Salt Tectonics in the Atlantic Margin of Morocco*

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Abstract

The Moroccan salt basin on average is ~50-150 km in width, but it stretches for at least 1000 km between the leading edge of the offshore pre-Rifean nappe in the north and the Canary Islands in the south. The significant along-strike variations in the cross-sectional and map-view distribution of the Upper Triassic to Lower Jurassic salt reflect its uneven original distribution. The seismically mapped individual salt structures such as tongues, sheets, and canopies might have originated from an autochthonous, "patchy" salt layer deposited in somewhat isolated half-grabens.

The offshore Essaouira Basin (Tafelney Plateau) segment of the salt basin displays various salt tectonic styles with mature allochthonous salt structures. The spectacular mid-Tertiary reactivation of salt tectonics in this segment is primarily attributed to the inversion associated with the Atlas mountain-building onshore. The ongoing compressional deformation, as the result of the Africa/Europe convergence, enhanced the steepness of the slope and is largely responsible for the ongoing salt movements. However, the basinward edge of the salt basin has dormant toe-thrust anticlines.

In the Agadir segment, the rapid influx of Tertiary sediments appears to be the dominant factor in the style of salt tectonics producing a wide diapiric domain underneath the slope. However, in this segment, the downdip edge of the salt basin is also clearly allochthonous. In general, the westernmost, leading edge of the salt deformational front with a well developed mid-Tertiary toe-thrust zone along most parts of the Moroccan salt basin offers world-class structural traps for hydrocarbon exploration. Besides the toe-thrust anticlines, numerous salt-related play types were defined in the deepwater and remain largely untested to date.

Salt tectonics in the Atlantic margin of Morocco

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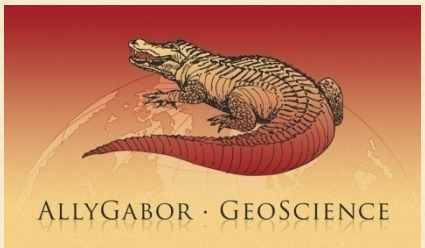

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OUTLINE

Regional transects

Seismic examples

Play types

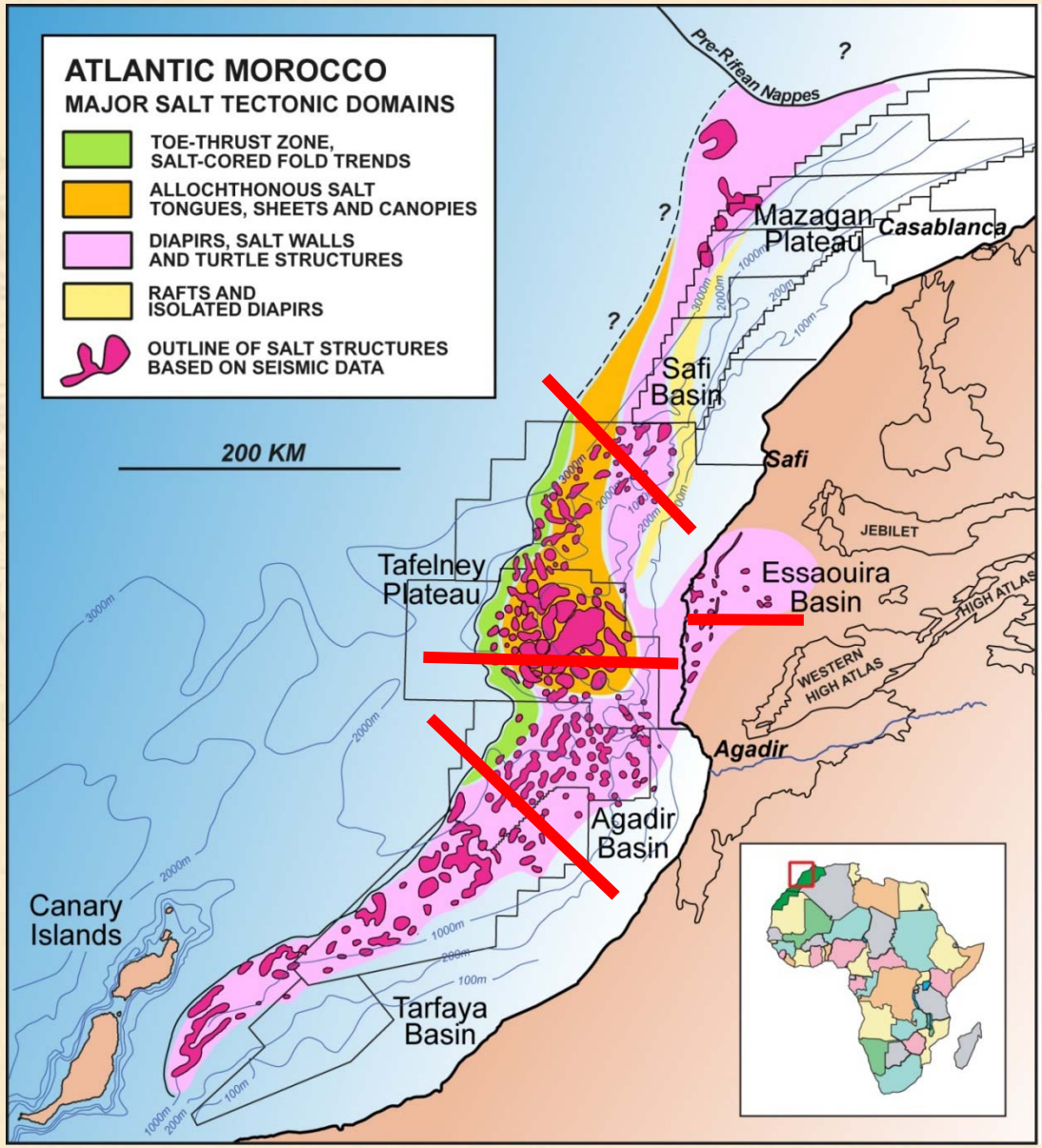
Comparison with Angola

Conclusions

Acknowledgement

Satellite image courtesy of
Johnson Space Center, NASA

The Moroccan salt basin



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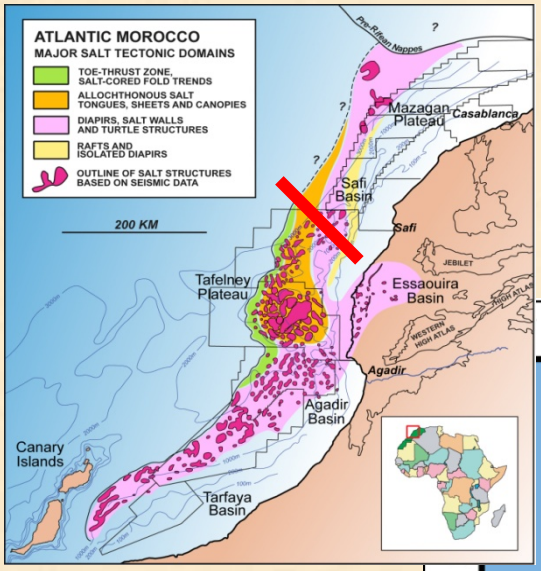
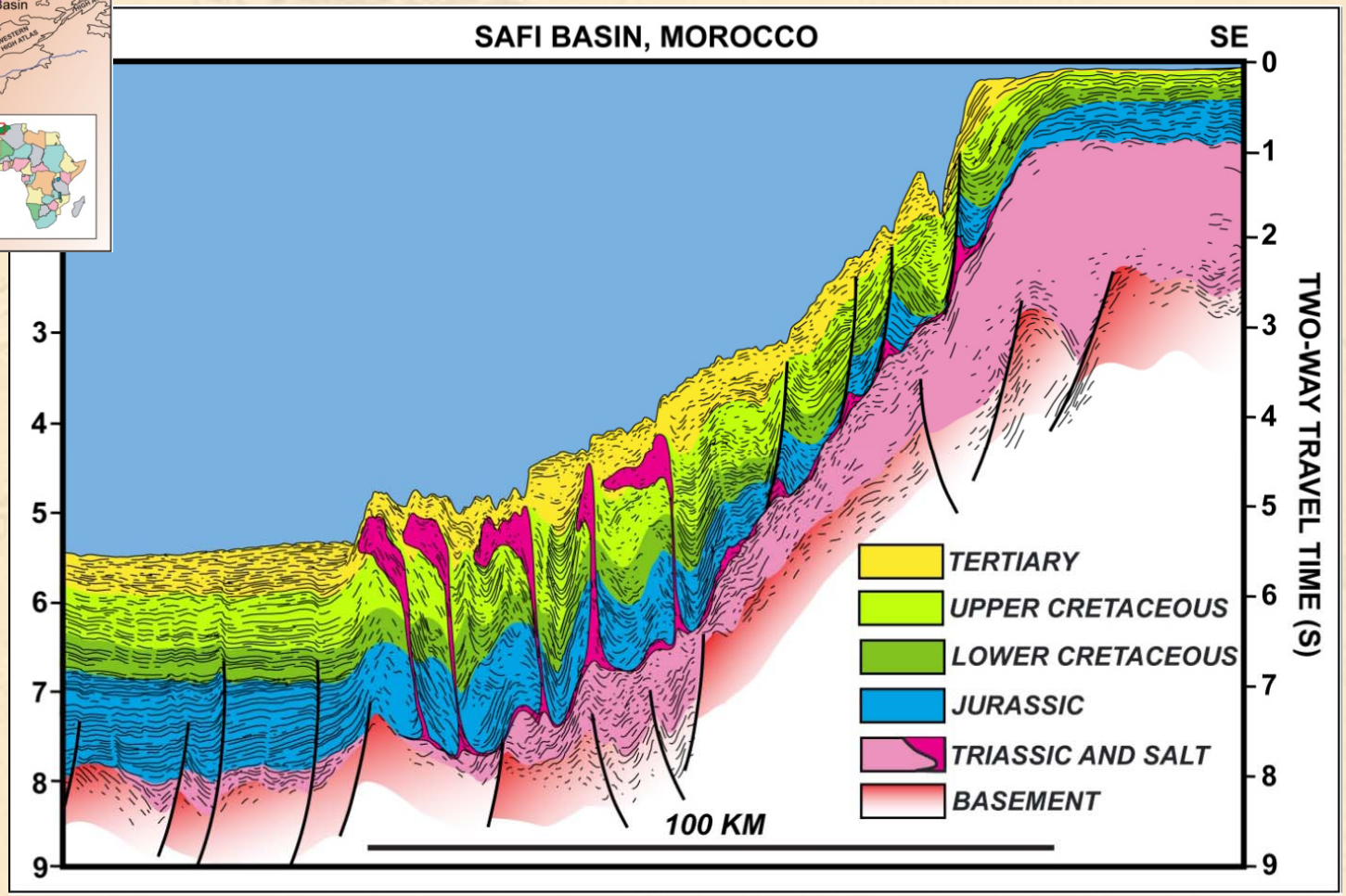
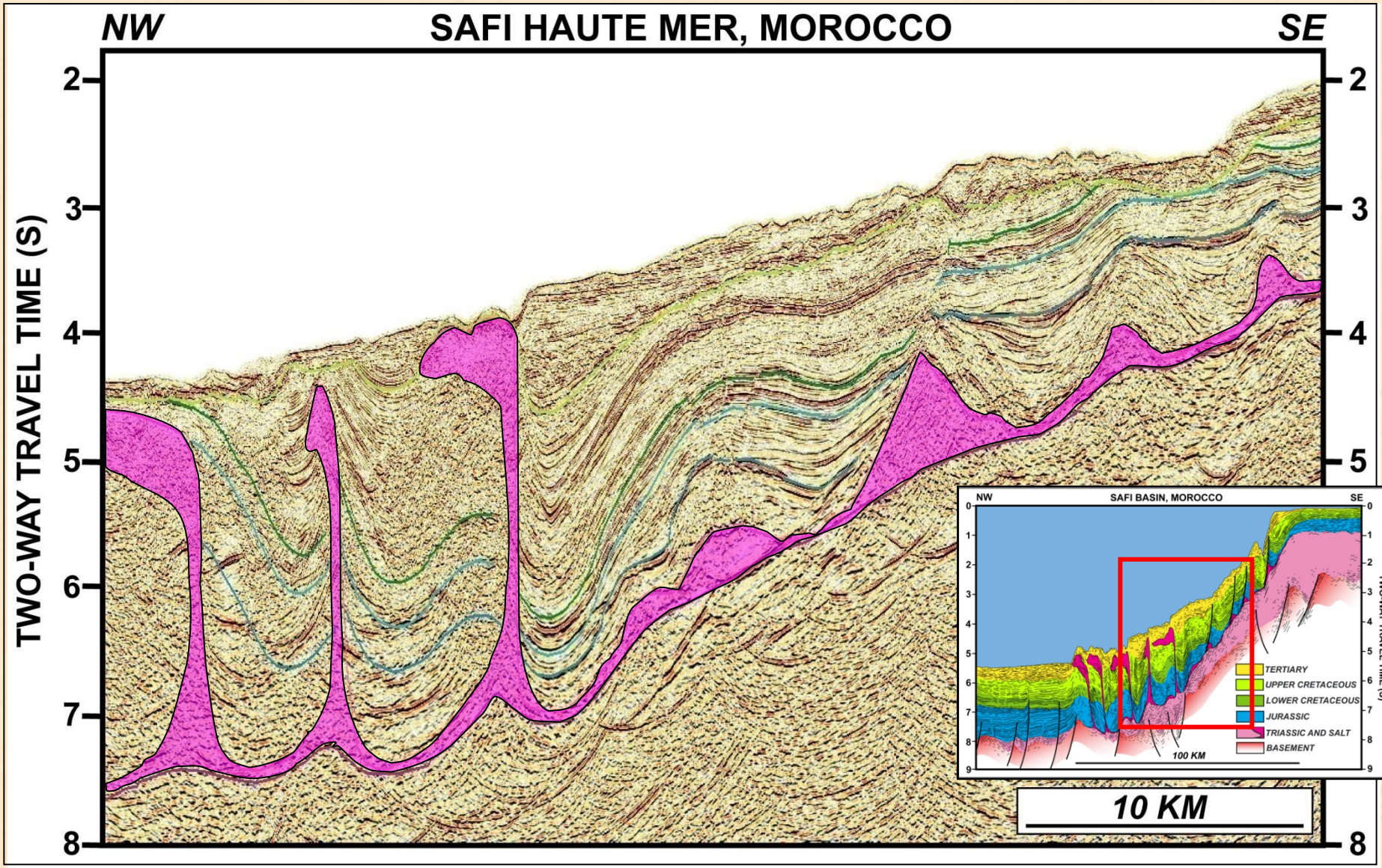

ATLANTIC MOROCCO
MAJOR SALT TECTONIC DOMAINS
TOE-THRUST ZONE, SALT-CORED FOLD TRENDS
ALLOCHTHONOUS SALT TONGUES, SHEETS AND CANOPIES
DIAPIRS, SALT WALLS AND TURTLE STRUCTURES
RAFTS AND ISOLATED DIAPIRS
OUTLINE OF SALT STRUCTURES BASED ON SEISMIC DATA
200 KM
Pre-Rifain Nappes
Mazagan Plateau
Casablanca
Safi Basin
Safi
JEBILET
Tafelney Plateau
Essaouira Basin
HIGH ATLAS
WESTERN HIGH ATLAS
Agadir
Agadir Basin
Canary Islands
Tarfaya Basin


SAFI BASIN, MOROCCO
SE
TWO-WAY TRAVEL TIME (S)
0
1
2
3
4
5
6
7
8
9
TERTIARY
UPPER CRETACEOUS
LOWER CRETACEOUS
JURASSIC
TRIASSIC AND SALT
BASEMENT
100 KM

2D seismic example



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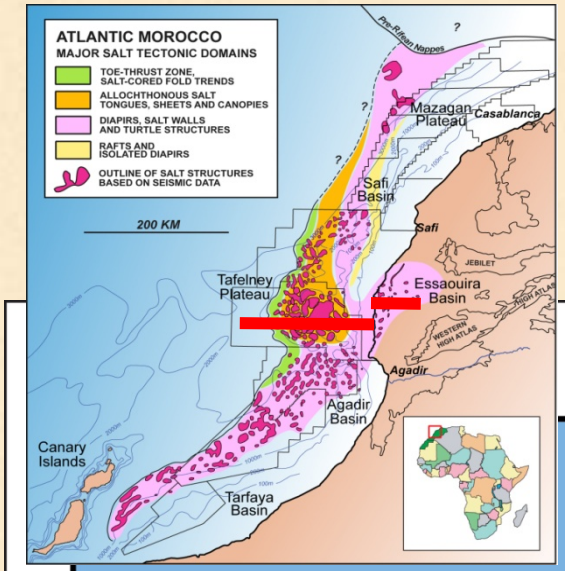


after Hafid et al. (2000)

RAS TAFELNEY PLATEAU, MOROCCO

E

?

TERTIARY

UPPER CRETACEOUS

LOWER CRETACEOUS

JURASSIC

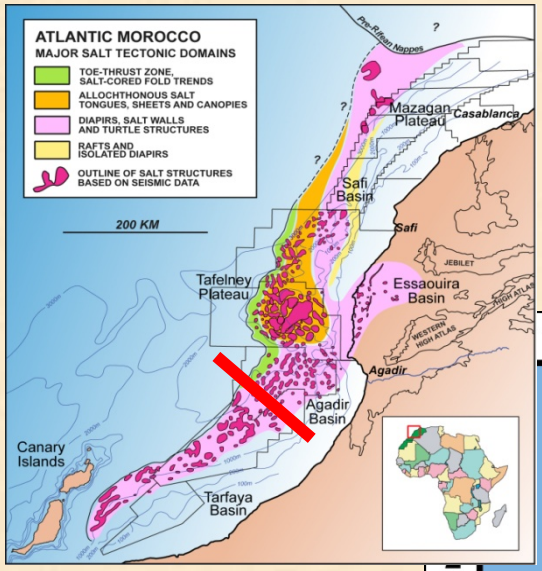
TRIASSIC AND SALT

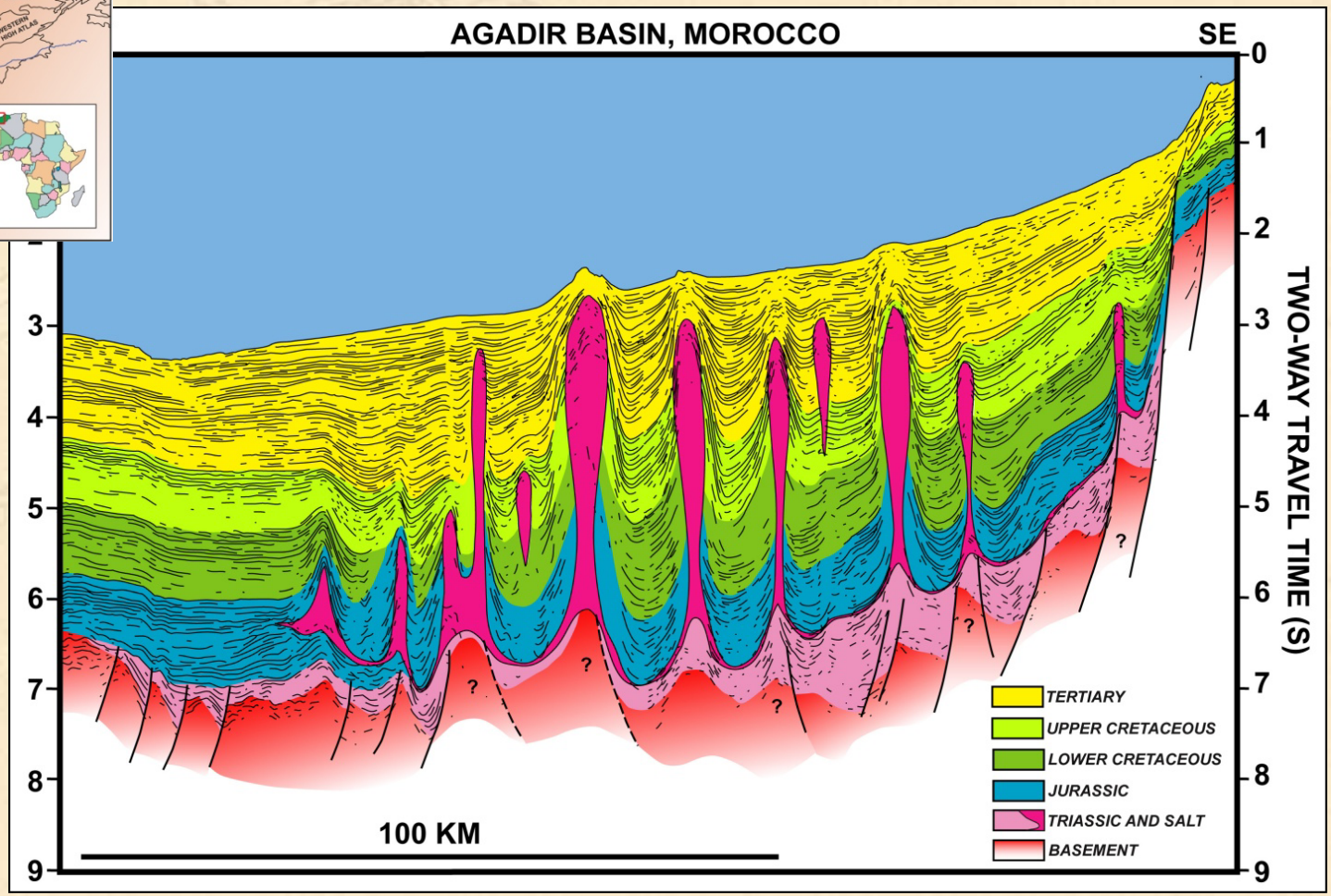
BASEMENT

100 KM

TWO-WAY TRAVEL TIME (S)

0 1 2 3 4 5 6 7 8 9





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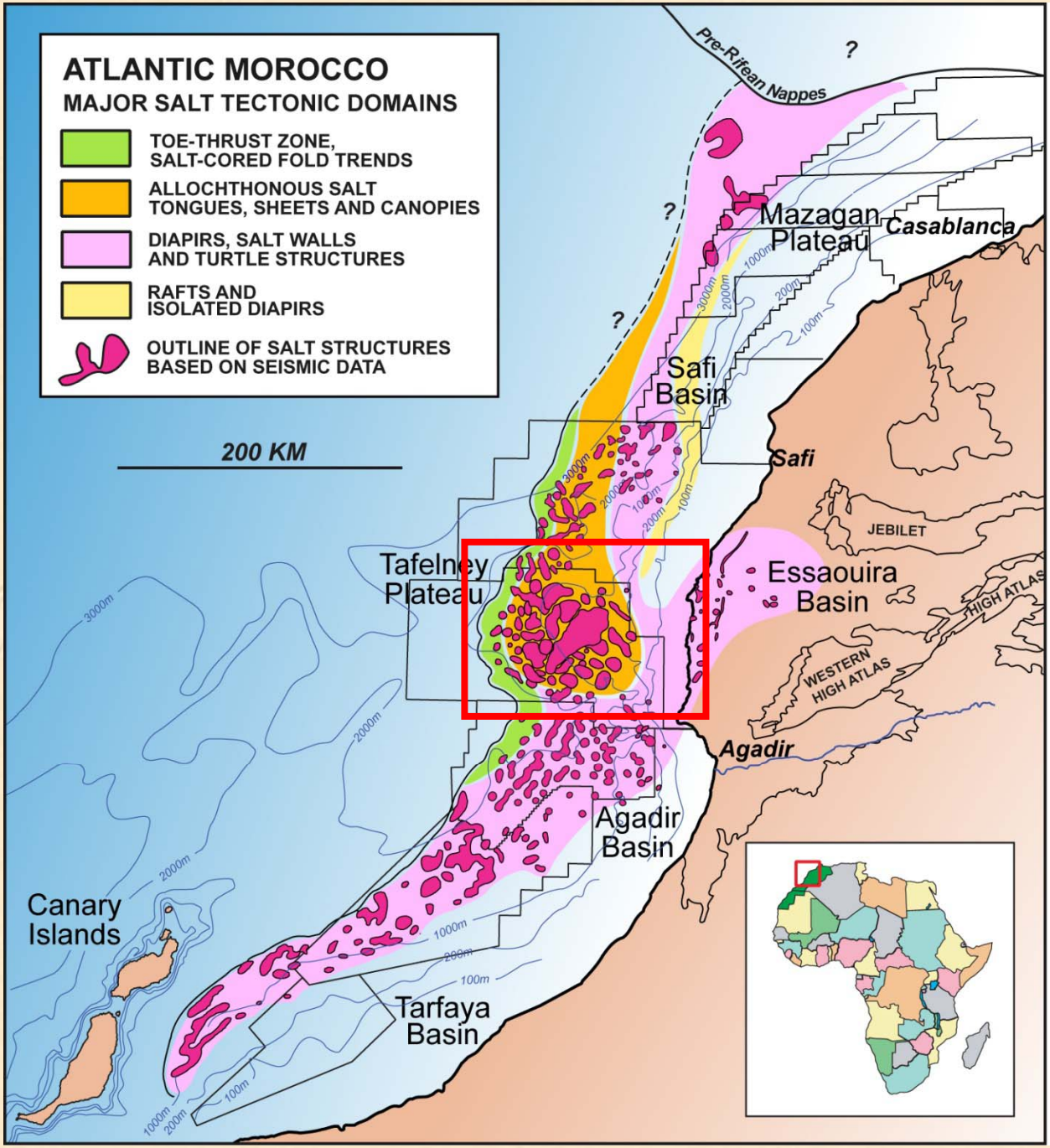

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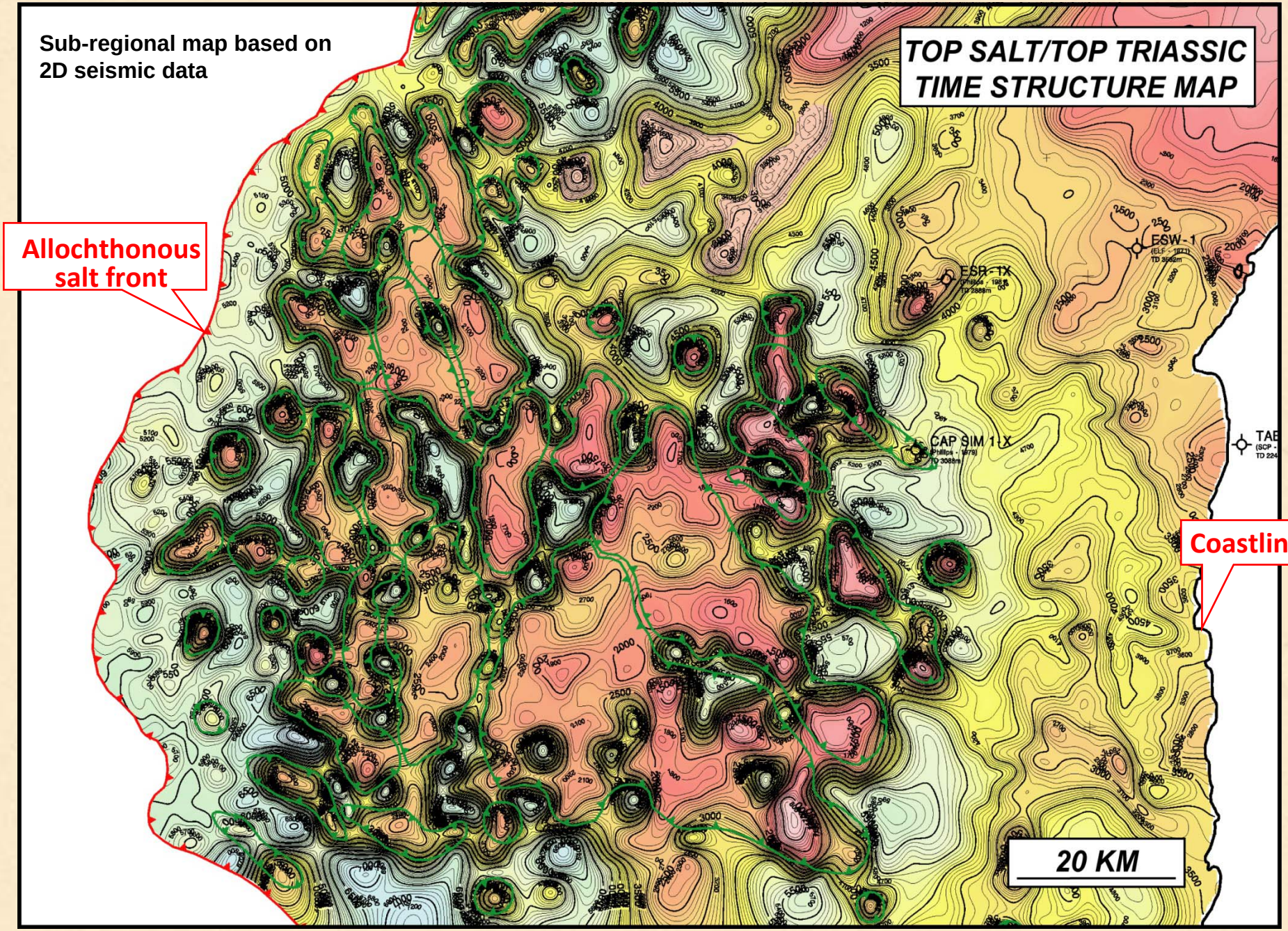

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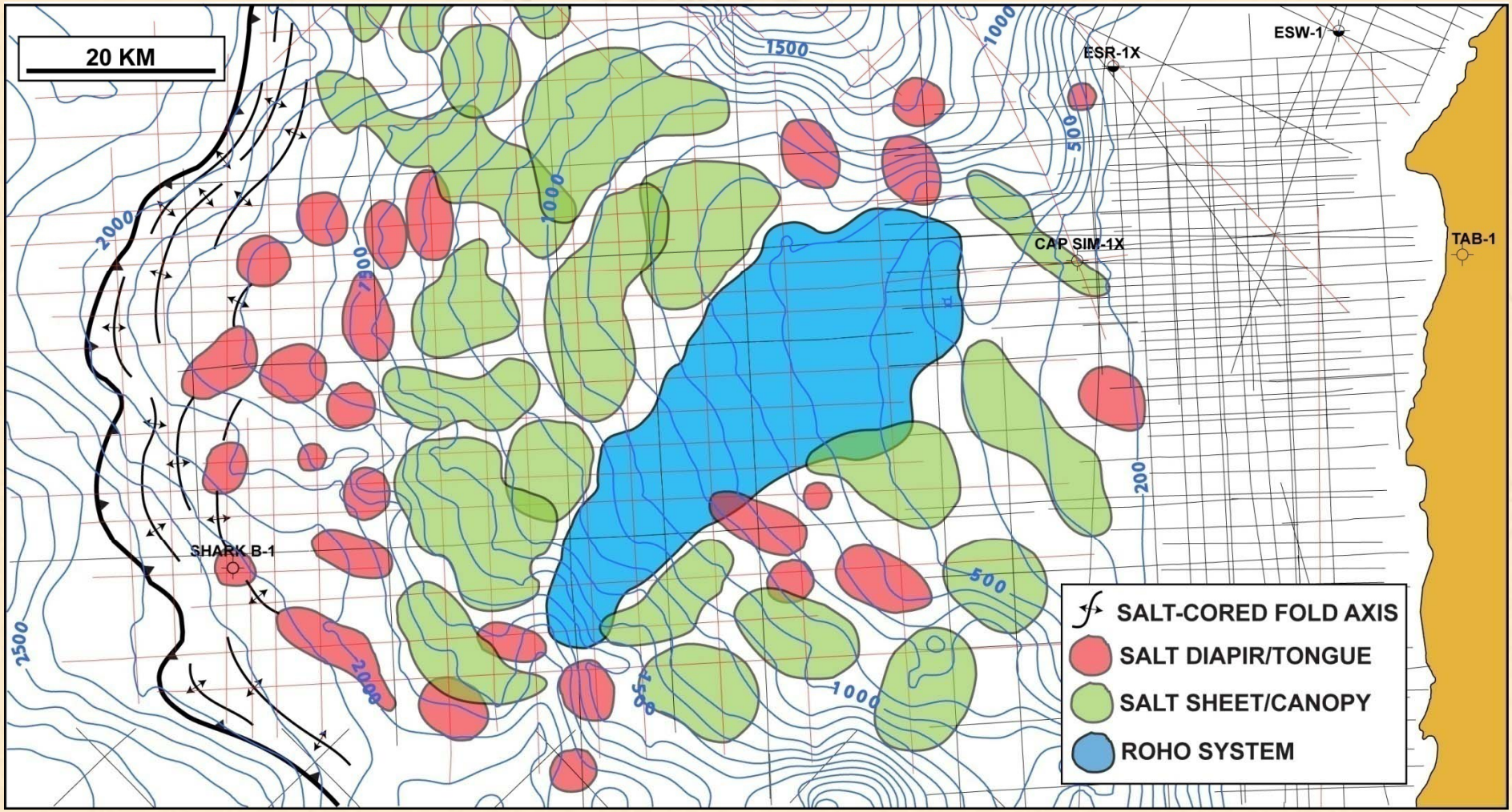
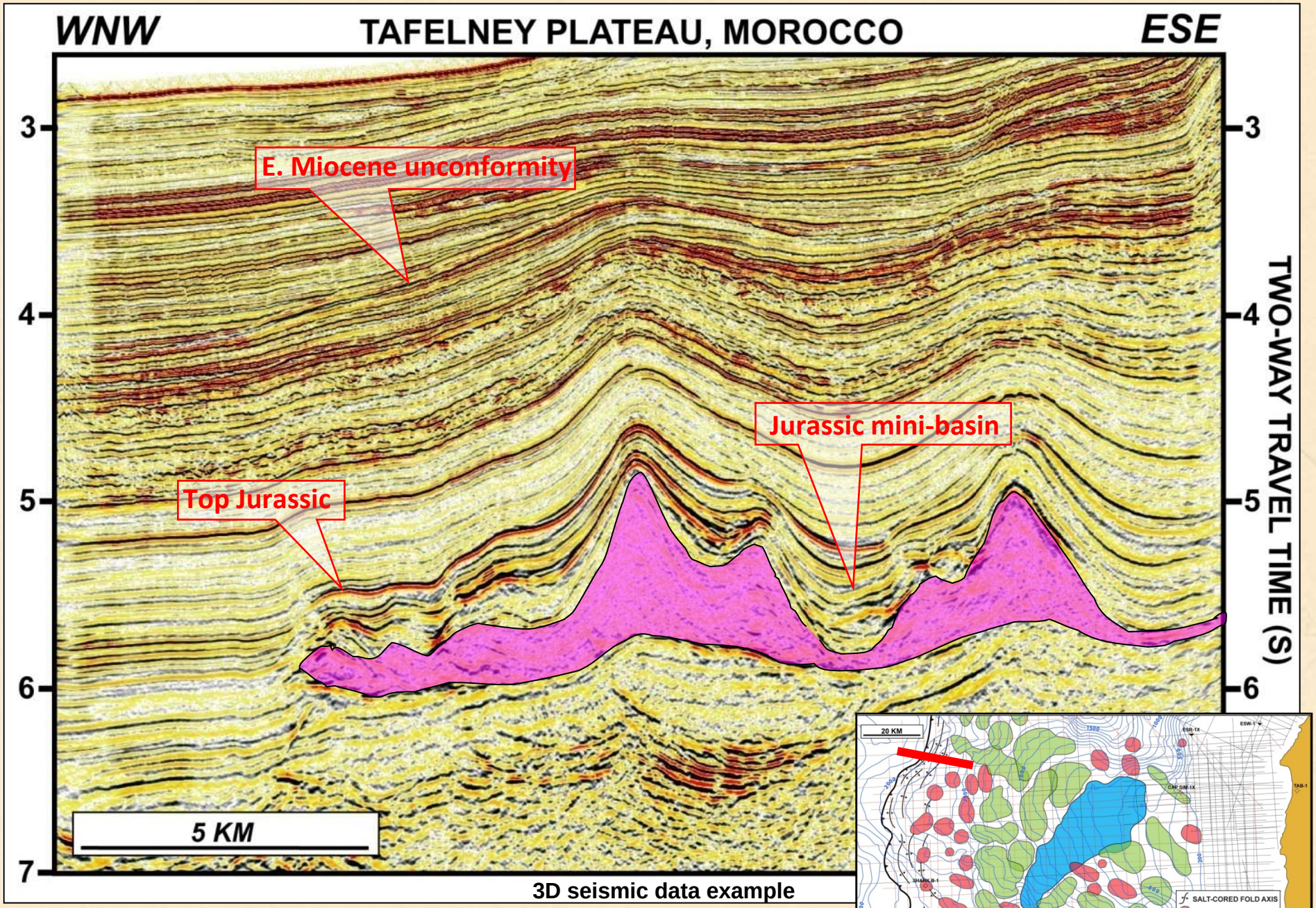
Simplified salt tectonic map
Tafelney Plateau, offshore Essaouira Basin



Jabour and Tari (2007)



3D seismic data example

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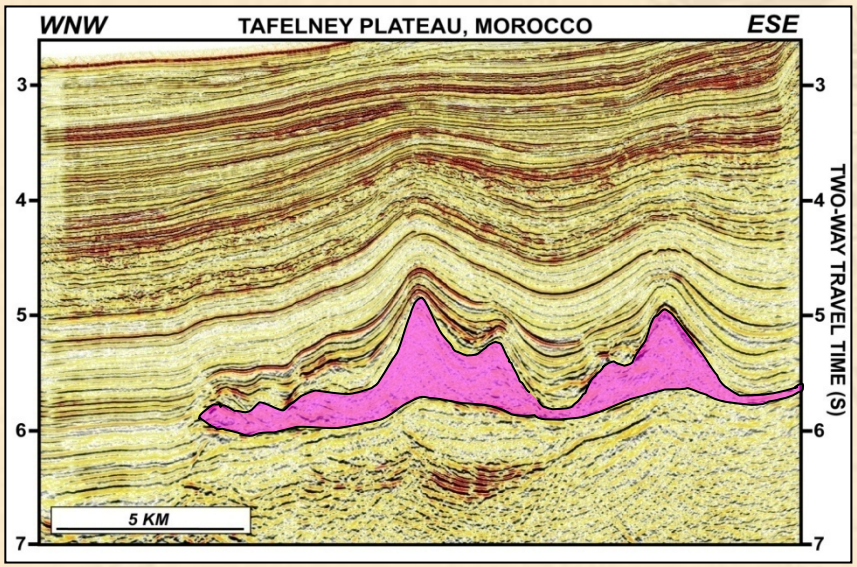
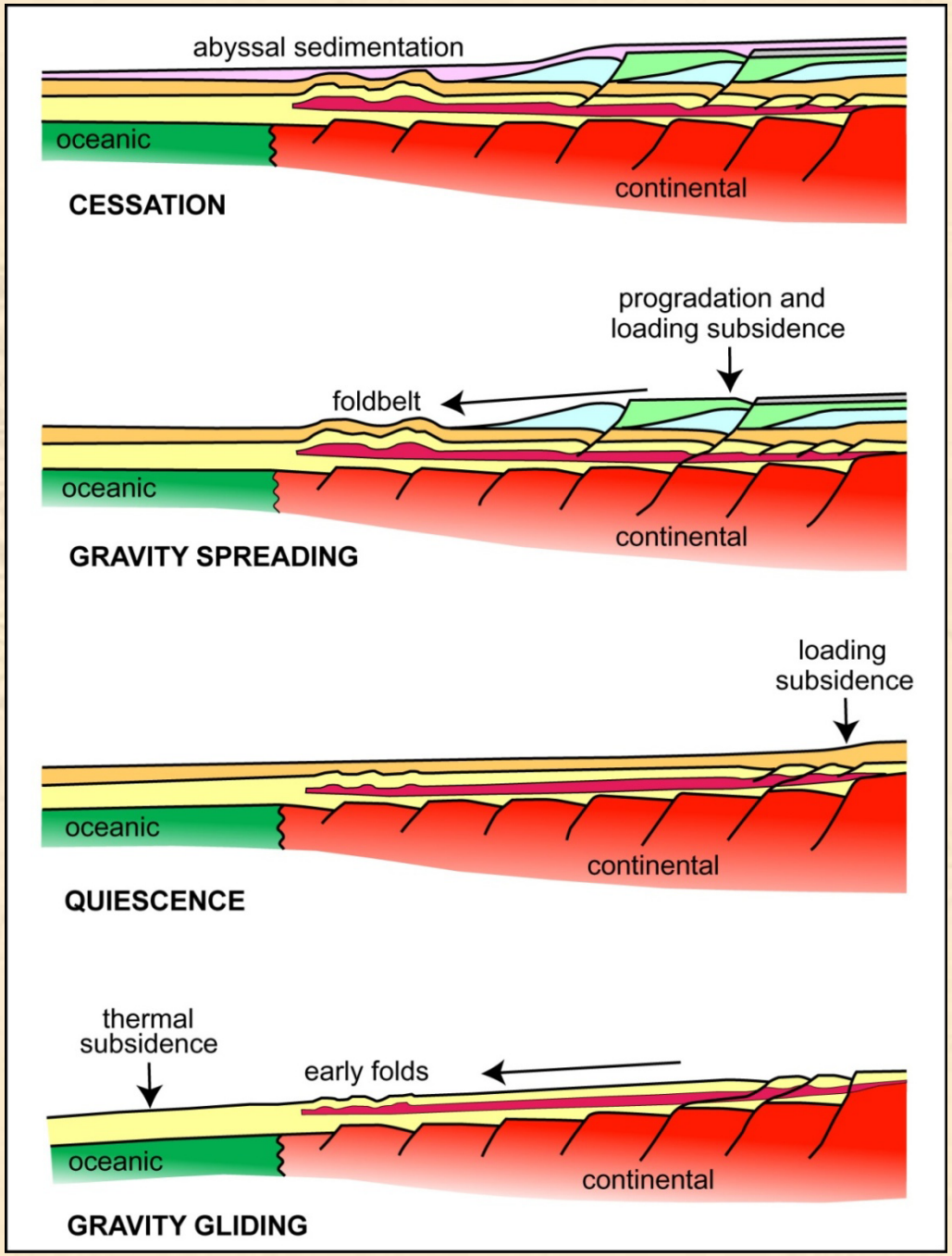
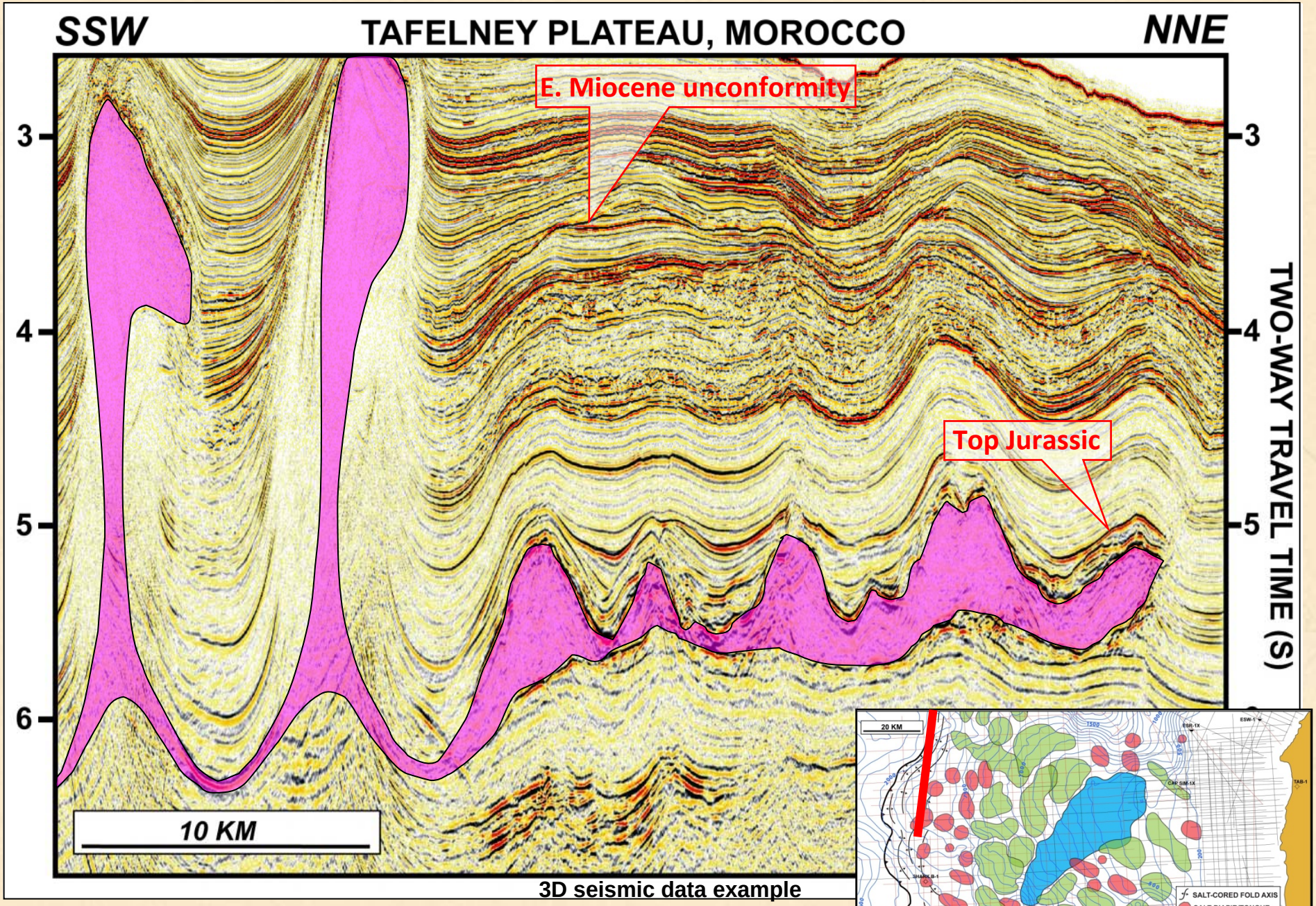


Reactivation of salt tectonics during the mid-Tertiary is due to the Atlas Mountains uplift and inversion



Rowan, 2000



3D seismic data example

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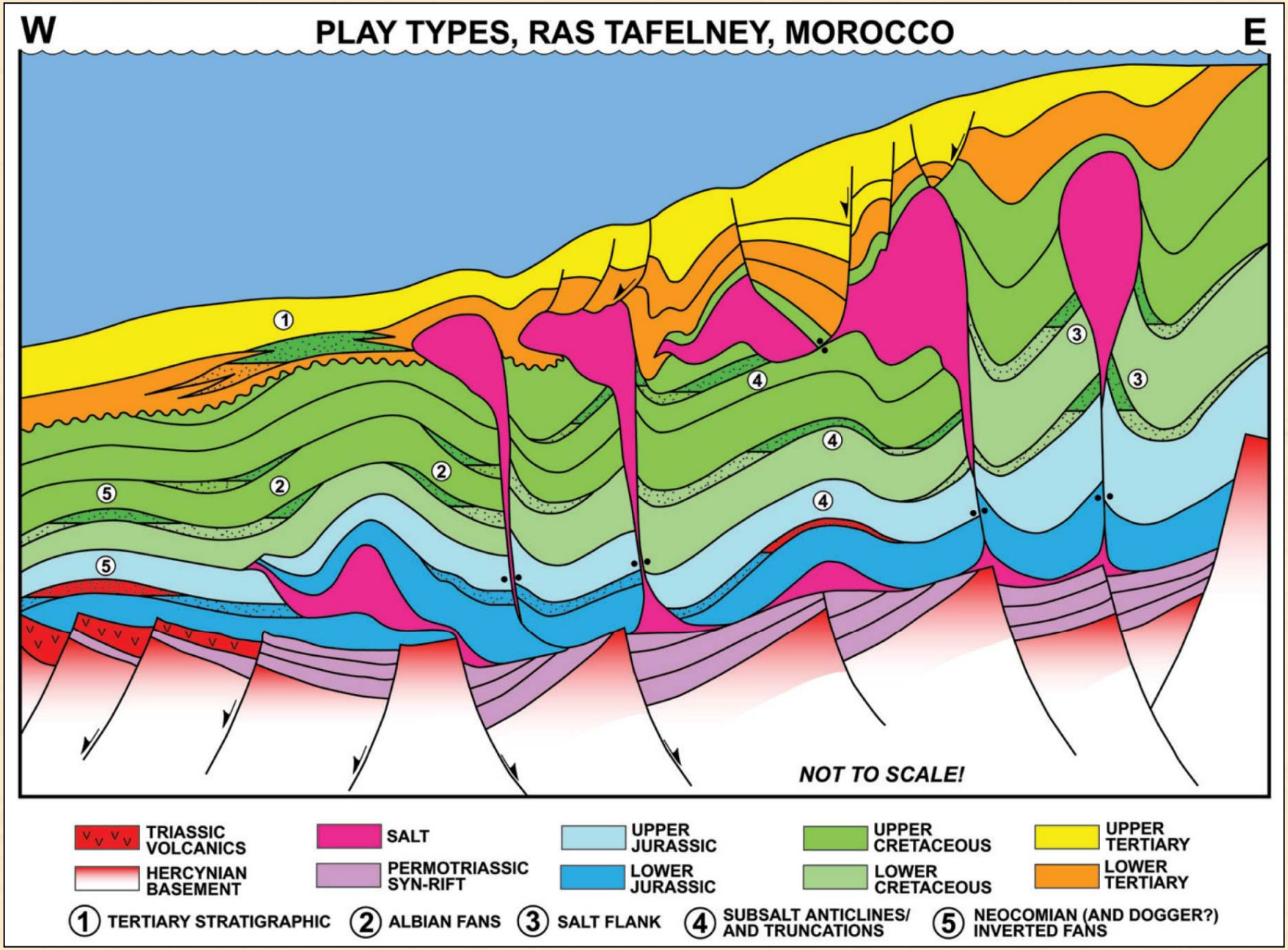
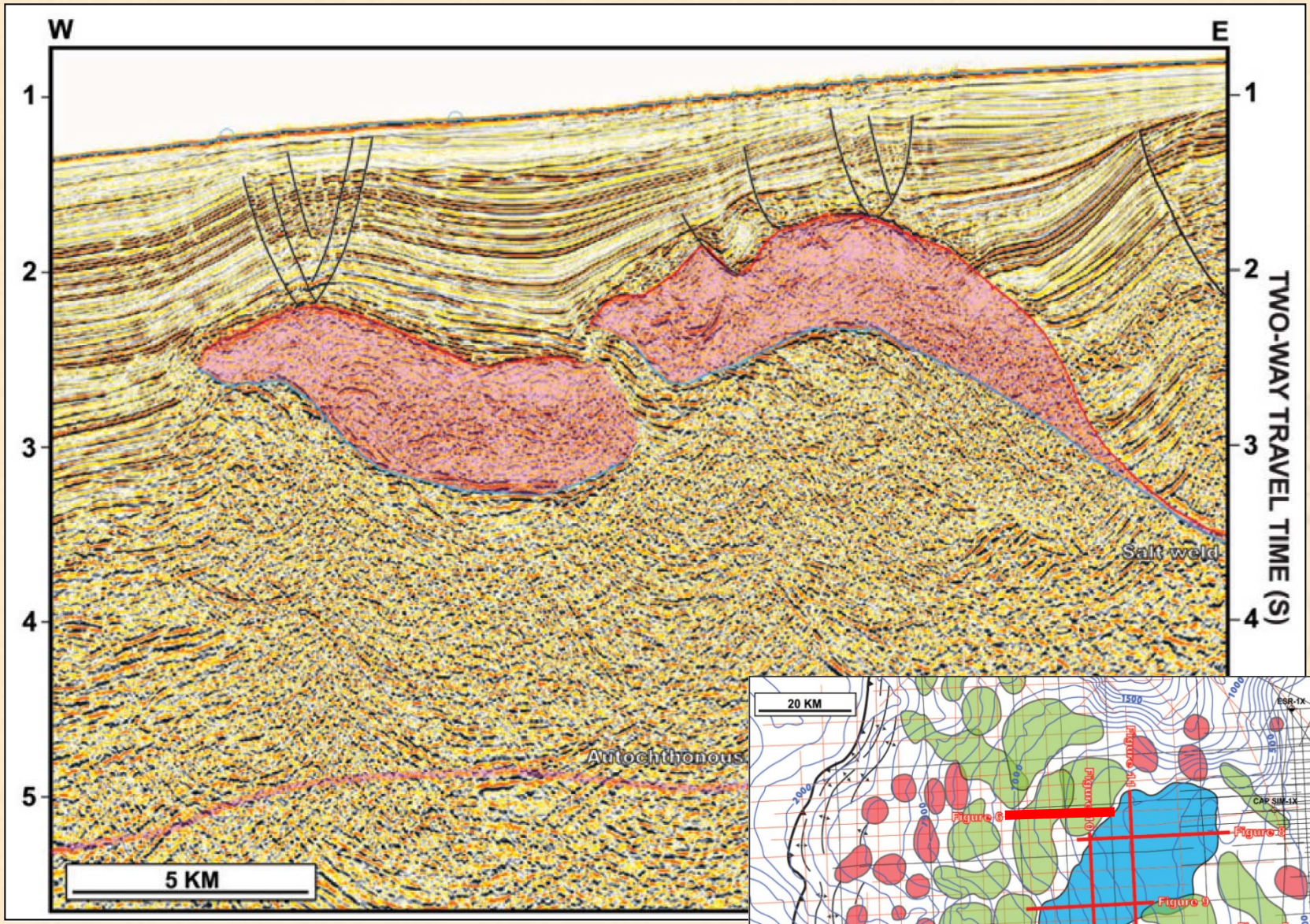
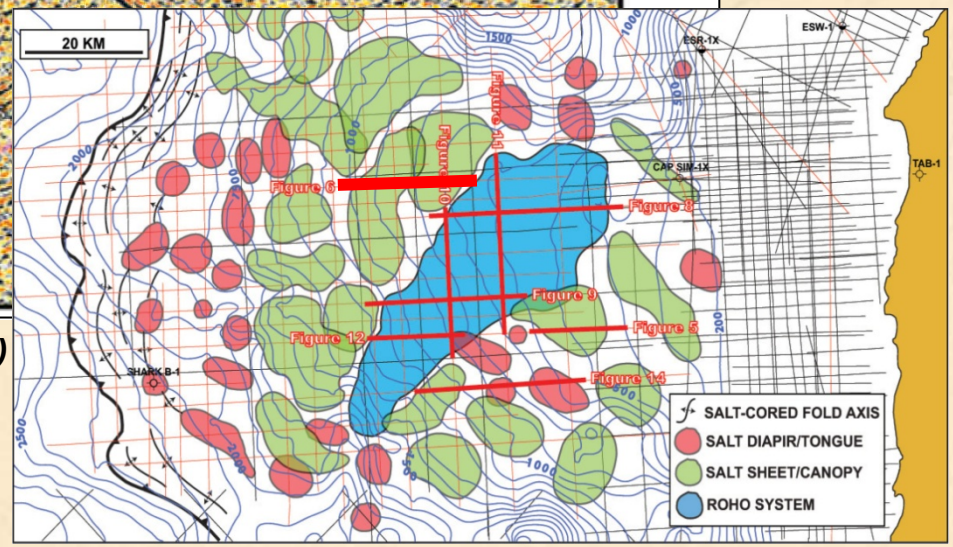
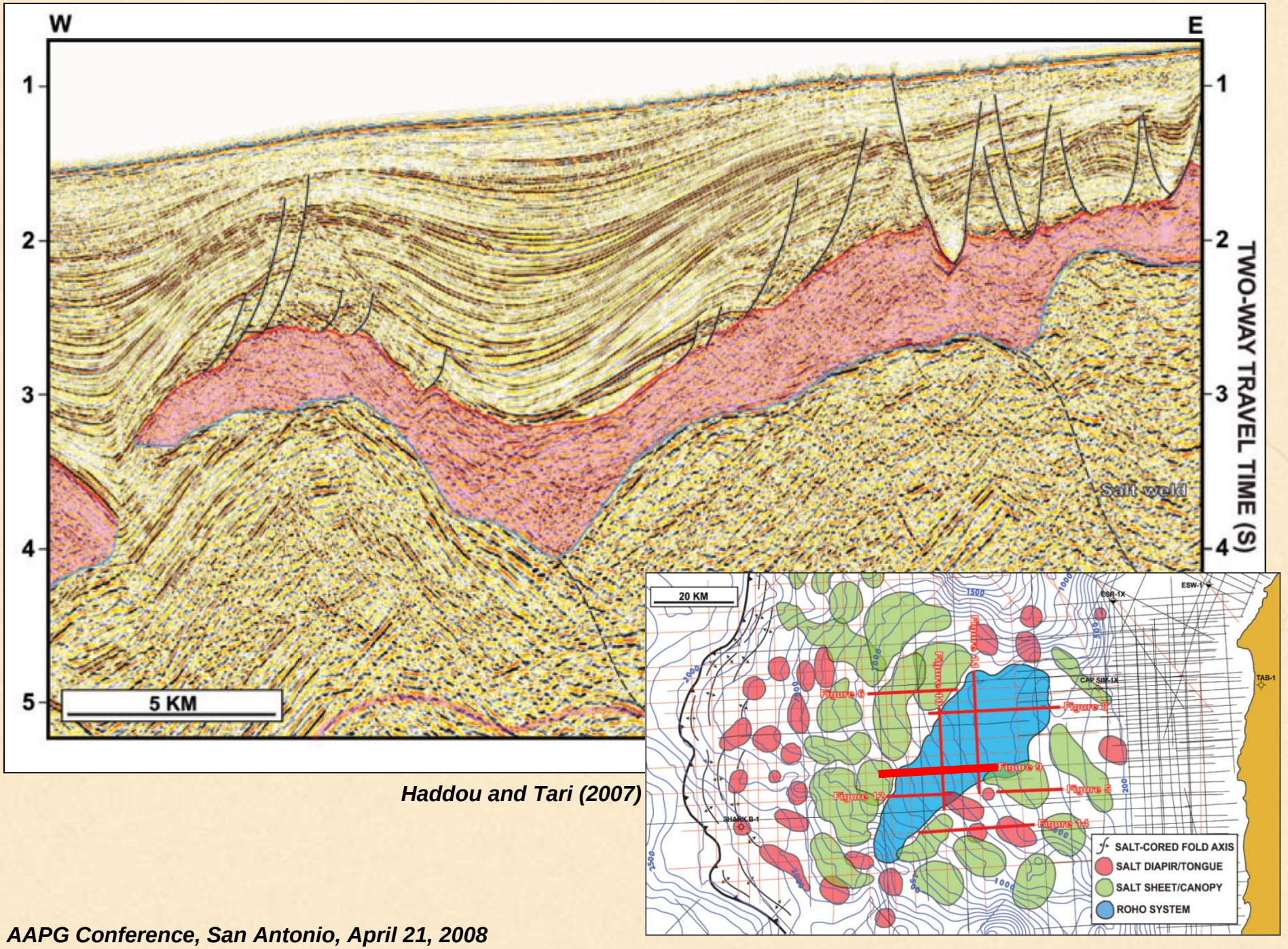


Jabour and Tari (2007)

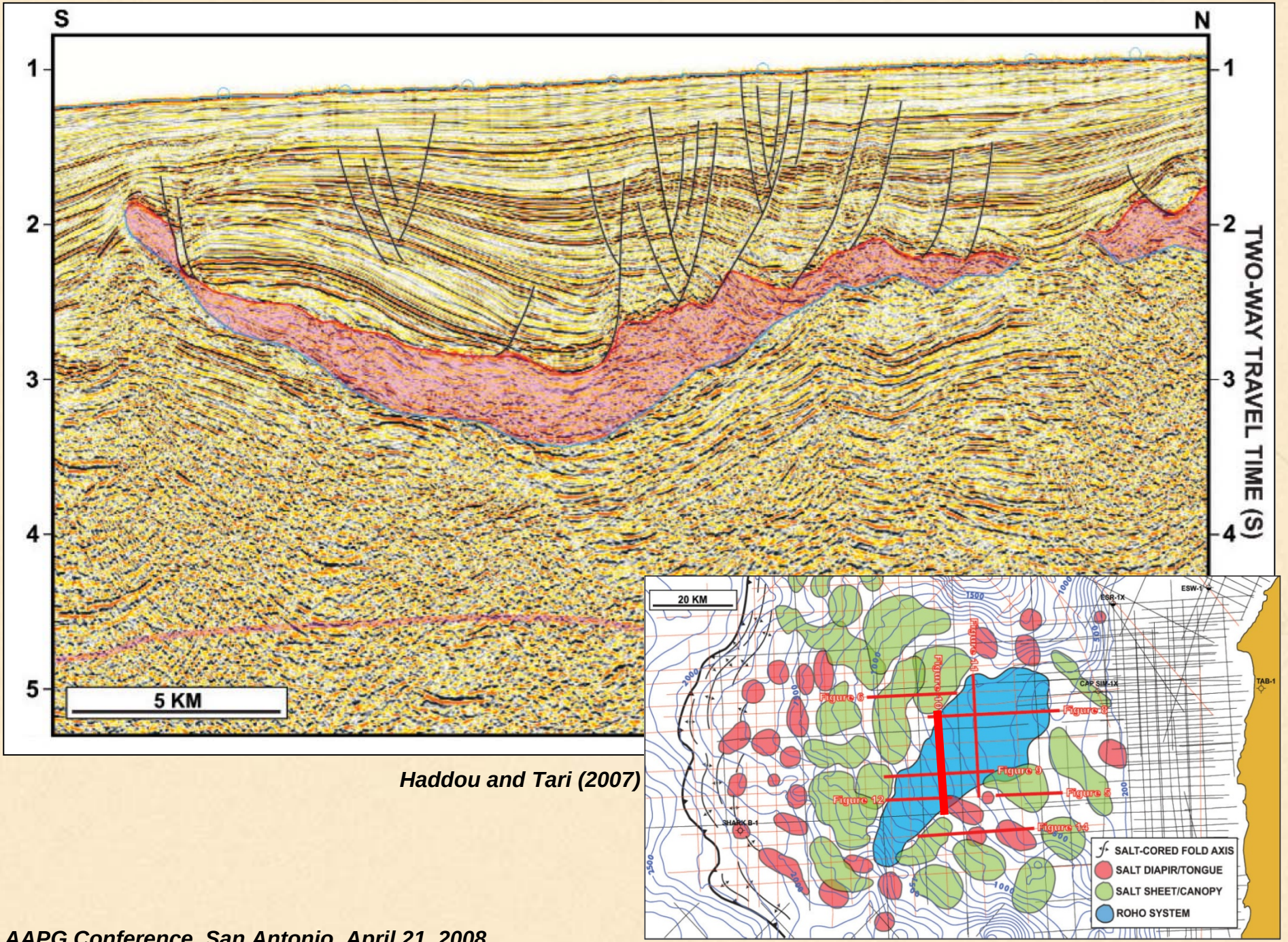




Haddou and Tari (2007)

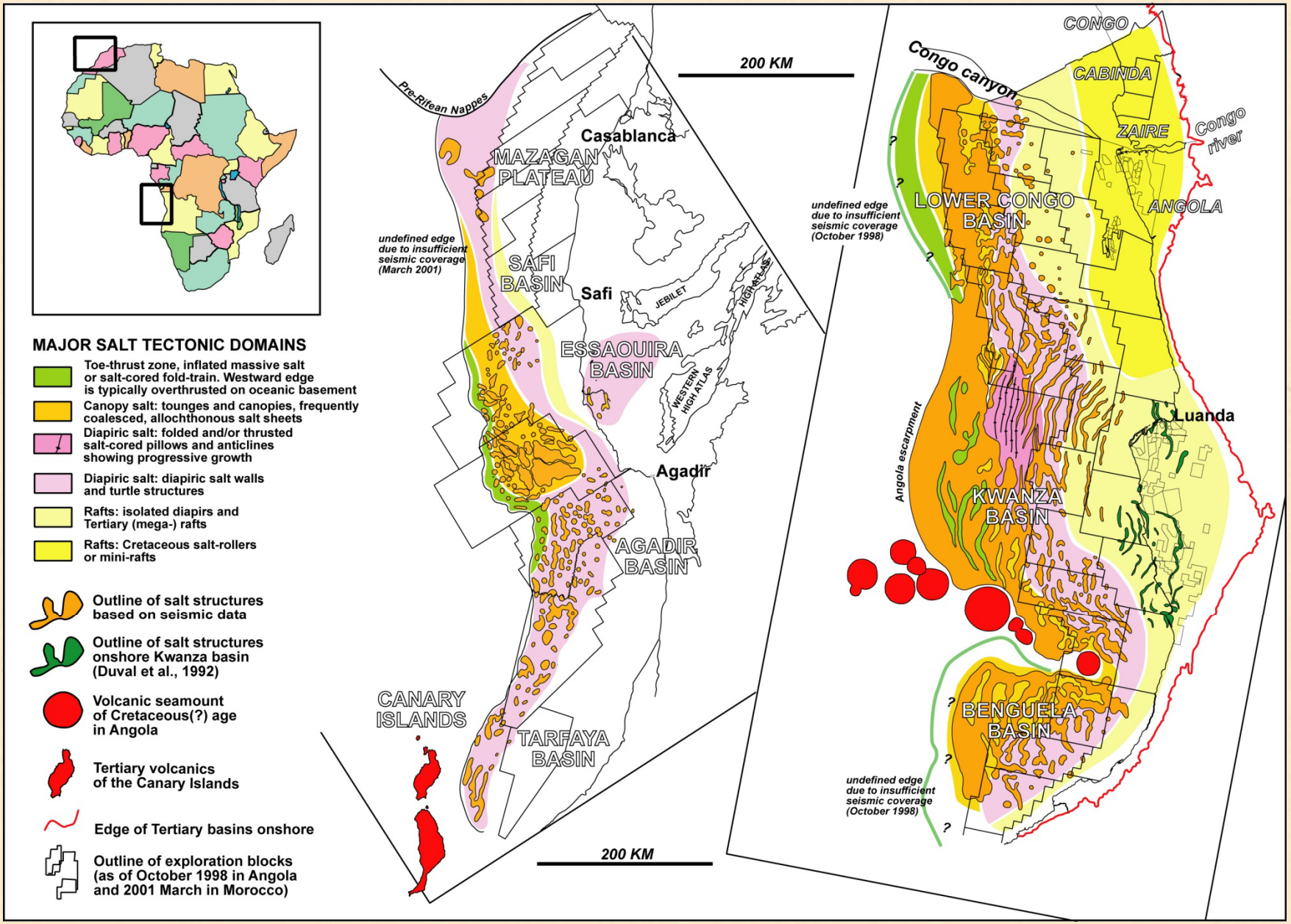


Haddou and Tari (2007)



Haddou and Tari (2007)

Salt tectonic maps of Angola and Morocco



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Some conclusions

The Moroccan salt basin is 50-150 km wide, but it stretches along strike for at least 1,000 km; still, it is the least explored salt basin in West Africa.

Several salt tectonic domains were defined with characteristic salt features, significant along-strike variations are attributed to the syn-rift nature of the salt.

The world-class Moroccan salt basin offers a large number of salt-related play types and prospects, both onshore and offshore, most of them untested to date.

Acknowledgement