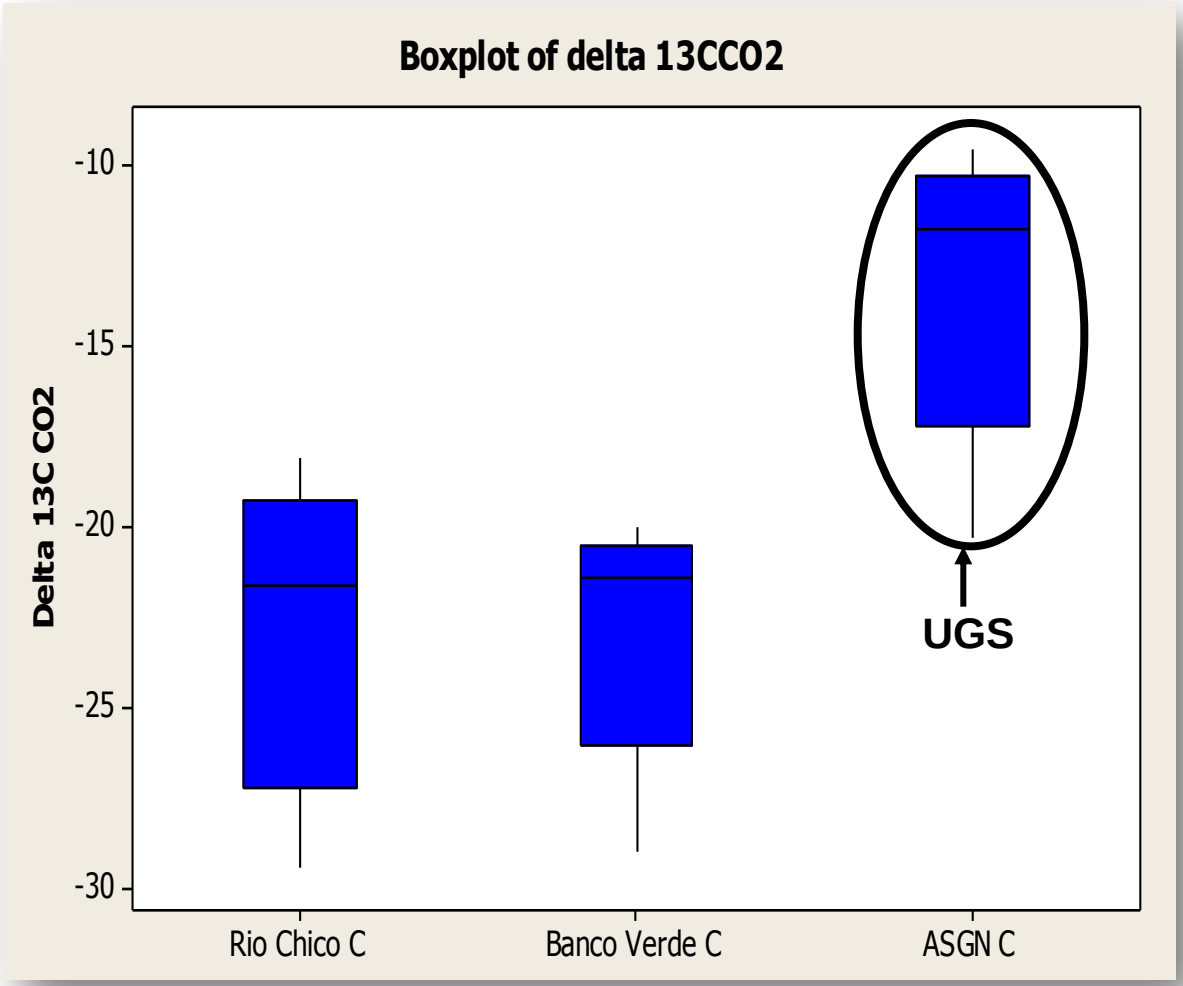
- Isotopic compositions of C_1 for **local gas** have relatively lower values (- 46 to -38 ‰) than **stored gas**. (-32 to -37 ‰)

- The value of δD CH_4 in **local gas** is lower (-174 to -217 ‰) than **stored gas** (-158 to -176 ‰)



ANALYSIS RESULTS

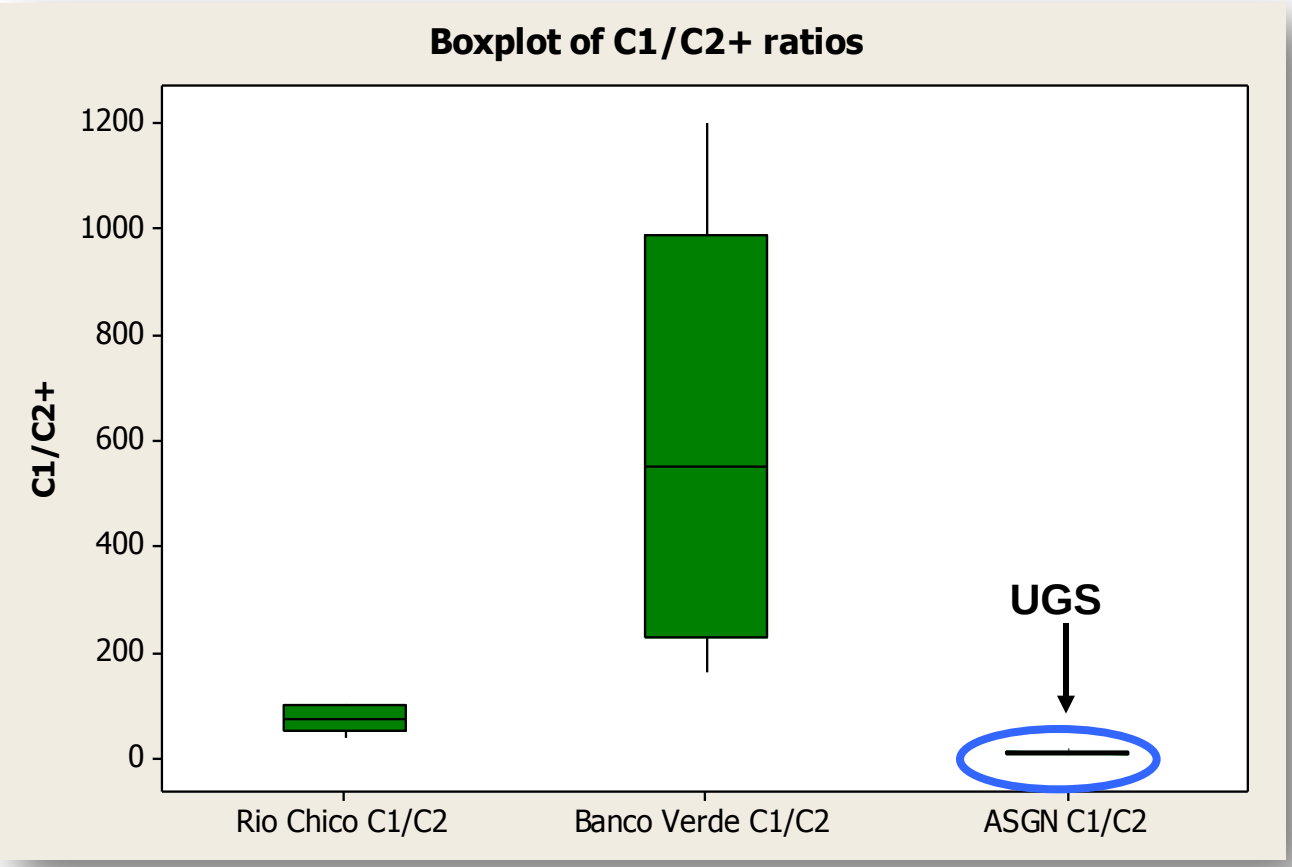
Isotopic Compositions



- The $\delta\ ^{13}C$ of the CO_2 is lighter at local gas (-18/-29‰) than the **stored gas** (-9.6/-20‰)

ANALYSIS RESULTS

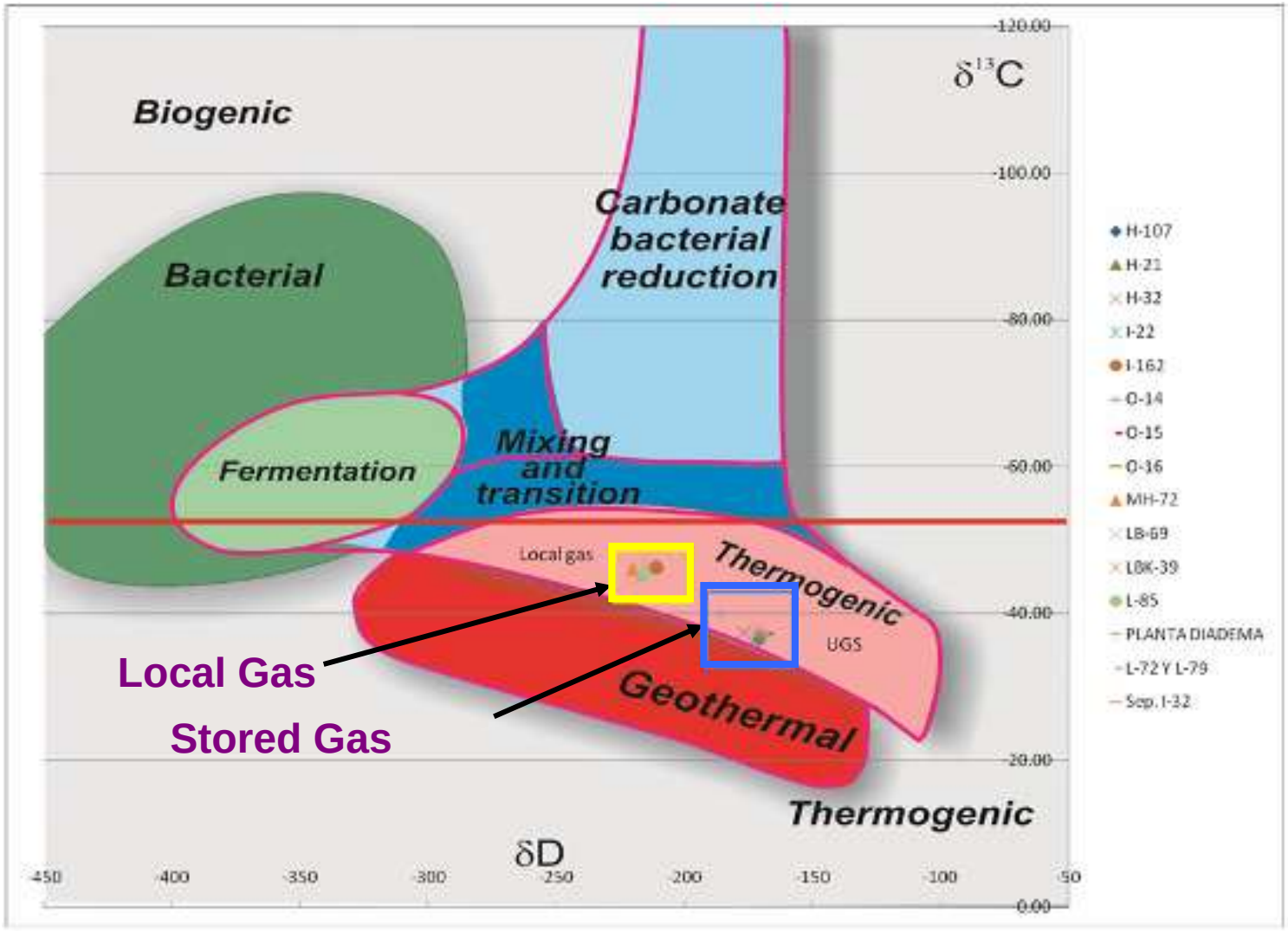
Geochemical Ratios



- C_1/C_2+ ratios for stored gas have varied between 9/15, while those for local gas vary between 41/1200

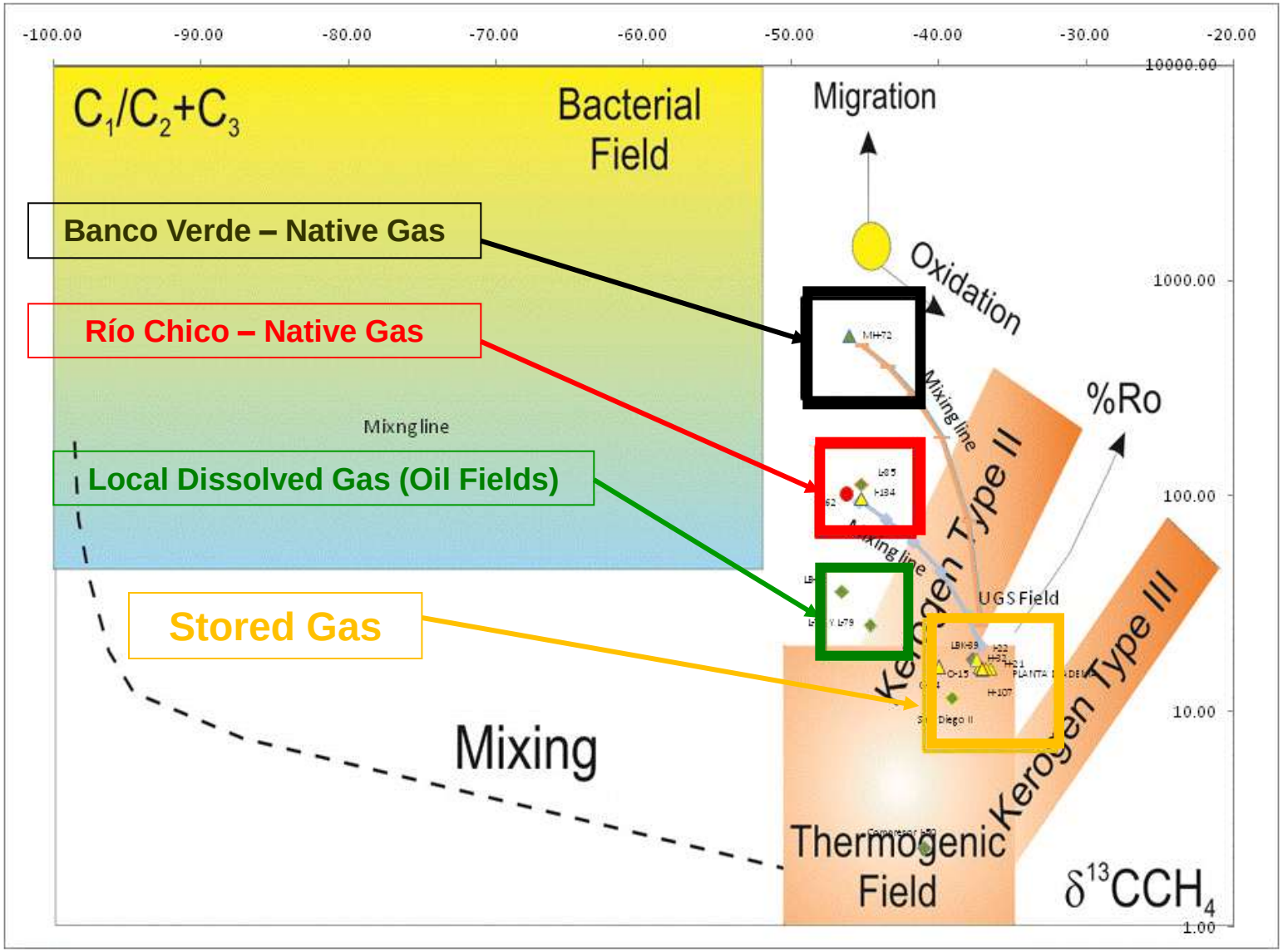
ANALYSIS RESULTS

Correlation diagram $\delta^{13}CCH_4 - \delta DCH_4$



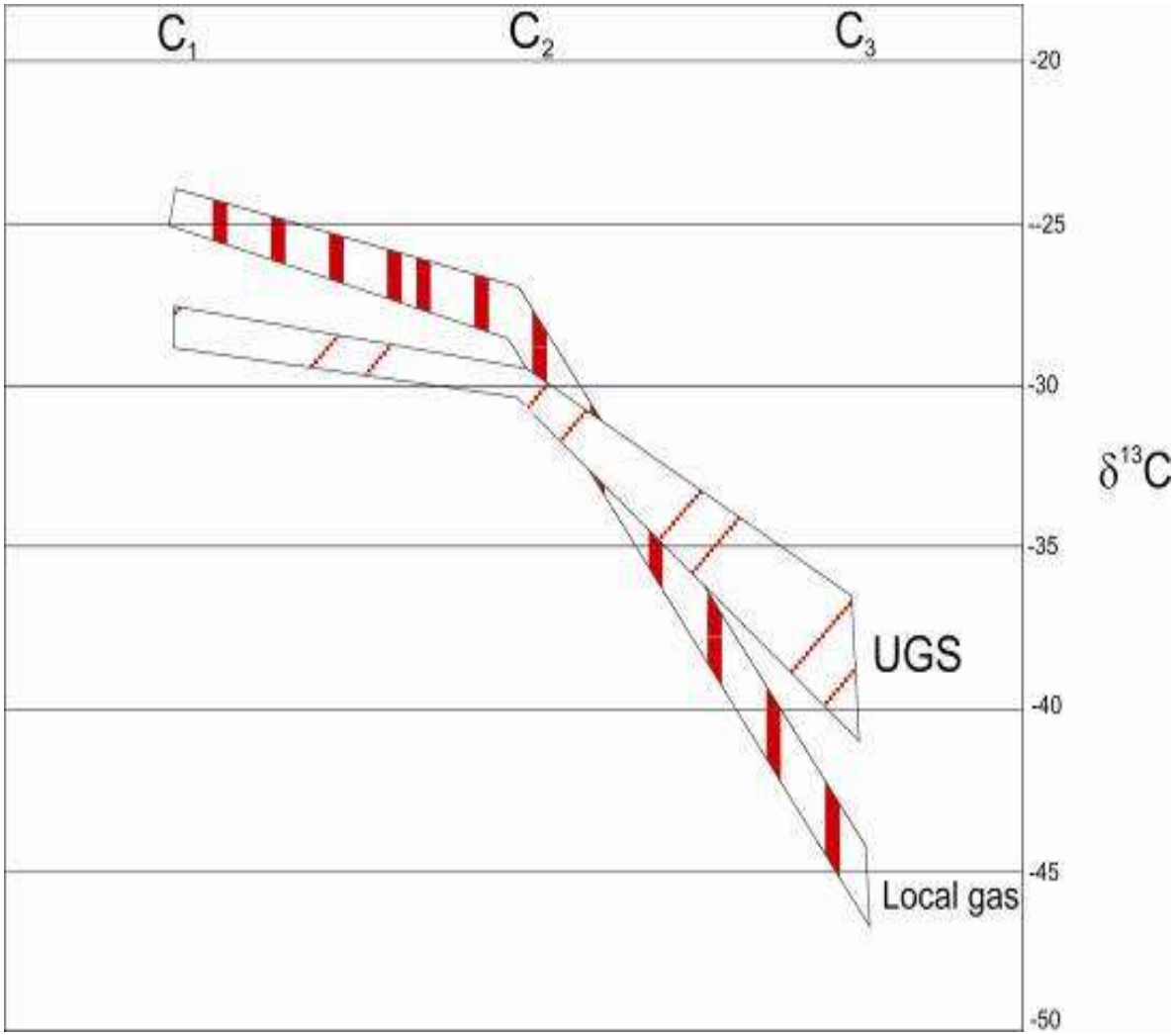
ANALYSIS RESULTS

Bernard's Diagram C_1/C_2+C_3 – $\delta^{13}CC_1$



ANALYSIS RESULTS

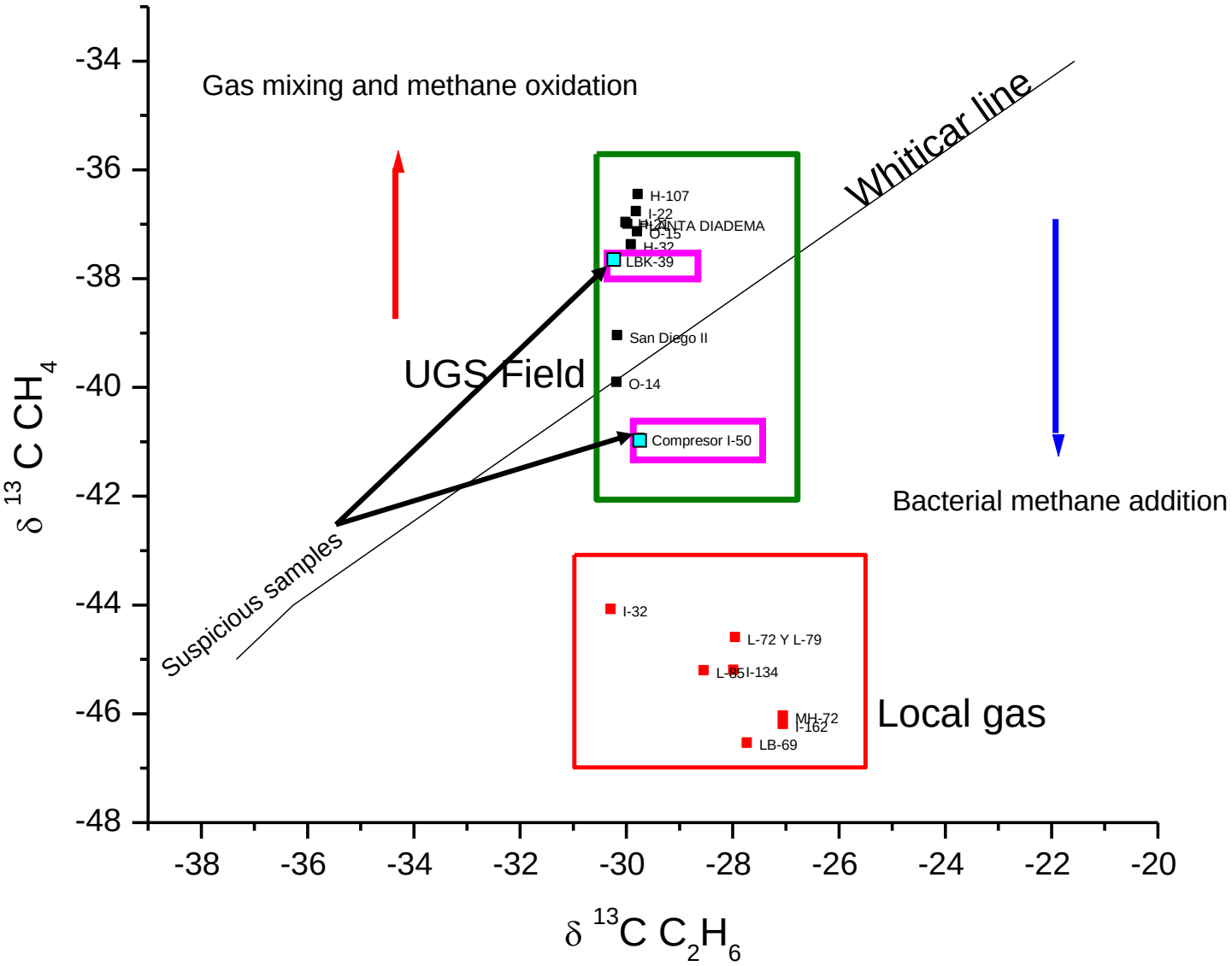
Chung's diagram



Applying the Chung's diagram it is possible to determine clearly the group of gas samples belonging to the UGS and the so called local gas (native gas)

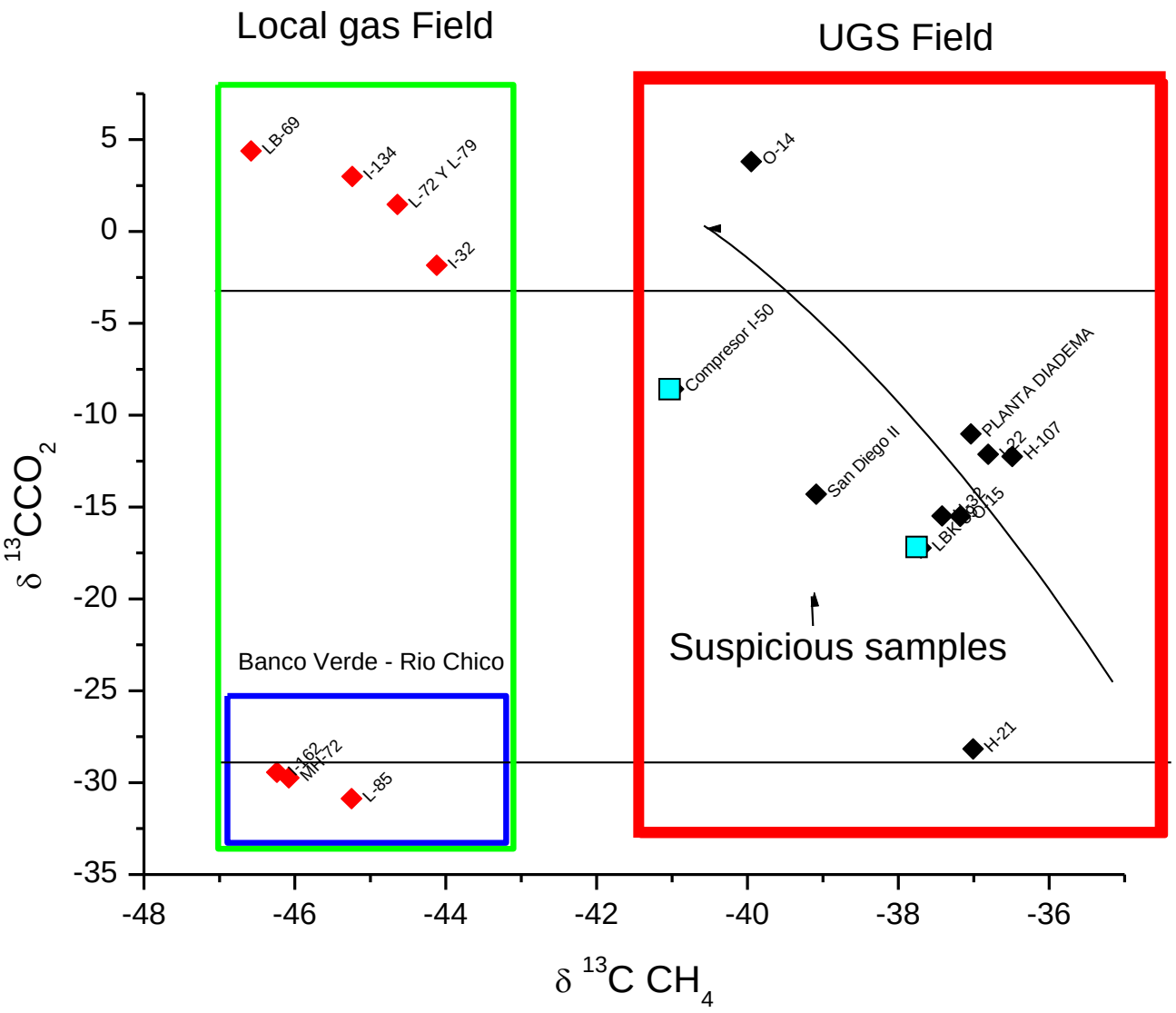
APPLICABILITY OF THE TECHNIQUE

Correlation Diagram - $\delta^{13}CC_1$ - $\delta^{13}CC_2$



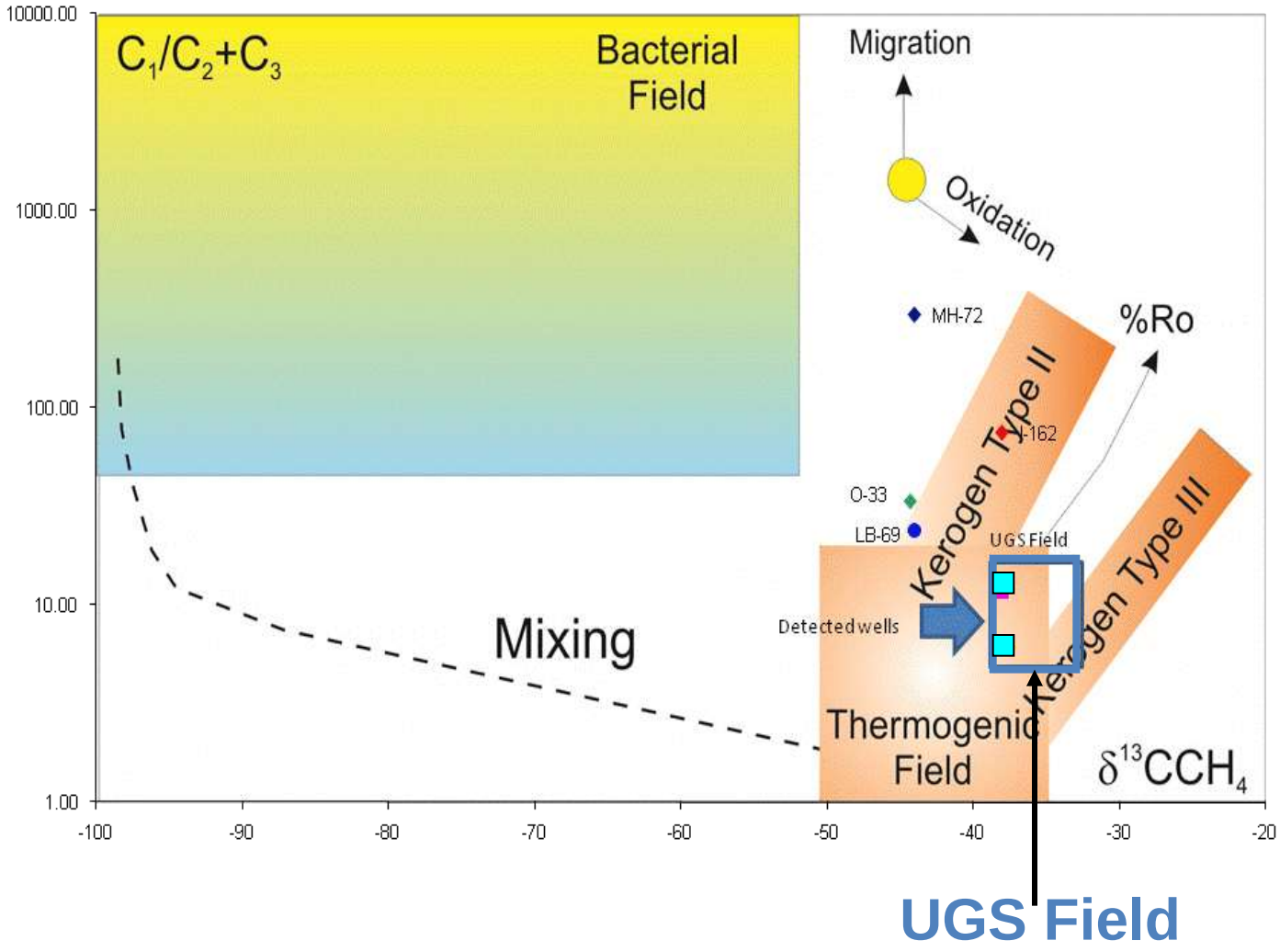
APPLICABILITY OF THE TECHNIQUE

Correlation Diagram - $\delta^{13}CCO2 - \delta^{13}CC1$



APPLICABILITY OF THE TECHNIQUE

Bernard's Diagram C_1/C_2+C_3 – $\delta^{13}CC_1$



CONCLUSIONS

- After seven campaigns, the results of the isotopic and geochemical analysis have indicated that there is neither evidence of gas migration to lower geological levels, nor upper aquifers.

- The results of the methodology indicate that it can be used regularly as a monitoring tool, to identify:
    - gas migration within the reservoir
    - native gas
    - compartments of the reservoir
    - permeability of faults
    - gas releases

- A proved use of this method is the identification of gas mixtures and releases in wells located at the UGS area, and the use of this tool for detecting cases of gas taken without permission.

MANY THANKS FOR YOUR ATTENTION ..!!!!