Three Different Exploration Plays in the Marine Guadalquivir Foreland Basin in the Context of the Late Miocene Closure of the Thethys Ocean (South of Spain)*

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Abstract

During the Burdigalian Alpine tectonic phase, the marine Guadalquivir foreland basin was established in the South of Spain between the passive Spanish Shield to the north and the uplifting Betic Chain to the south. In the Tortonian, the SW-NE marine North Betic Strait that connected the Atlantic and the Mediterranean was closed due to the last compressive events of the Betic Cordillera uplifting. So, the Atlantic and Mediterranean only remained connected by the Gibraltar Strait and some short and isolated north-south canyons communicating with the Alboran Sea and Guadalquivir Basin.

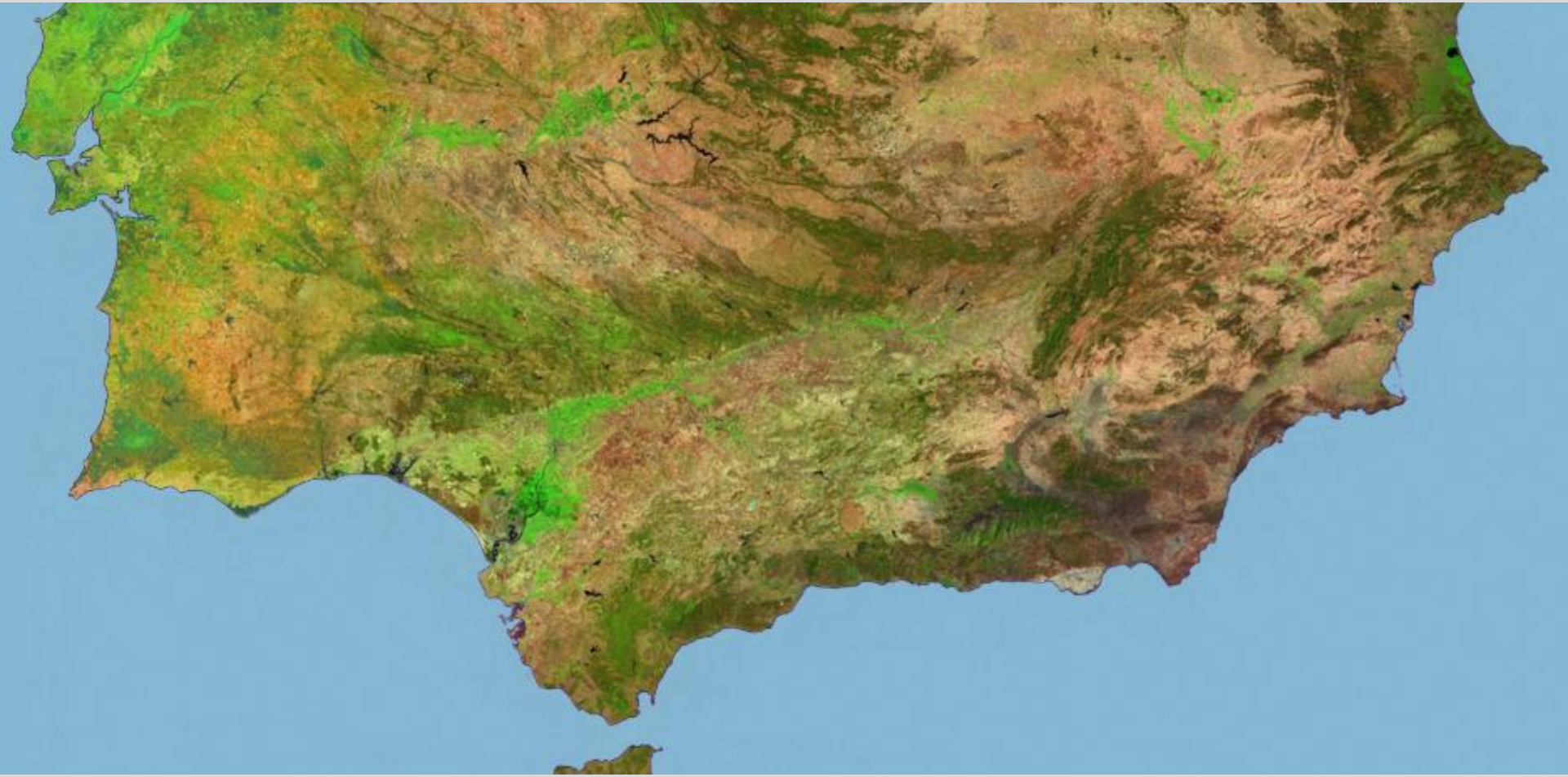
In the Guadalquivir foreland basin the seismic lines allow us to distinguish three different exploration plays: (1) Upper Miocene sandy turbidites, (2) Hanging wall anticlines, and (3) Stephanian-Permian sub-basins.

In the Upper Miocene turbidites (Guadalquivir sandstones Formation) more than 20 biogenic gas fields have been found with individual reserves from 2 to 6 BCFG. The historic exploration success (> 50%) is in part due to successful AVO analysis, the gas price ($10 MBTU), the prospects shallowness (from 600 to 2,300 ft.), and a large area that still remains underexplored.

Hanging wall anticlines are a new prospect play identified in the seismic images in an area with excellent shale and salt seal (the Miocene Olistostrome) above a thick Mesozoic series in four-way-closure fault propagation anticlines. Source rocks are present in Miocene marls (biogenic, out of structure) and especially in the Neocomian, Kimmeridgian and Liassic shales in the structure. Mesozoic shales have kerogene type III-II.

Stephanian-Permian sub-basins are also an unexplored play seen in seismic lines with improved definition below the basal Miocene unconformity (3,000-4,000 ft. deep). These Late Hercynian sub-basins can be correlated with the coal-bearing NW-SE trending sub-basins present in the Southern Spanish Shield. Their sedimentary infill opens a new opportunity for coal bed methane exploration.

THREE DIFFERENT EXPLORATION PLAYS IN THE MARINE GUADALQUIVIR FORELAND BASIN IN THE CONTEXT OF THE LATE MIOCENE CLOSURE OF THE TETHYS OCEAN (SOUTH OF SPAIN)



KILIAN MOTIS & WENCESLAO MARTÍNEZ DEL OLMO

OIL & GAS CAPITAL

1- INTRODUCTION (i)

OIL & GAS CAPITAL

GEOGRAPHIC LOCATION

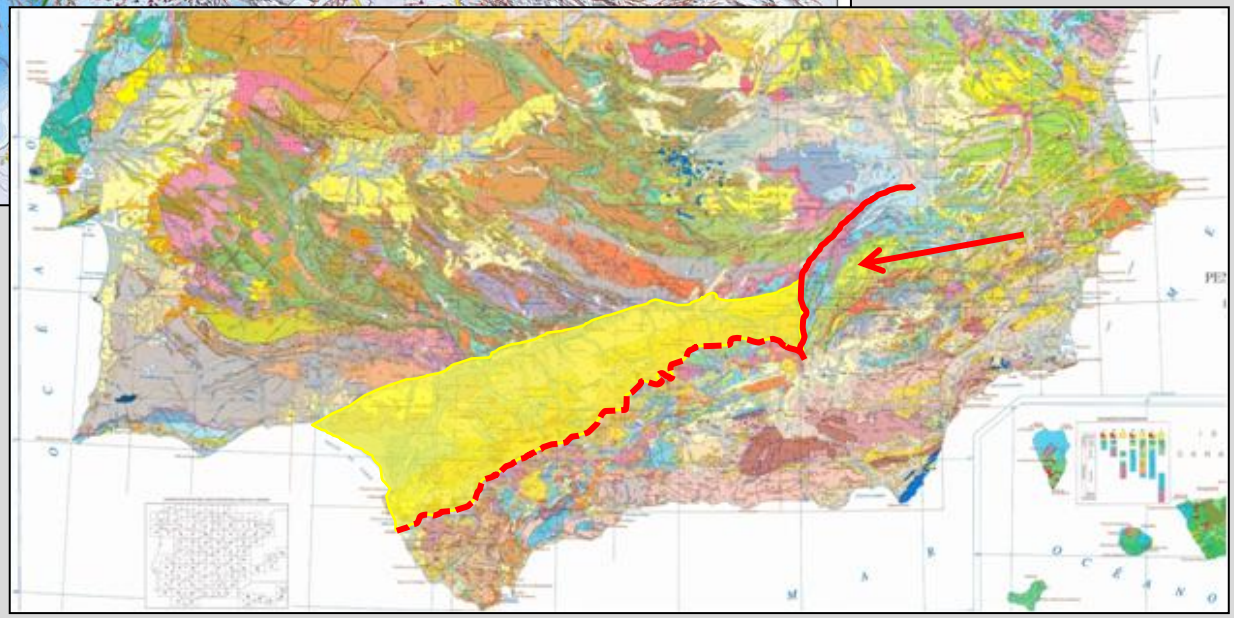
1- INTRODUCTION (ii)

OIL & GAS CAPITAL

GEOLOGICAL SETTING

Source: BGR

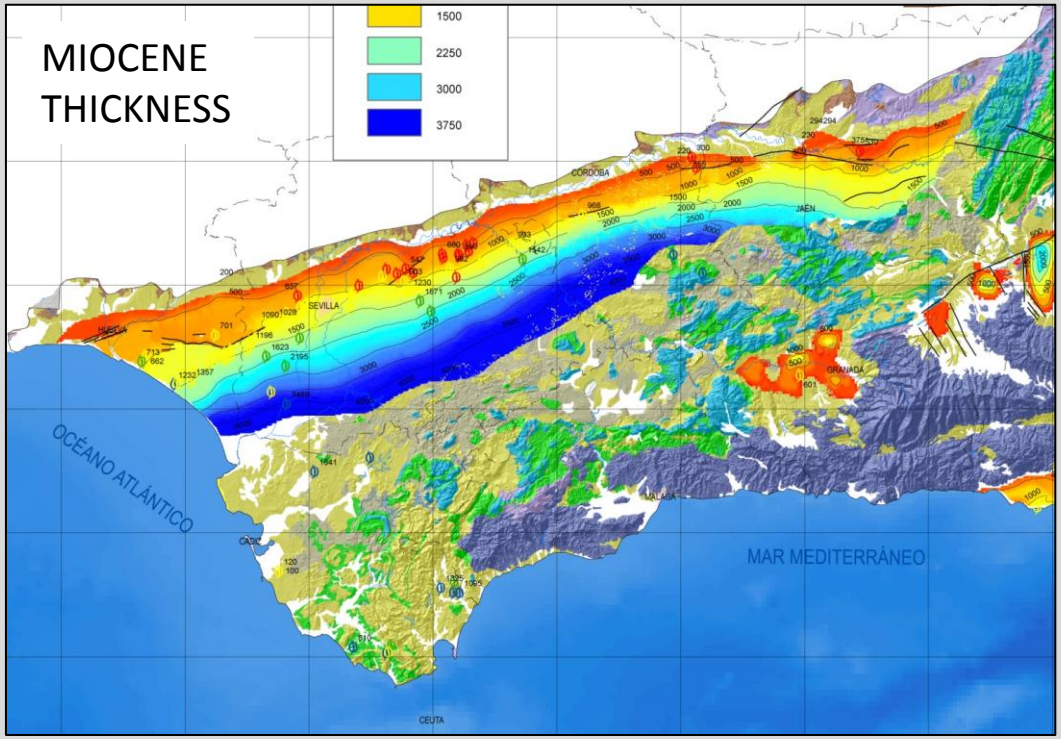
Source: IGME



1- INTRODUCTION (iii)

OIL & GAS CAPITAL

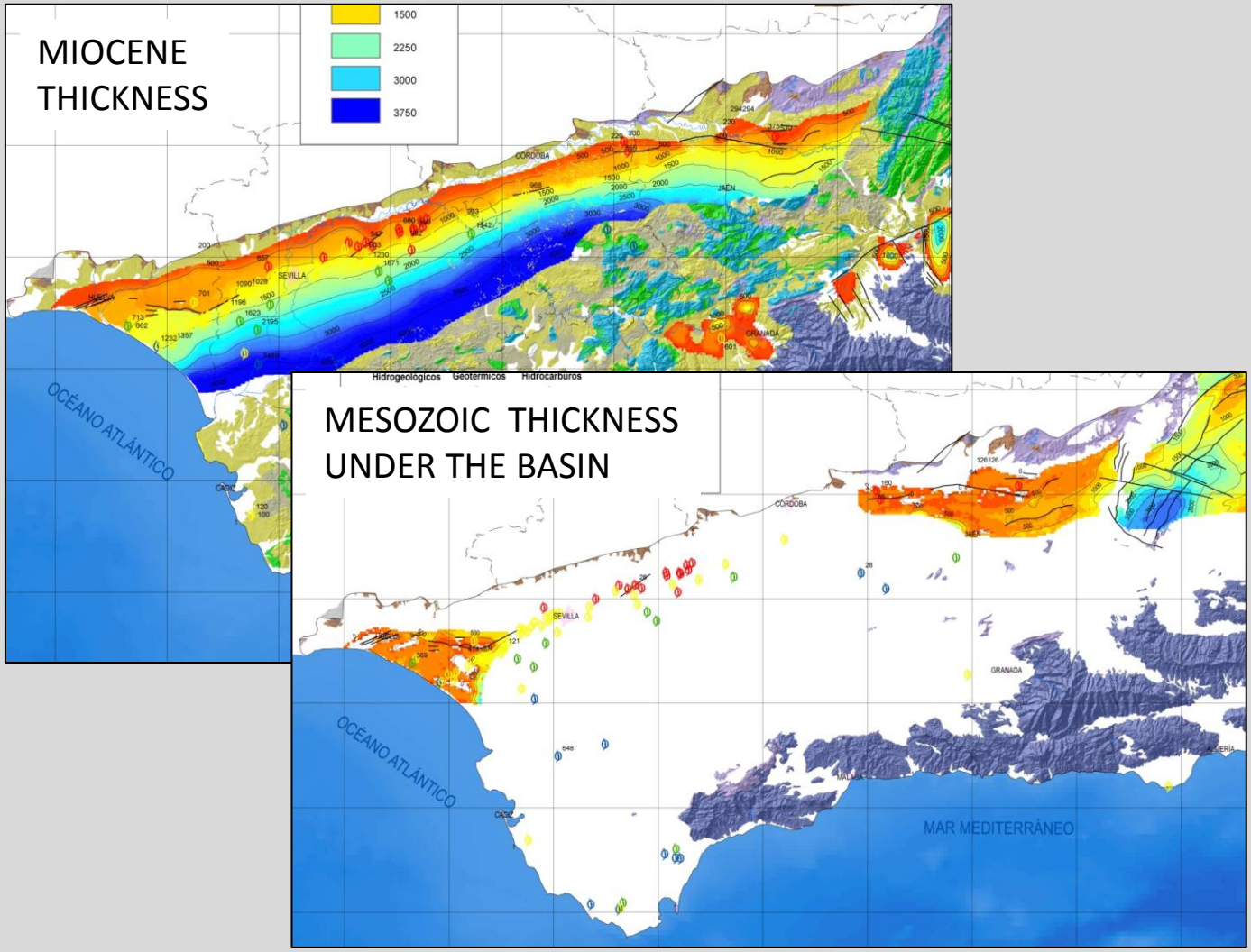
Source: IGME



1- INTRODUCTION (iii)

OIL & GAS CAPITAL

Source: IGME



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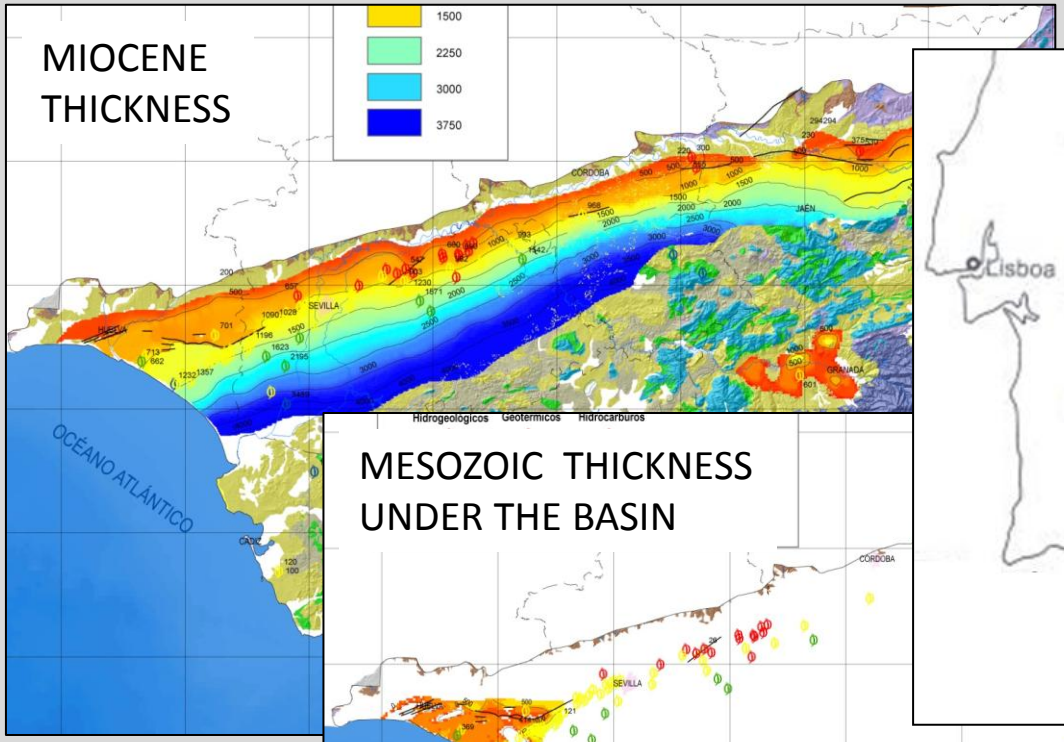
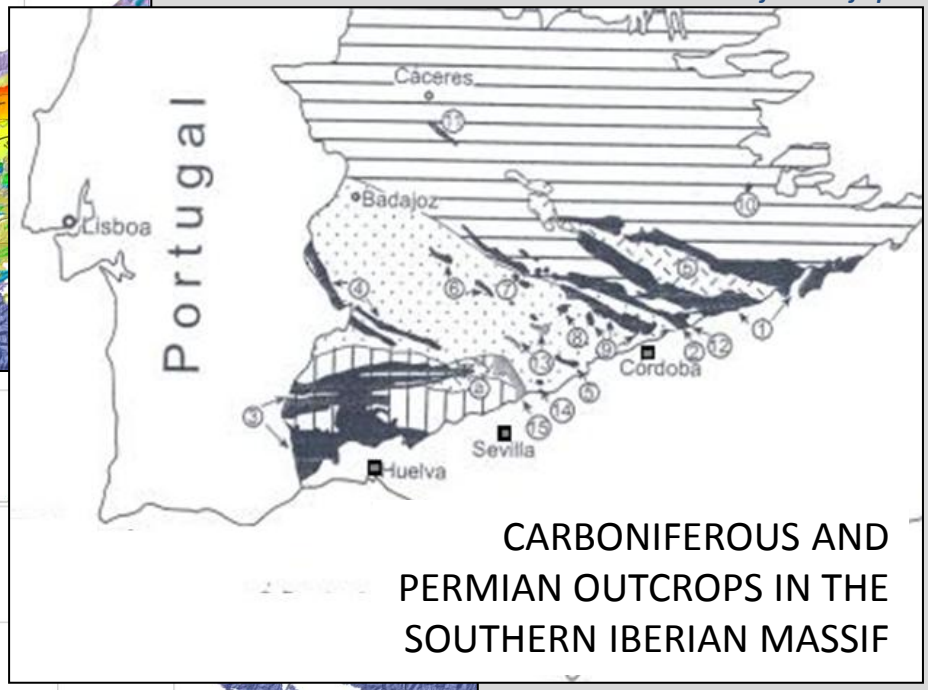
1- INTRODUCTION (iii)

OIL & GAS CAPITAL

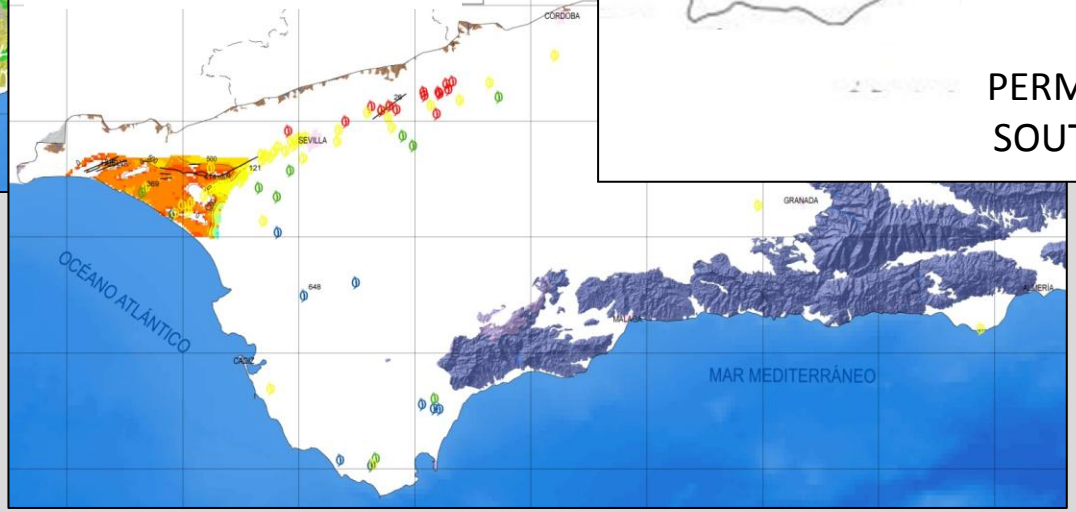
Source: IGME



Source: Carboniferous of Spain



CARBONIFEROUS AND PERMIAN OUTCROPS IN THE SOUTHERN IBERIAN MASSIF

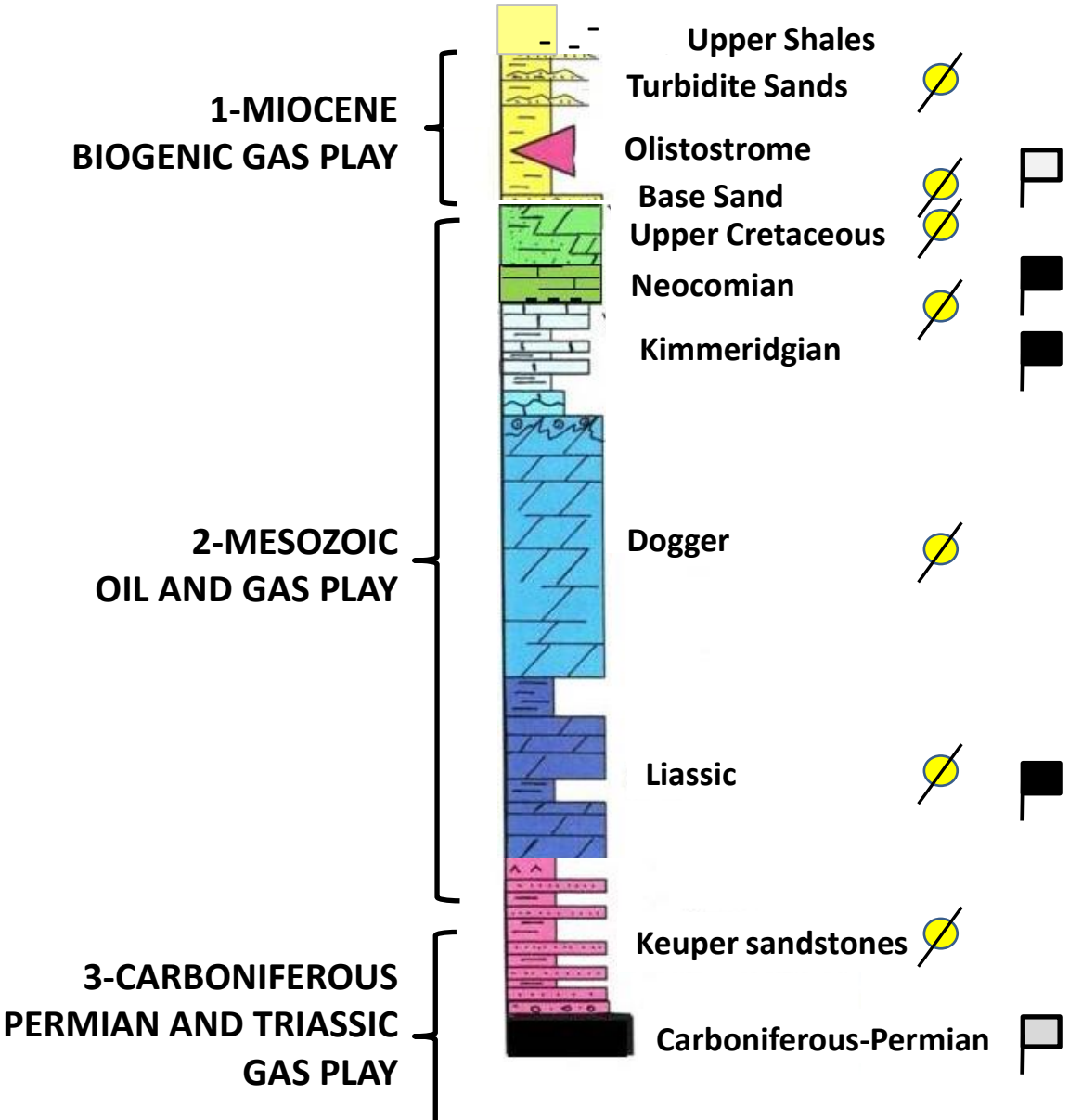


Source: IGME

1- INTRODUCTION (iv)

OIL & GAS CAPITAL

THE THREE GUADALQUIVIR EXPLORATION PLAYS



2- PLAYS: 1-MIOCENE BIOGENIC (i)

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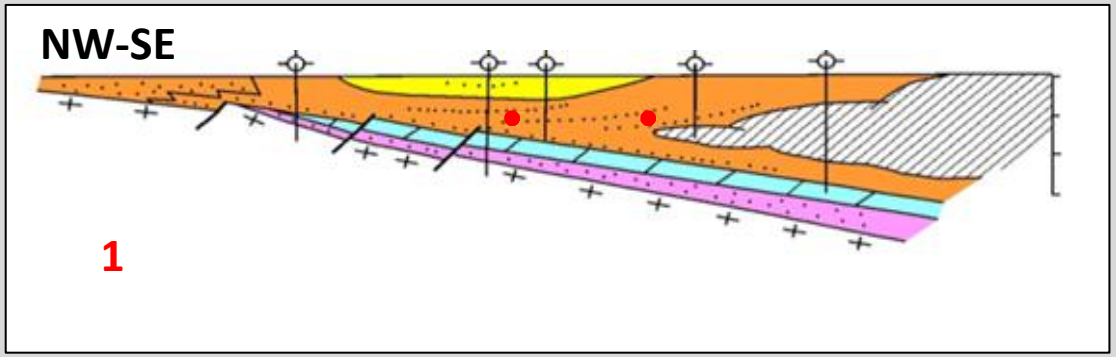
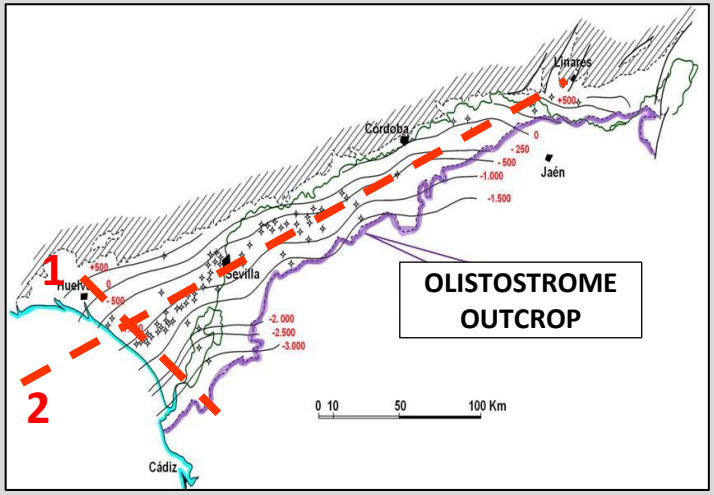
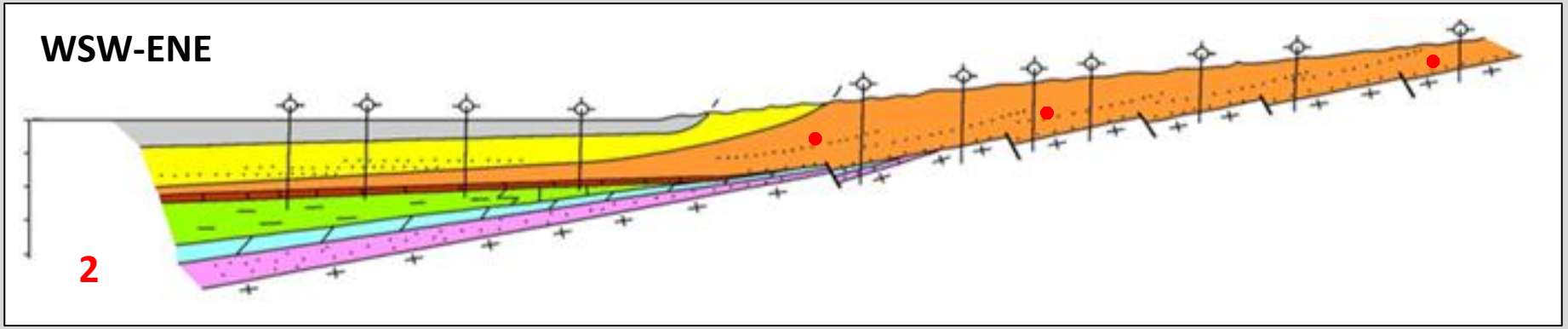
GUADALQUIVIR BASIN SYNTHETIC CROSS SECTIONS

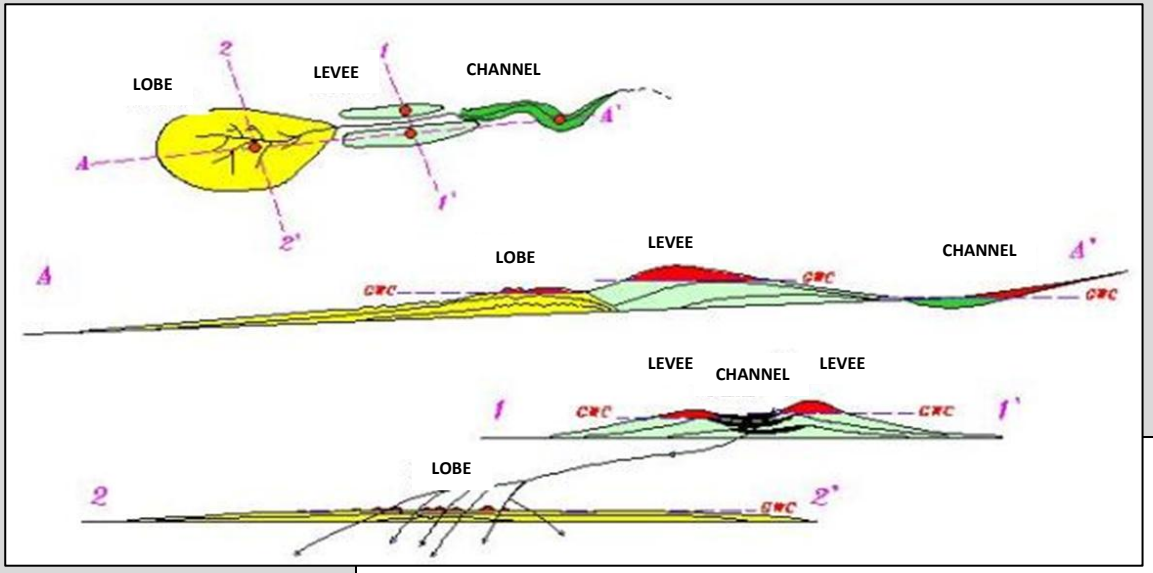




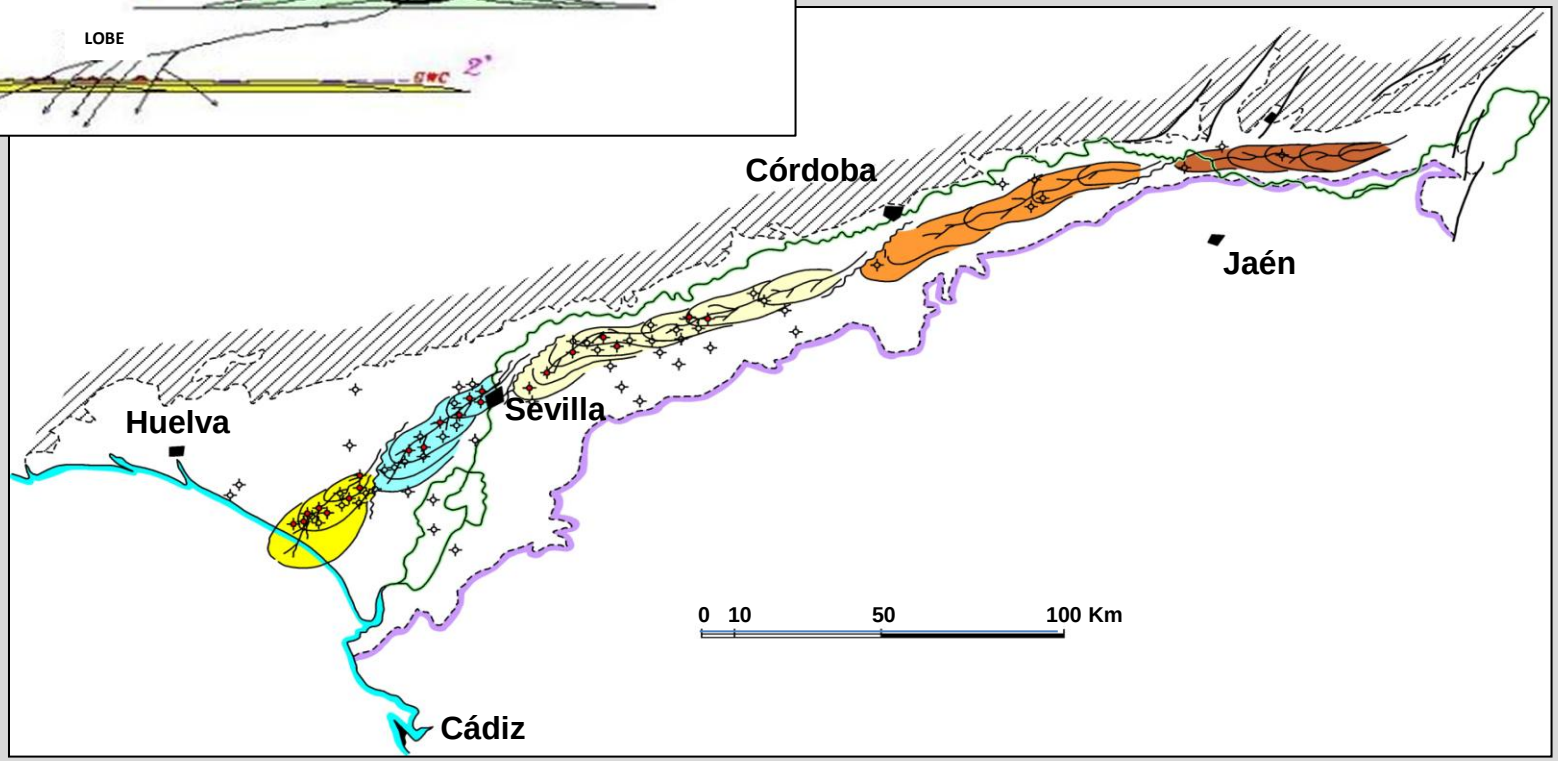


2- PLAYS: 1-MIOCENE BIOGENIC (ii)

OIL & GAS CAPITAL



GUADALQUIVIR SANDS FM SEDIMENTARY MODEL



2- PLAYS: 1-MIOCENE BIOGENIC (iii)

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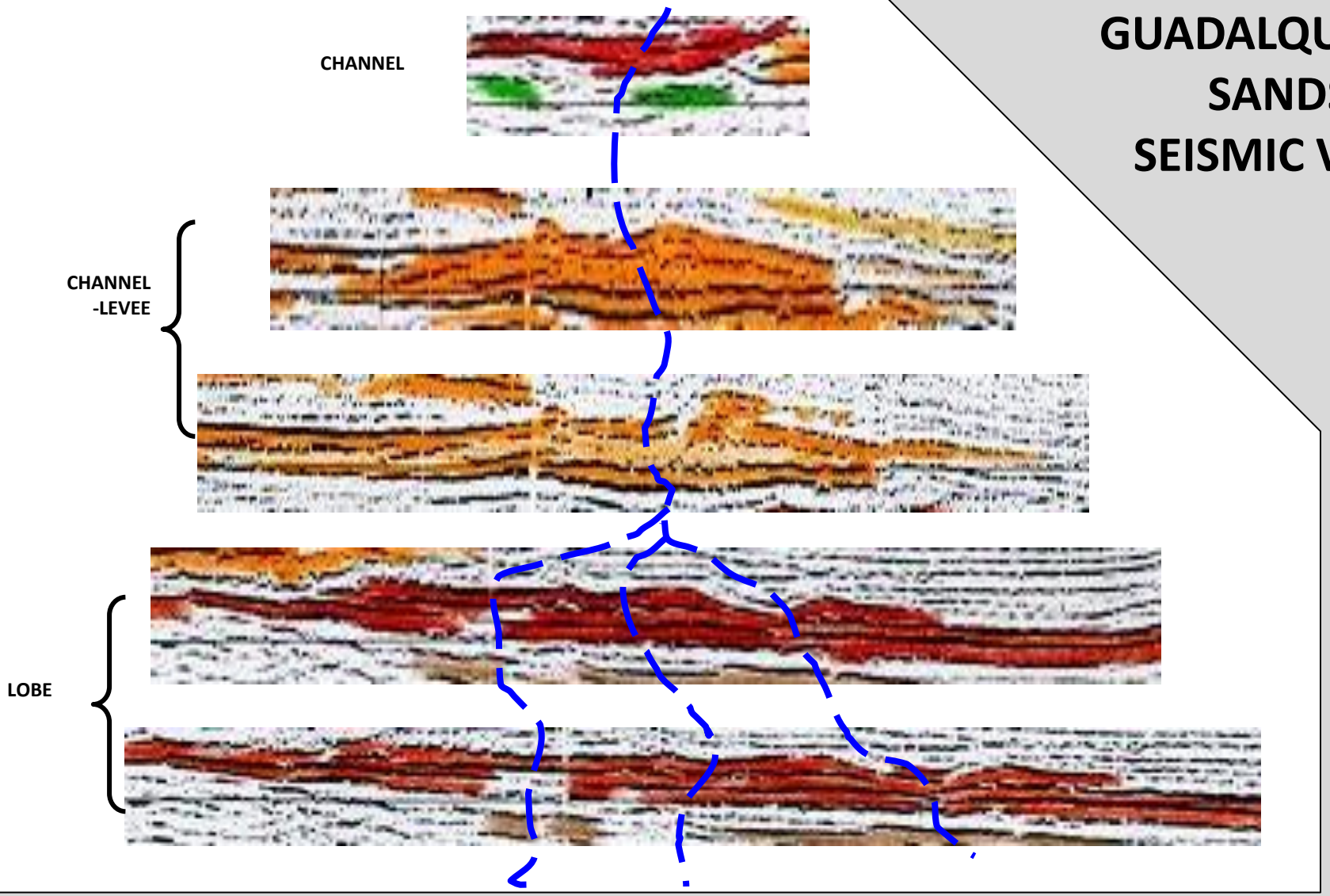
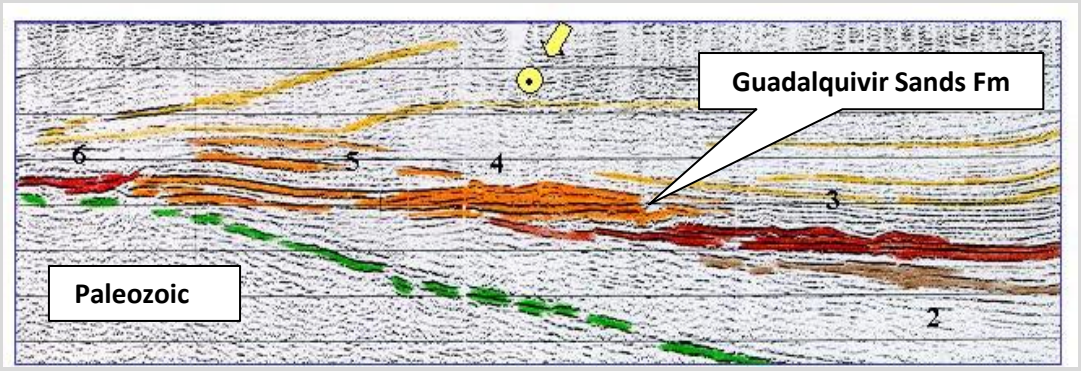
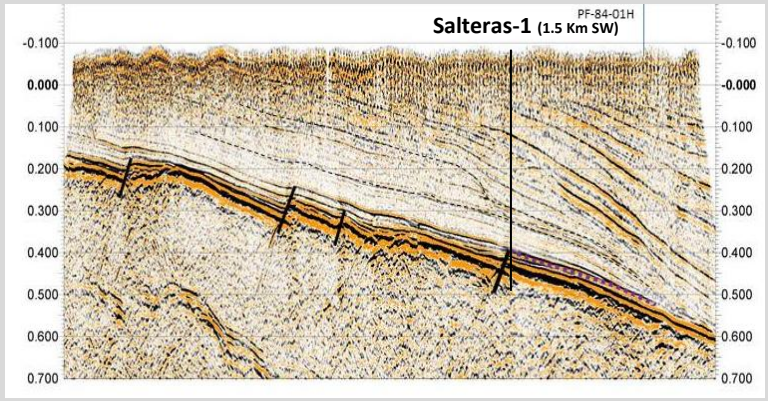
GUADALQUIVIR SANDS FM SEISMIC VIEW

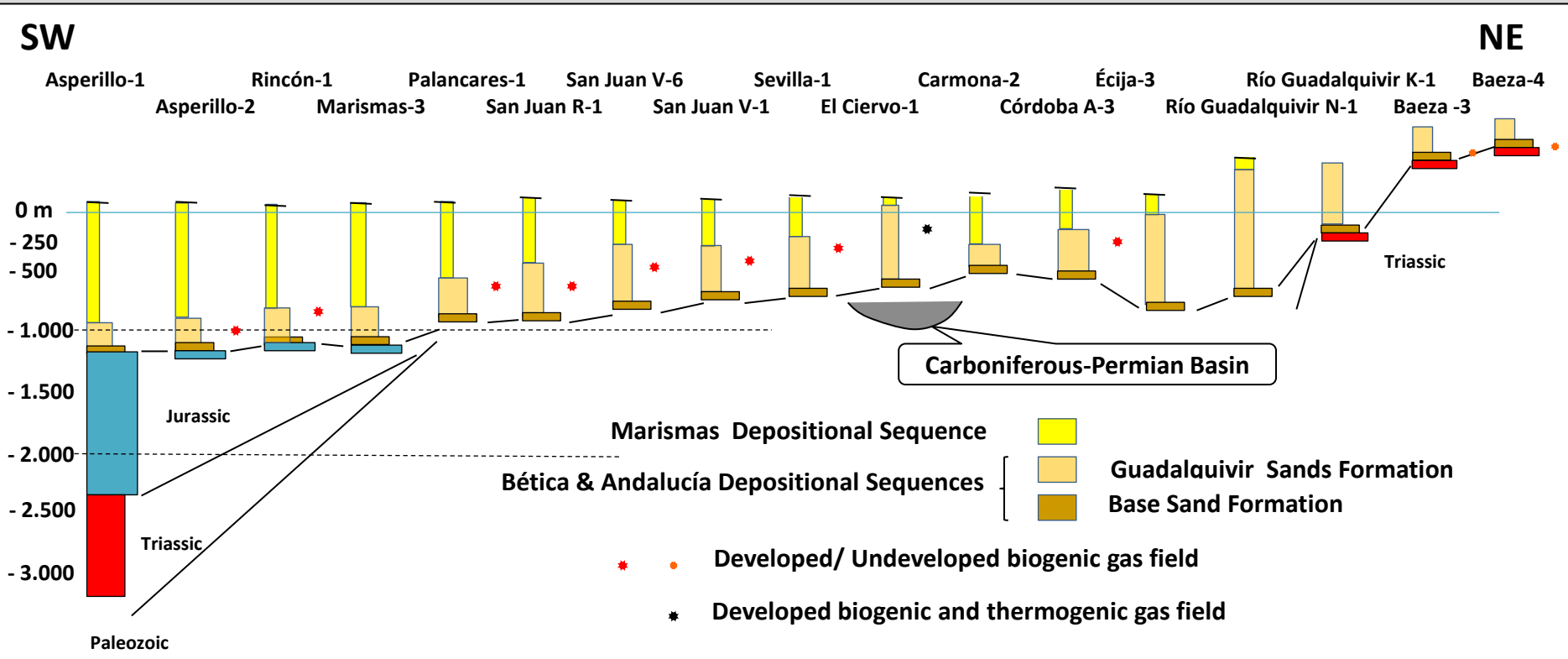


2- PLAYS: 1-MIOCENE BIOGENIC (iv)

OIL & GAS CAPITAL

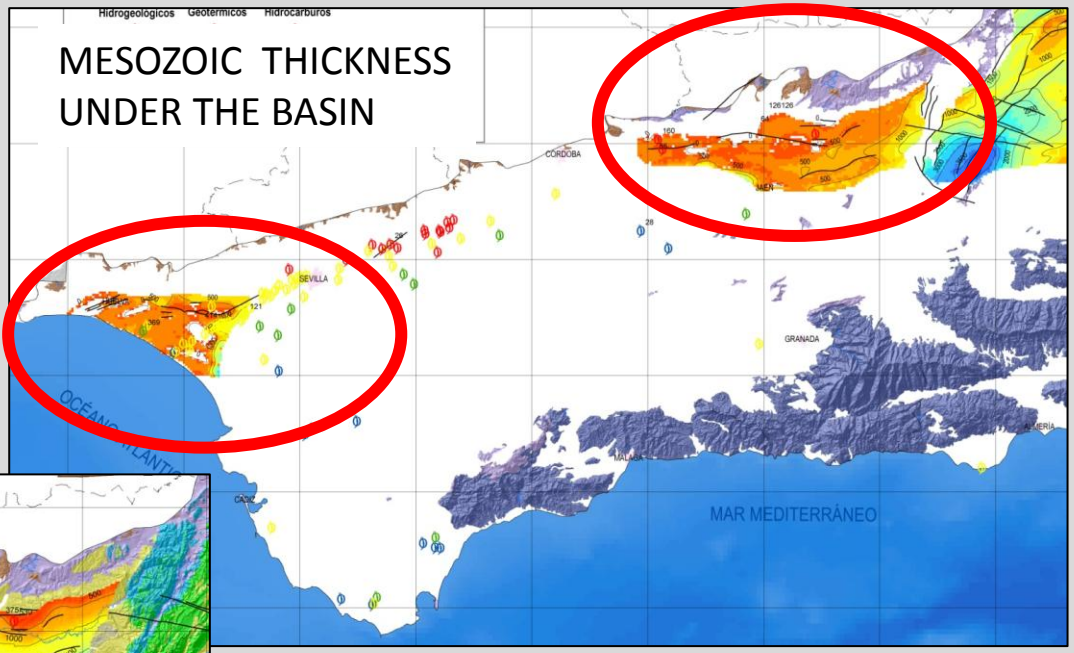




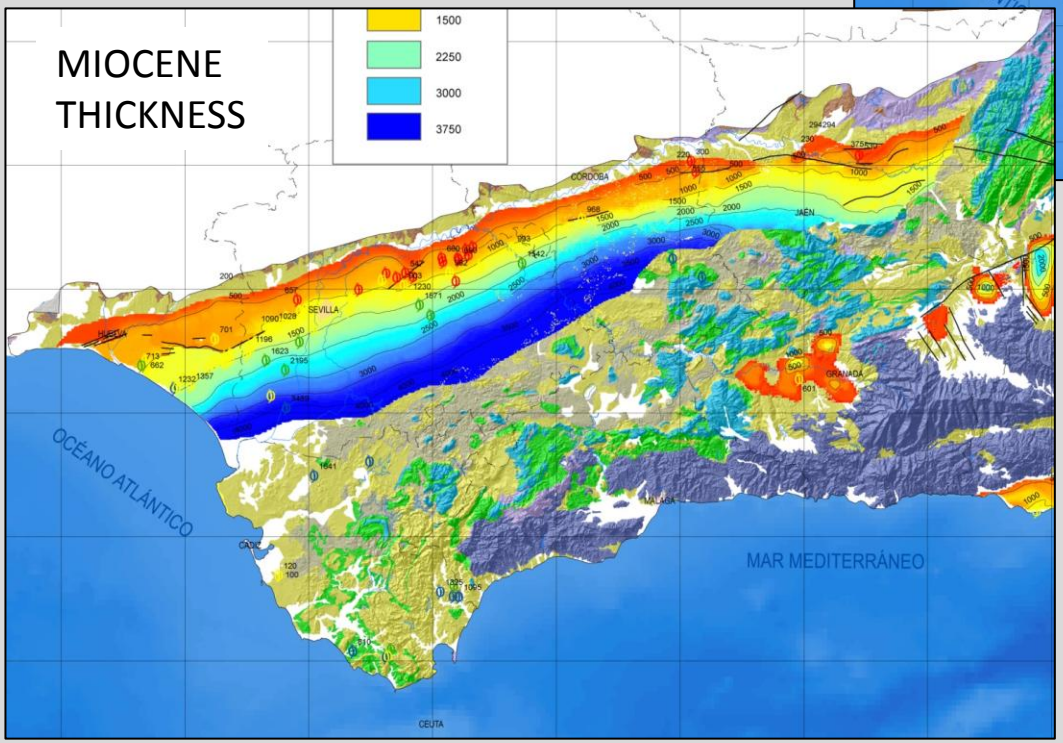


2- PLAYS: 2-BETIC MESOZOIC (i)

OIL & GAS CAPITAL



Source: IGME



Source: IGME

2- PLAYS: 2-BETIC MESOZOIC (ii)

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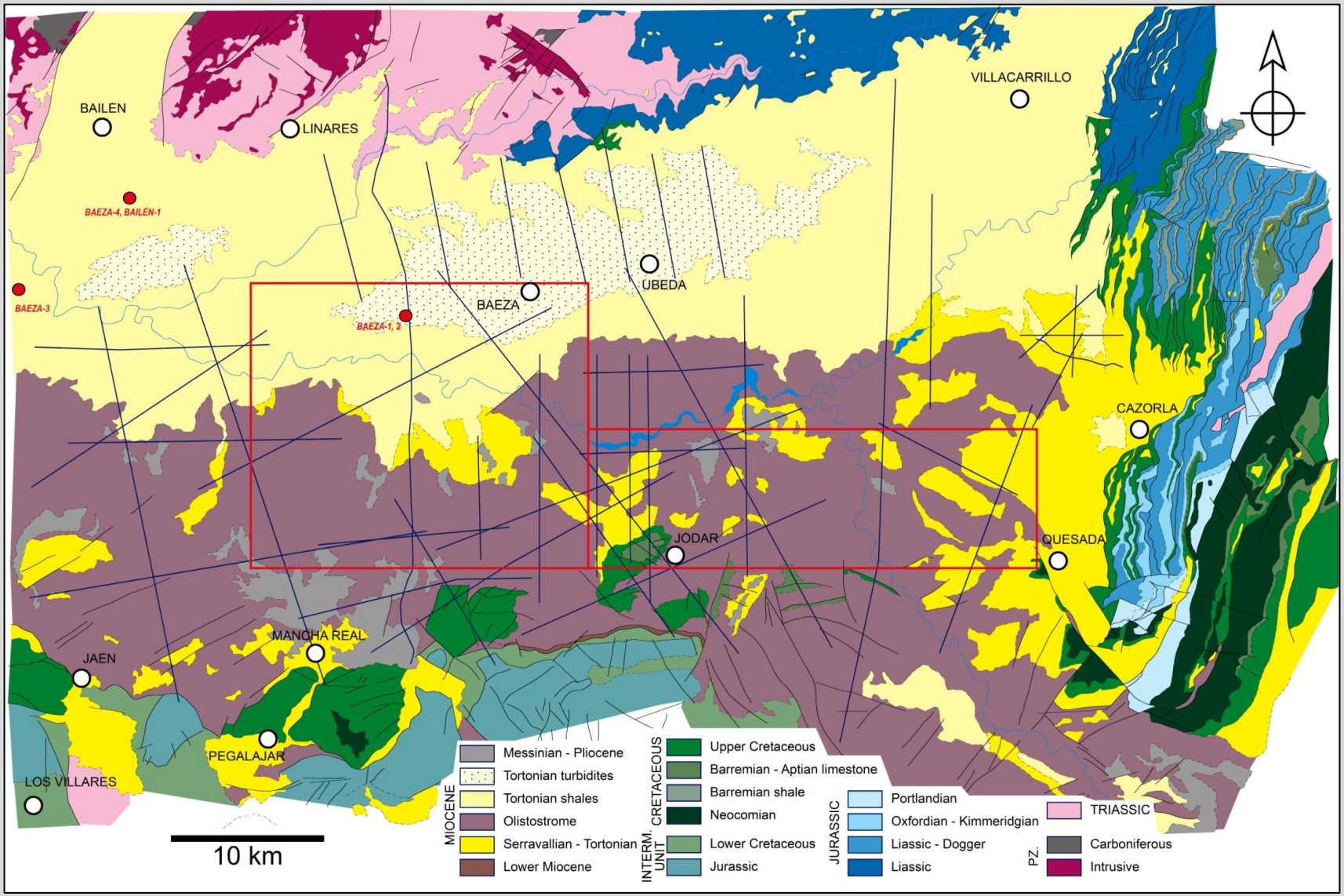
HIGHER GUADALQUIVIR AREA ('ULISES')



Source: Motis & Martínez del Olmo, 2012

2- PLAYS: 2-BETIC MESOZOIC (iii)

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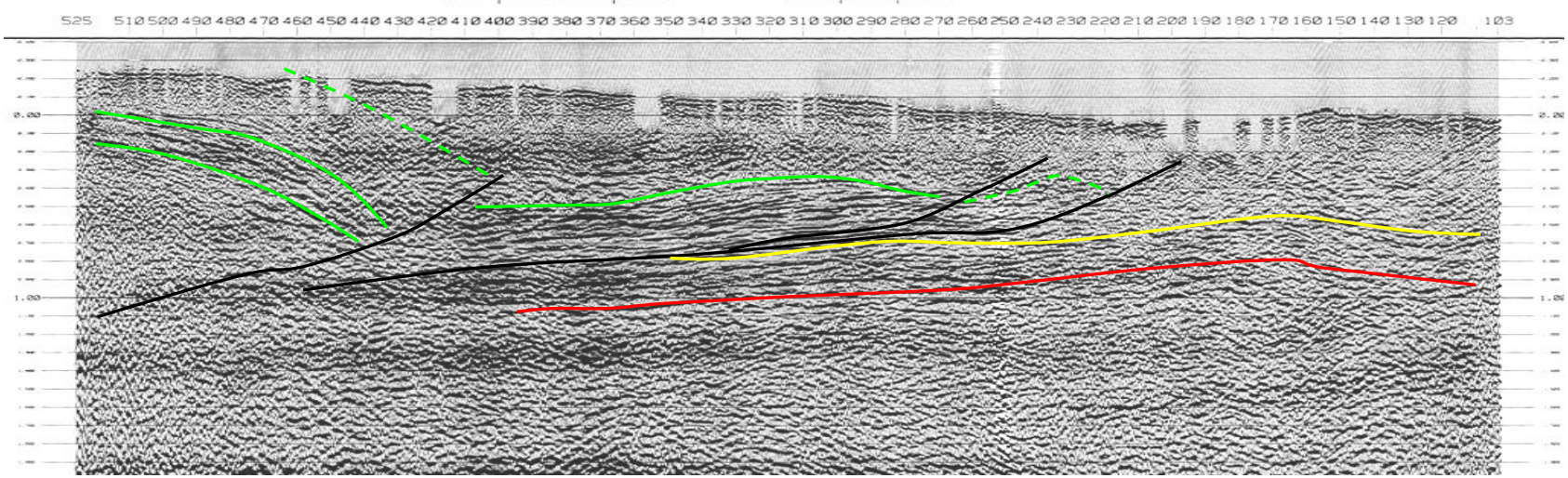
S-N



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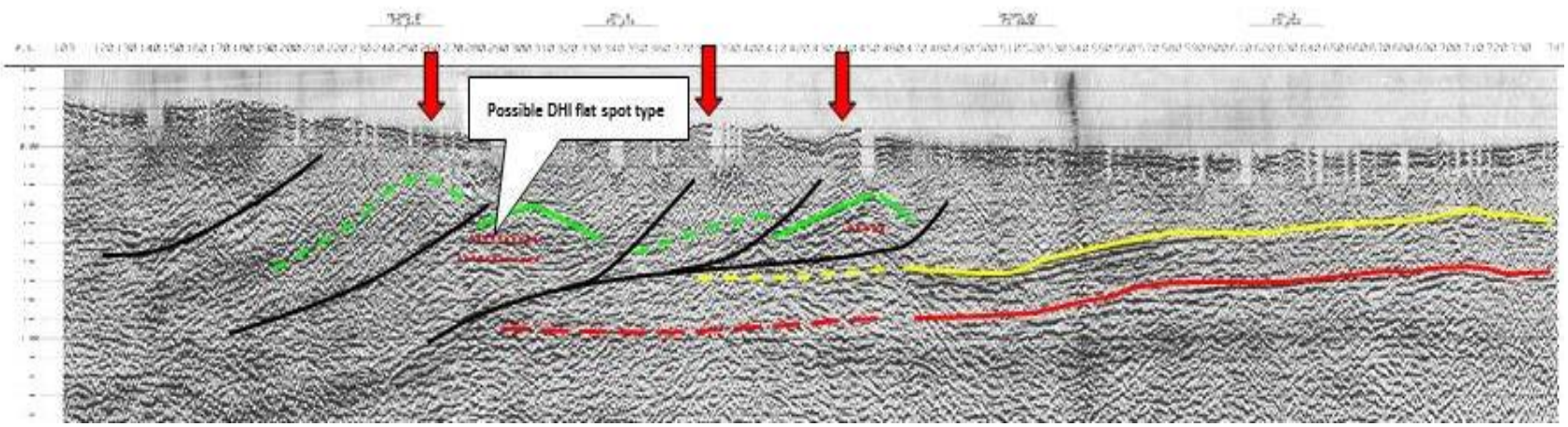

2- PLAYS: 2-BETIC MESOZOIC (iv)

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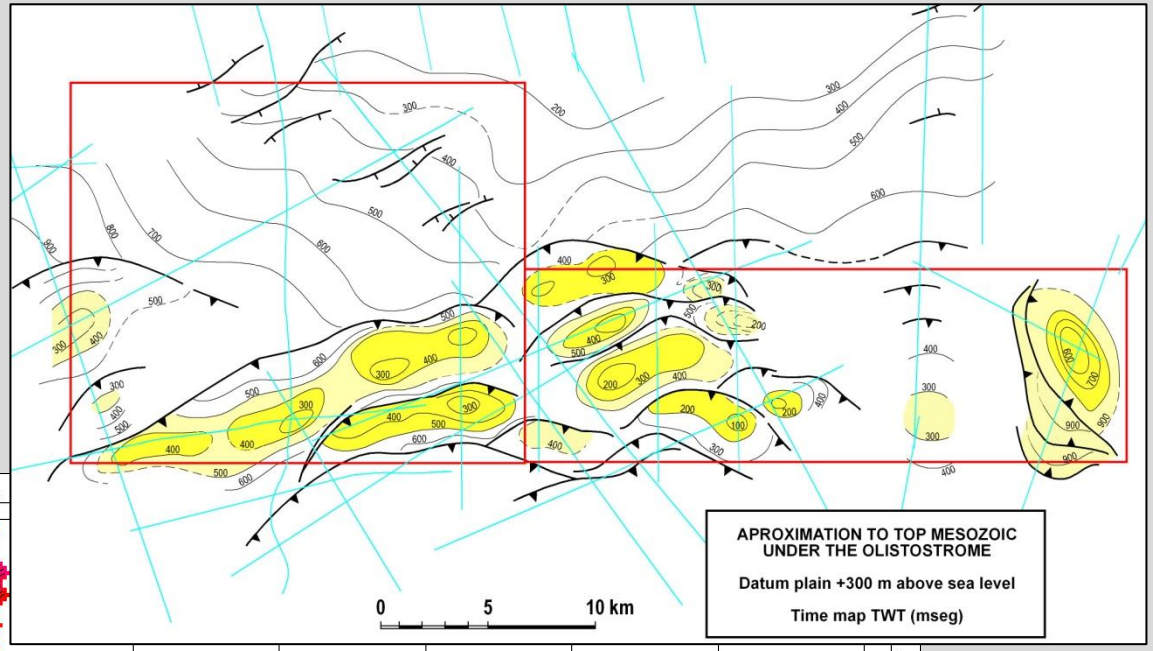
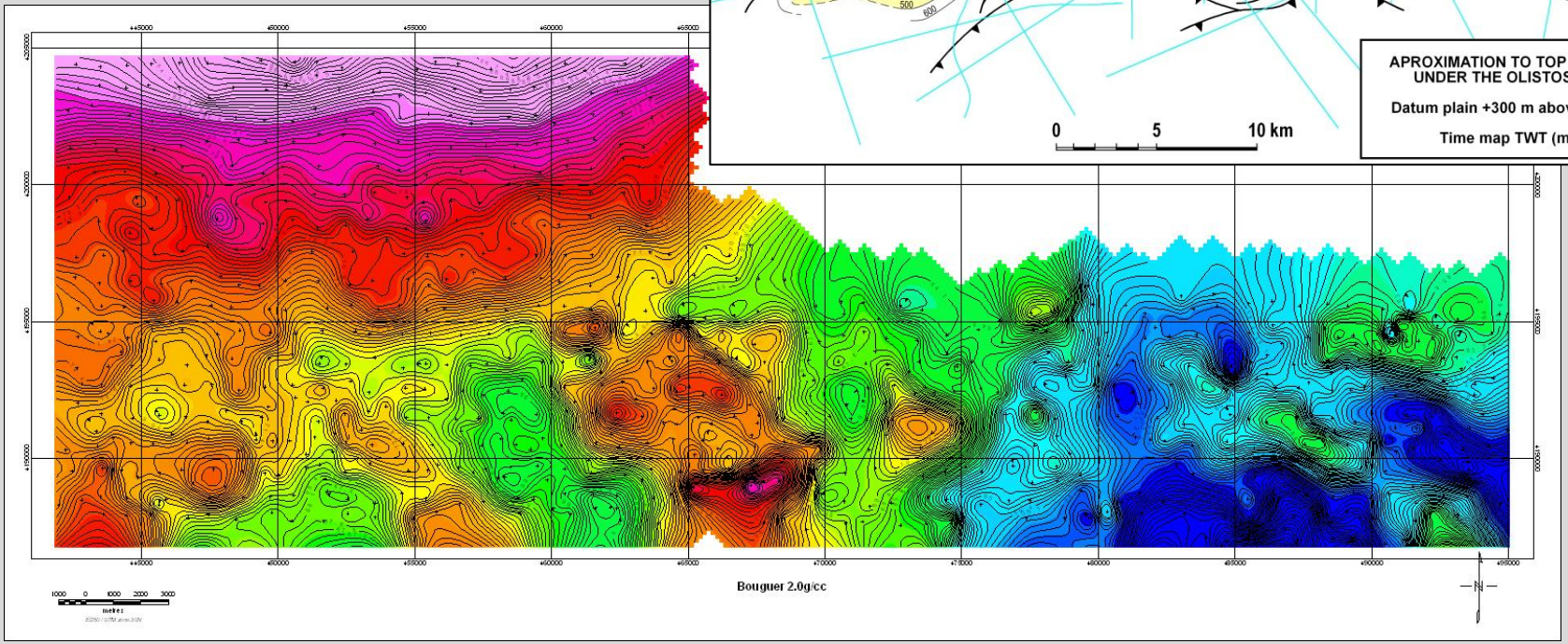
TECTONIC STYLE

(FOUR-WAY CLOSURES)





2- PLAYS: 2-BETIC MESOZOIC (vi)

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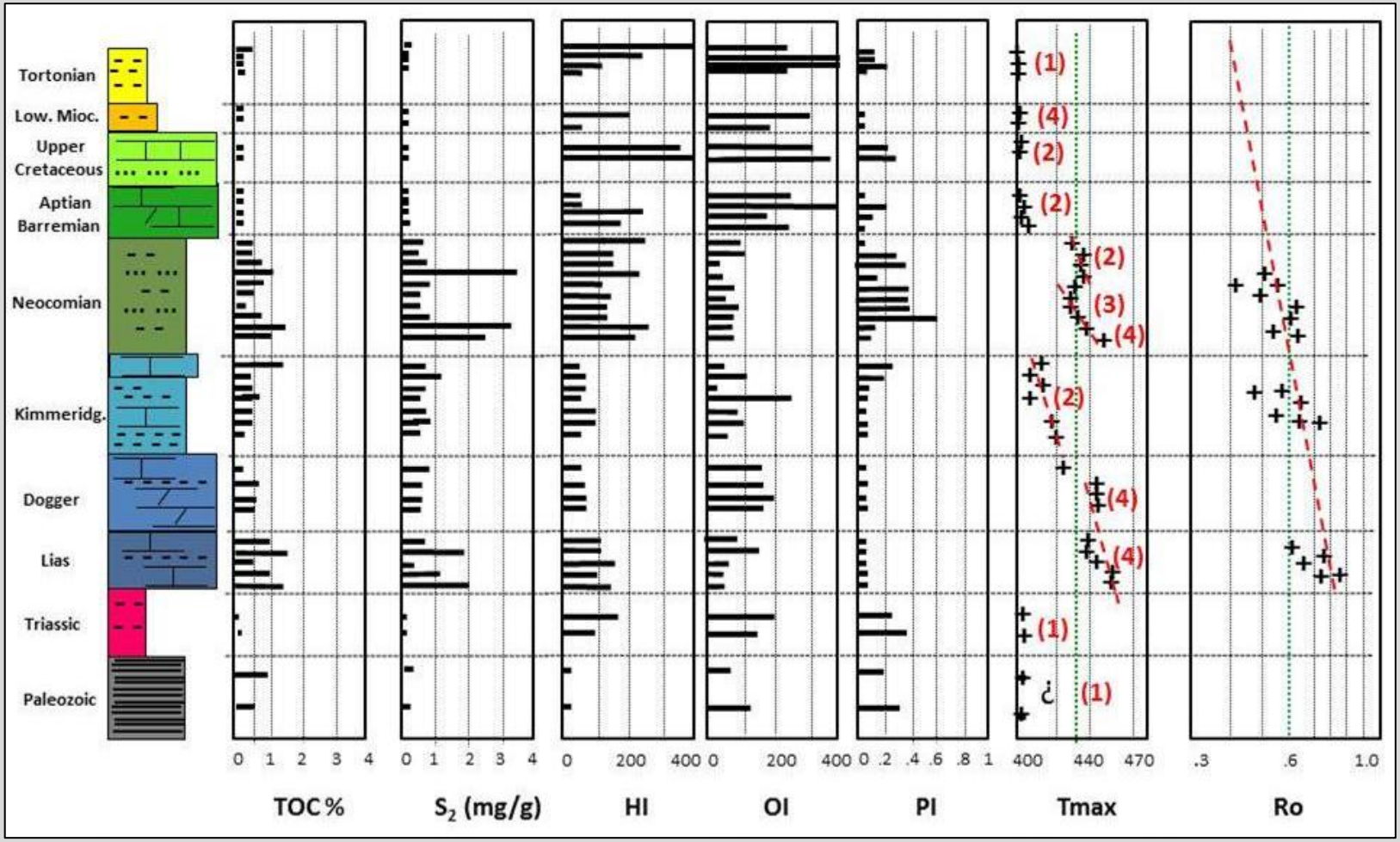
SYNTHETIC DIAGRAM FROM THE GEOCHEMICAL ANALYSIS (SAMPLES COLLECTED IN OUTCROPS)



(1) 'Cobertera Tabular' (2) Outern Prebetic (3) Inner Prebetic (4) 'Unidad Intermedia'

2- PLAYS: 3-LATE HERCYNIAN (i)

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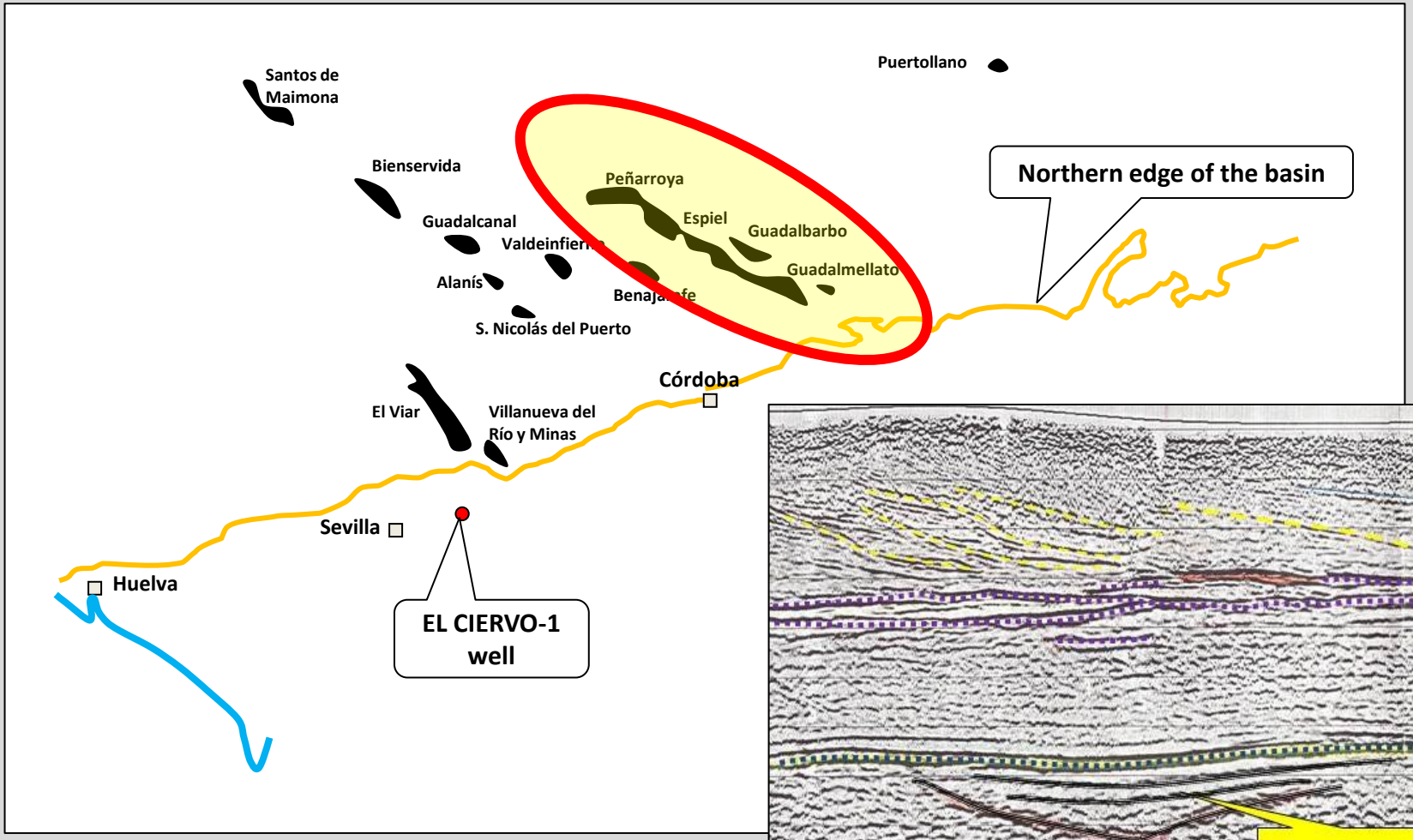
CARBONIFEROUS AND PERMIAN COAL SEEMS



2- PLAYS: 3-LATE HERCYNIAN (ii)

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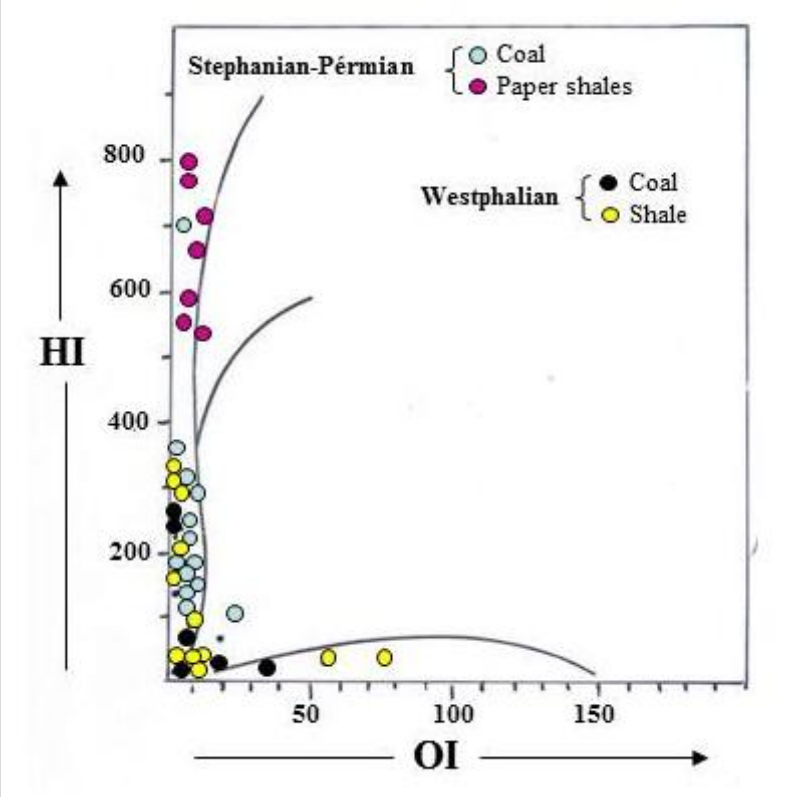
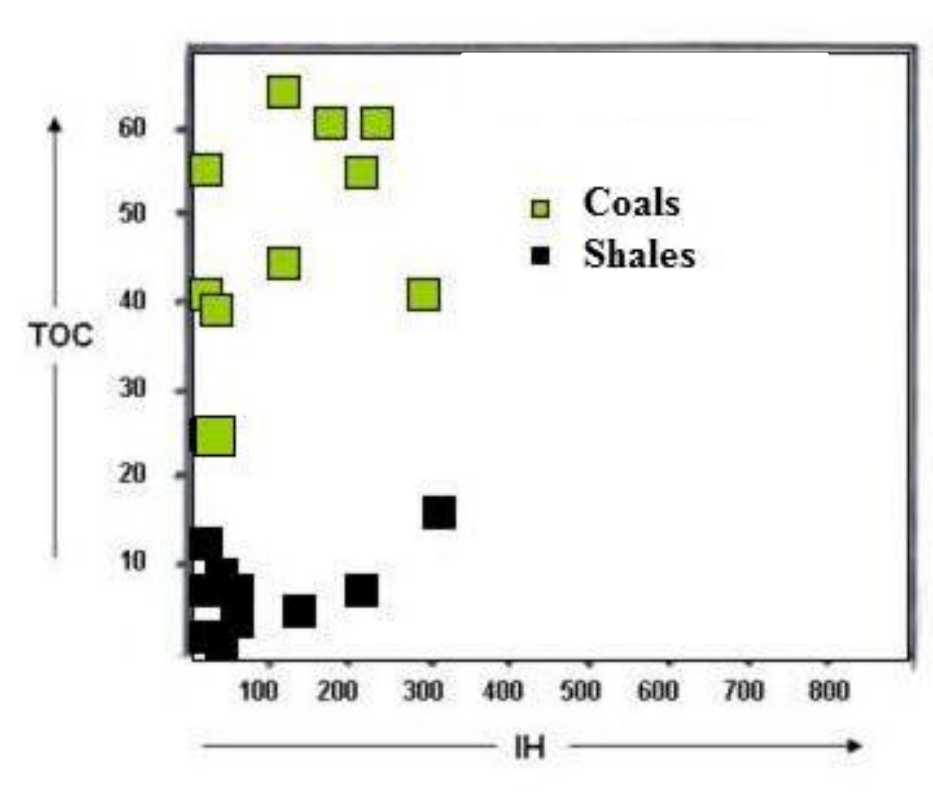
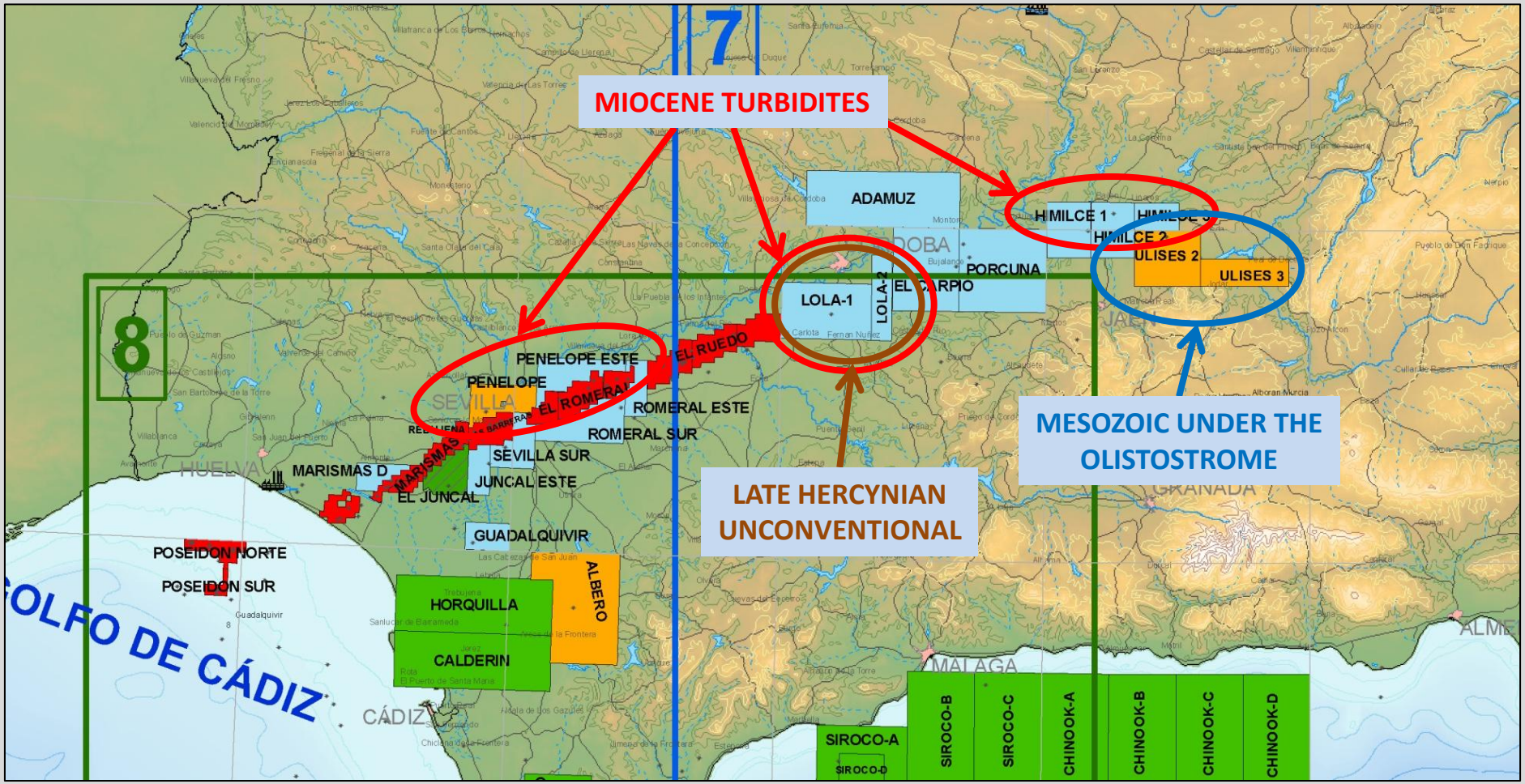
PEÑARROYA-ESPIEL COAL BASIN GEOCHEMICAL ANALYSIS





3- PERMITS AND CONCESSIONS



Source: MITYC. Updated March 1, 2013

4- CONCLUSIONS

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- 3 different exploration plays are found in the Guadalquivir Basin:

1) **Upper Miocene sandy turbidites** with very low exploratory risk and moderate gas reserves in very shallow wells.

2) **Hanging wall anticlines** in Prebetic thrust sheets under the Olistostrome with moderate risk and high oil and gas reserve expectations in 1,500 to 2,000 m deep wells.

3) **Stephanian-Permian sub-basins** with coal-bearing levels buried under the basin that offer unconventional opportunities (CBM and tight/shale gas). Also a conventional frontier gas play can be found in Triassic sandstones.

In Oil and Gas Capital we are working to reprocess vintage data and acquire new seismic lines to develop those plays.

Hopefully in a further stage we will be able to show you new progresses and, why not, find new partners.

THANK YOU FOR YOUR TIME AND ATTENTION!

kmotis@oilandgascapital.com