Tectonics of Eastern Mexico – Gulf of Mexico and its Hydrocarbon Potential*

Ricardo J. Padilla y Sánchez[1]

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Abstract

Major oil and gas reservoirs occur in Mexico in seven main basins, from northwest to southeast: Sabinas, Burgos, Tampico-Misantla, Chicontepec, Veracruz, Salina del Istmo, and Macuspana y Comalcalco; over, or around carbonate build-ups, of buried basement horsts like the Golden Lane and Akal Horst, as well as in salt-related structures. These features are located along the Gulf Coastal Plain, onshore and offshore, between the Sierra Madre Oriental on the west, and the Perdido Fold Belt, the Mexican Ridges, and the Yucatan Platform, on the east. The age of the source rocks for these conventional reservoirs is Tithonian, but could be even Kimmeridgian or Oxfordian. The regional migration trend for the hydrocarbons, generated by these sources and accumulated in the conventional known reservoirs, came most probably from east to west, from the deepest part of the Gulf of Mexico, upward to the final traps, in different times. A series of chronological paleogeographic maps are presented in order to try to understand the regional facies distribution and the orogenic events resulting from a combination of gravity-driven, passive margin, near-field stress-driven type 1 systems and a continuous transpressional state of stress due to the fastest movement of the northern portion of the North American Plate respect to Mexico, since the Mesozoic to the present. An additional evidence for the proposed routes of migration and today's activity of the petroleum system are the numerous oil-gas seeps in the Gulf of Mexico. A reliable estimate of the undiscovered recoverable conventional petroleum resources is presented.

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Tectonics of Eastern Mexico - Gulf of Mexico and its Hydrocarbon Potential

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Universidad Nacional Autónoma de México

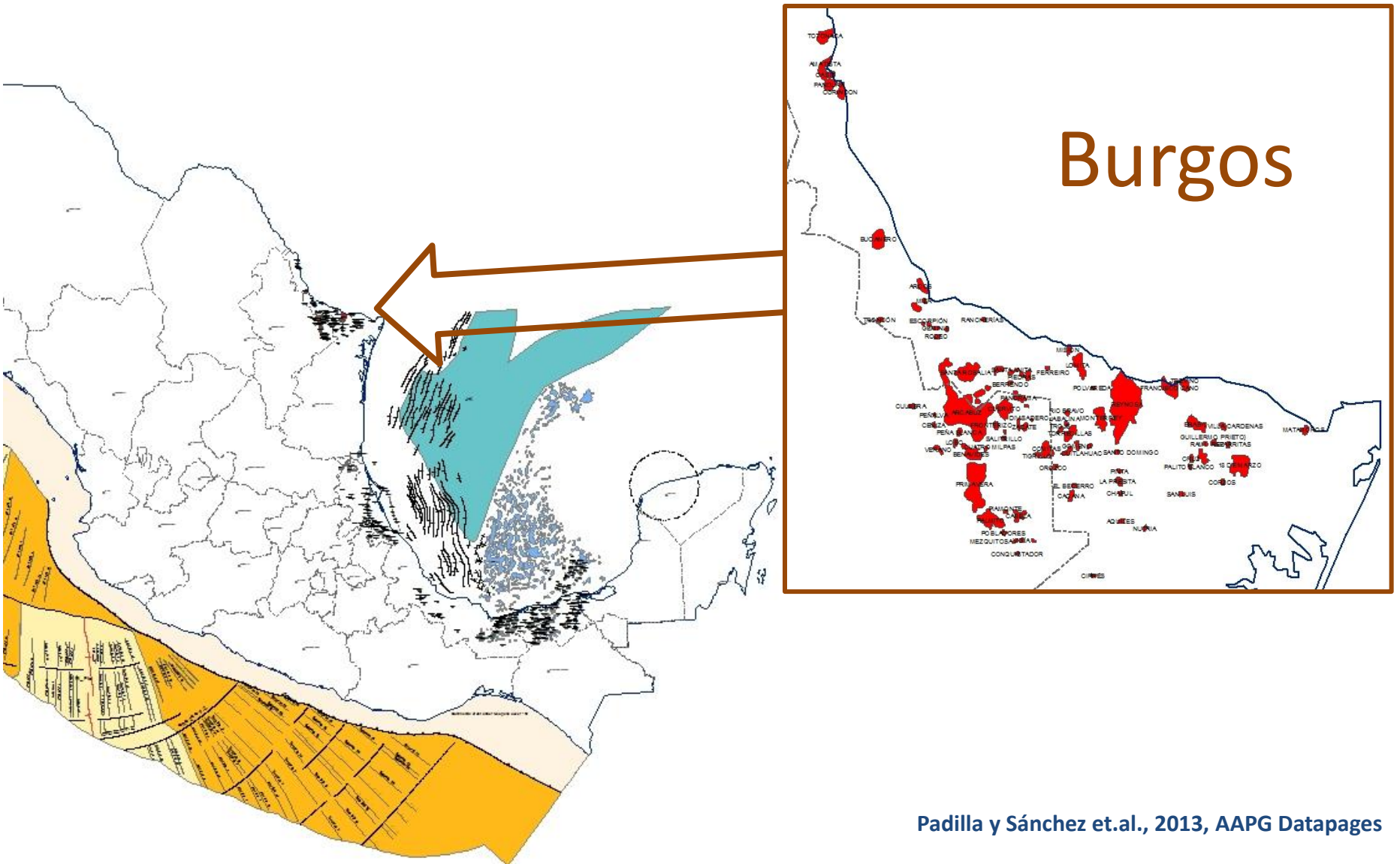
AAPG-ACE-HOUSTON, April – 2014

Tectonics of Eastern Mexico - Gulf of Mexico and its Hydrocarbon Potential

Contents:

- **Major oil & gas reservoirs in Mexico - GOM**
- Petroleum basins of Mexico
- Source rocks
- Petroleum systems
- Late Paleozoic – Cenozoic tectonic evolution
- Undiscovered recoverable resources

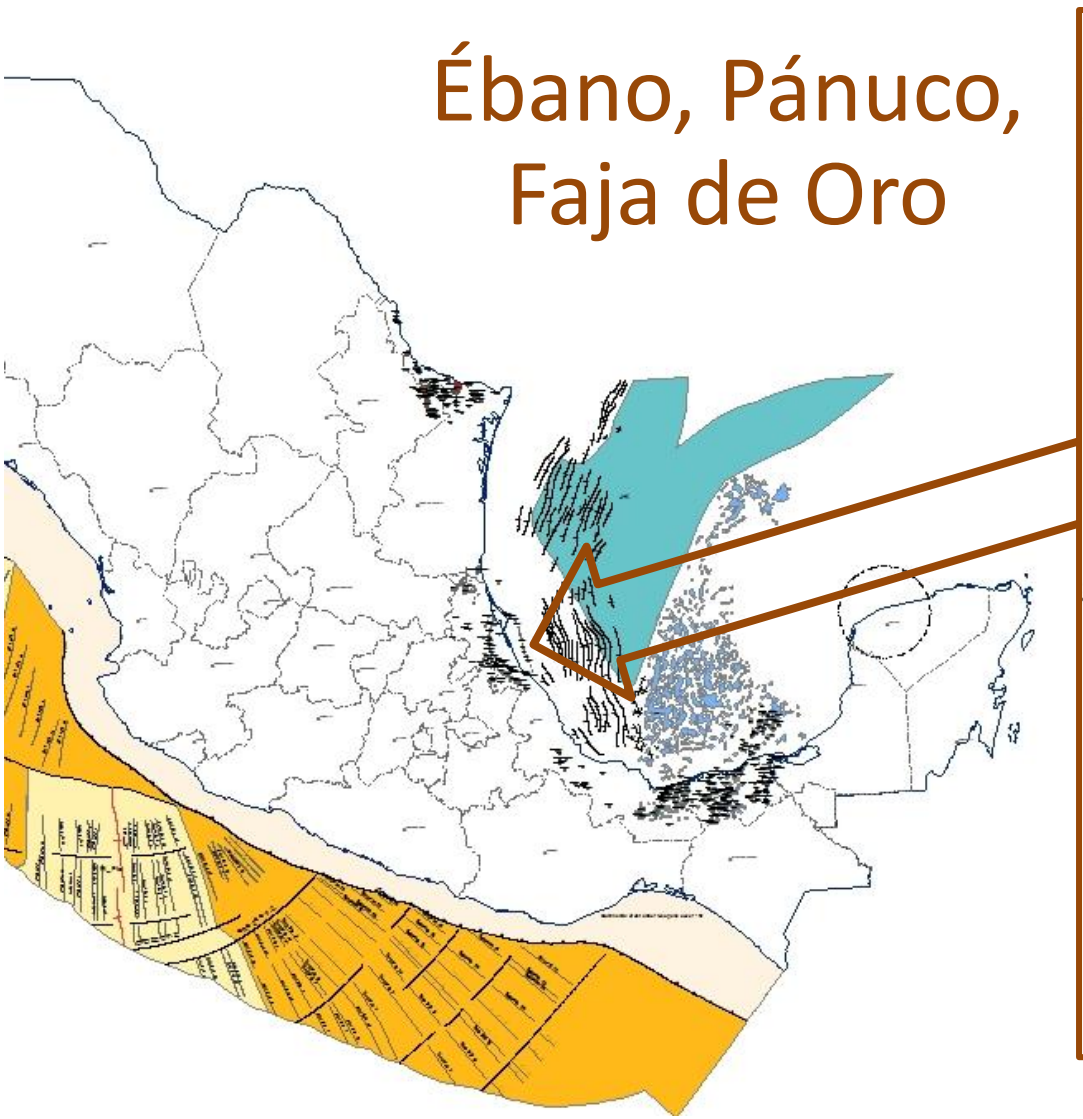
Major oil & gas reservoirs in Mexico

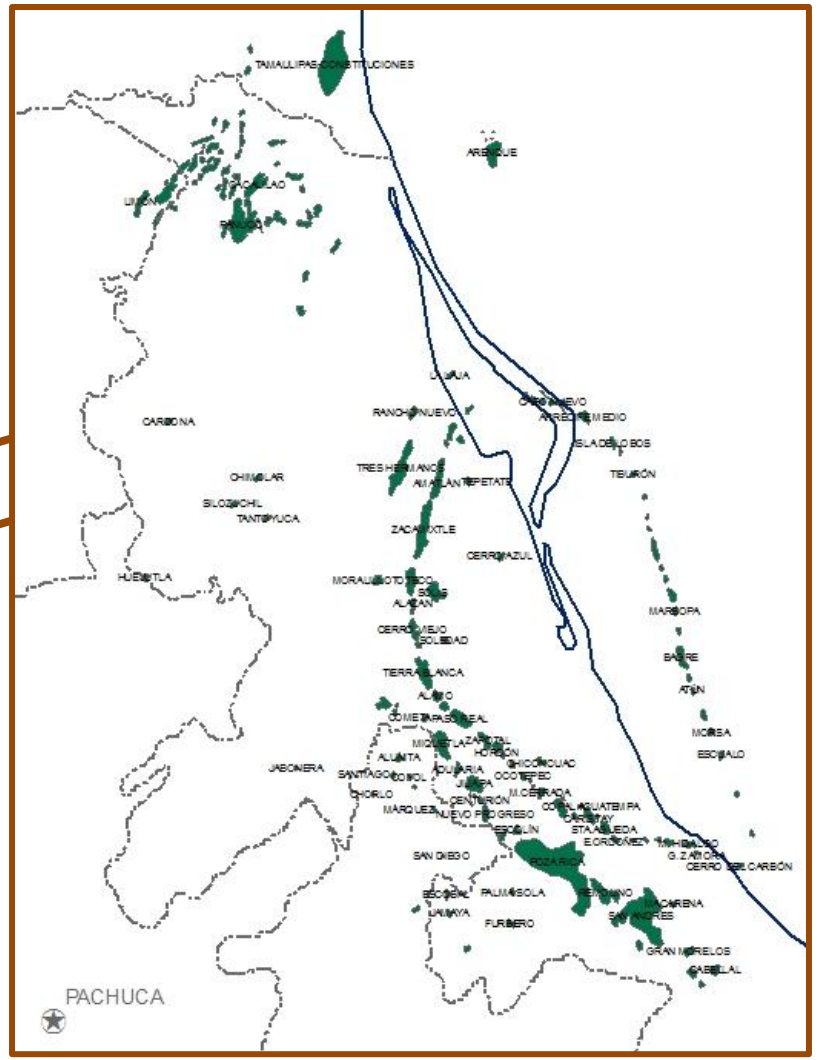


Padilla y Sánchez et.al., 2013, AAPG Datapages

Major oil & gas reservoirs in Mexico

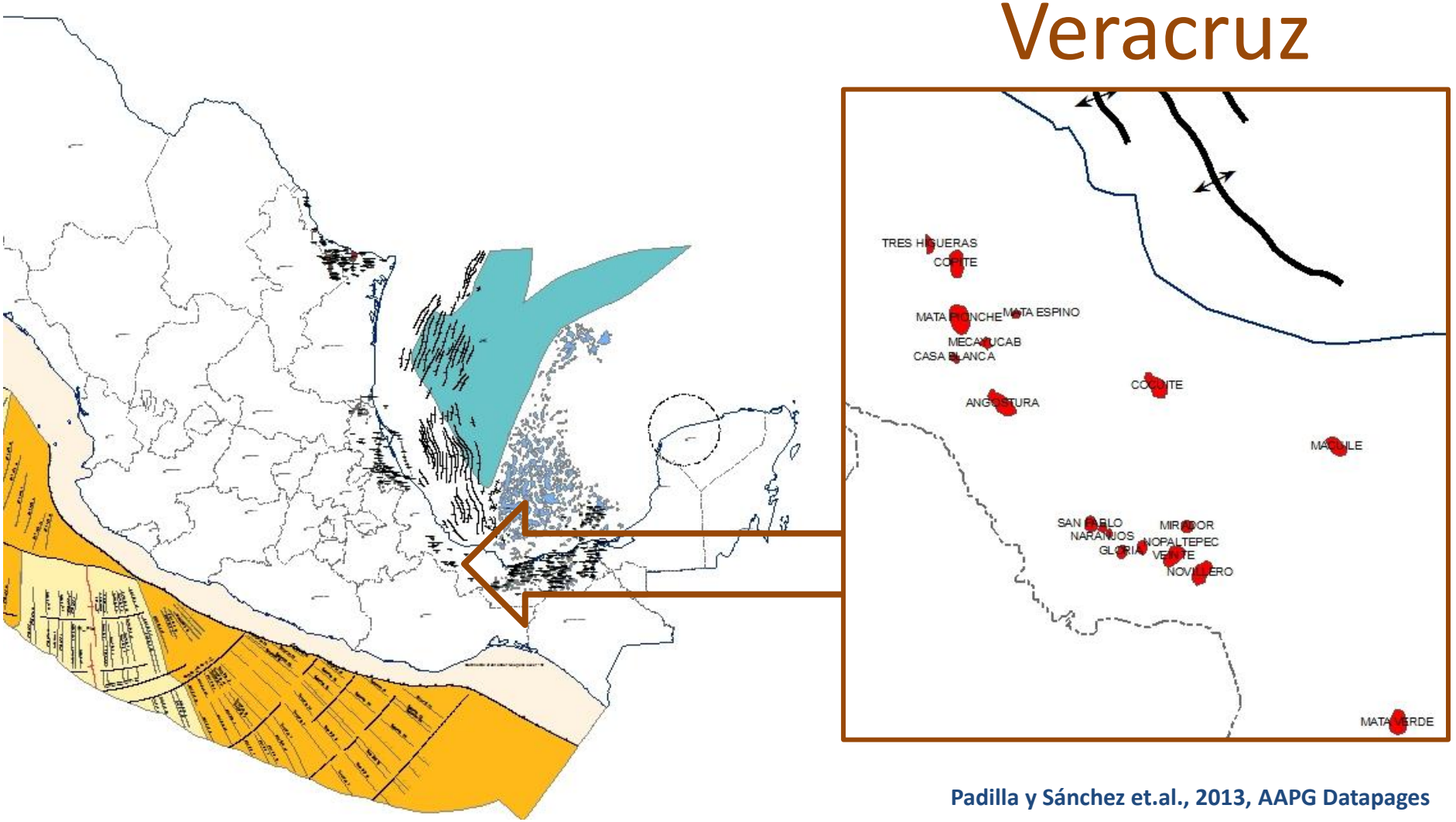
Ébano, Pánuco, Faja de Oro





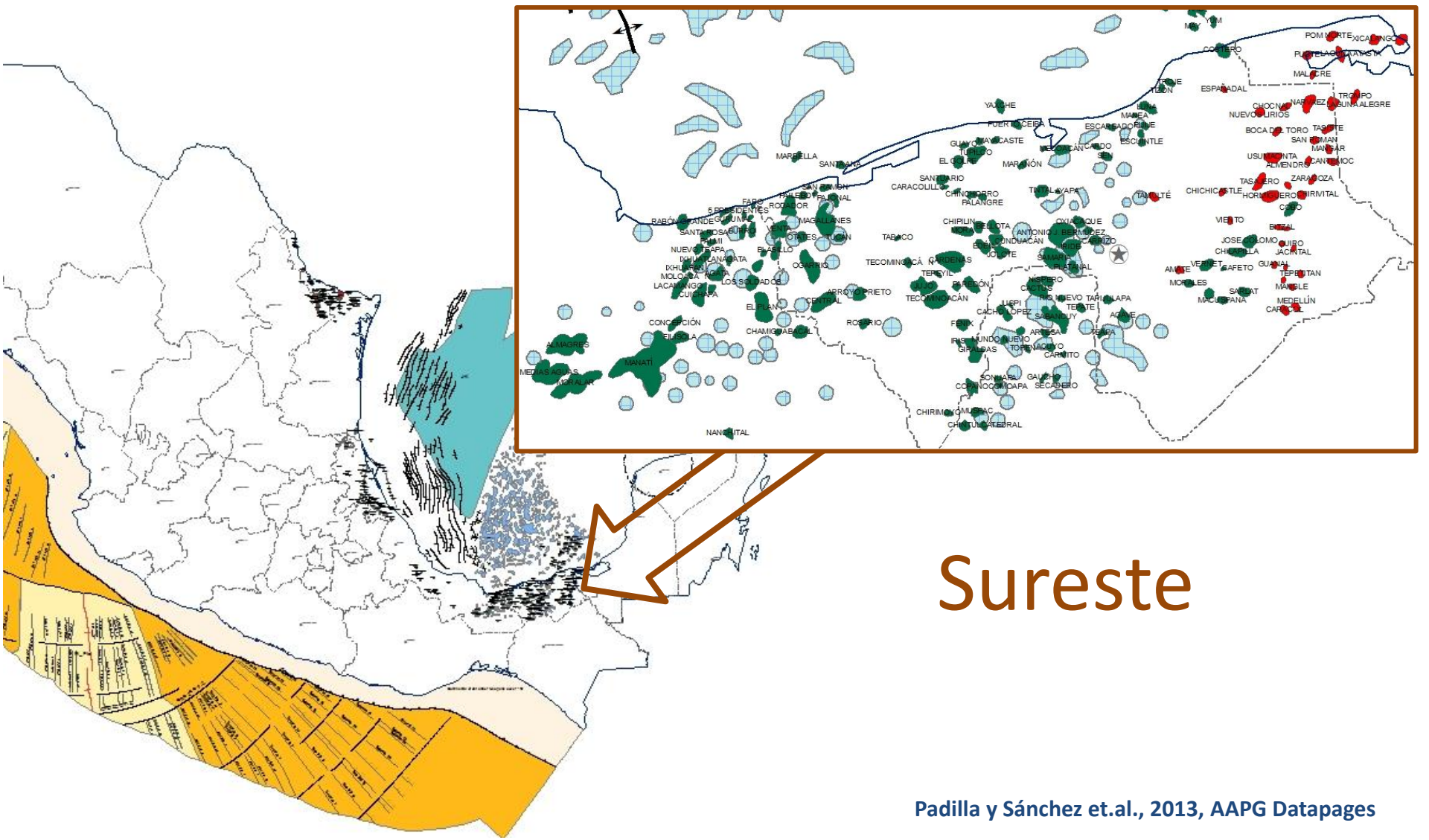
Padilla y Sánchez et.al., 2013, AAPG Datapages

Major oil & gas reservoirs in Mexico



Padilla y Sánchez et.al., 2013, AAPG Datapages

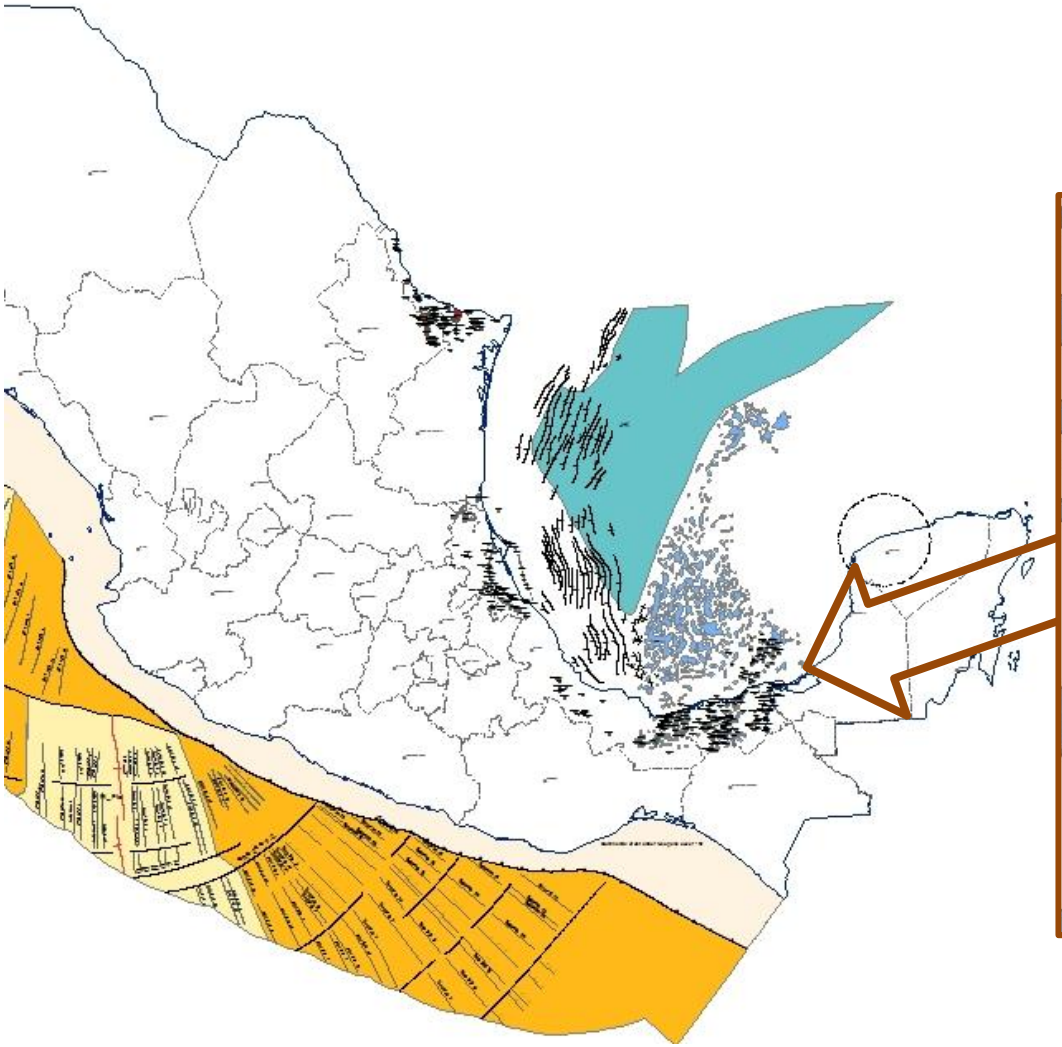
Major oil & gas reservoirs in Mexico

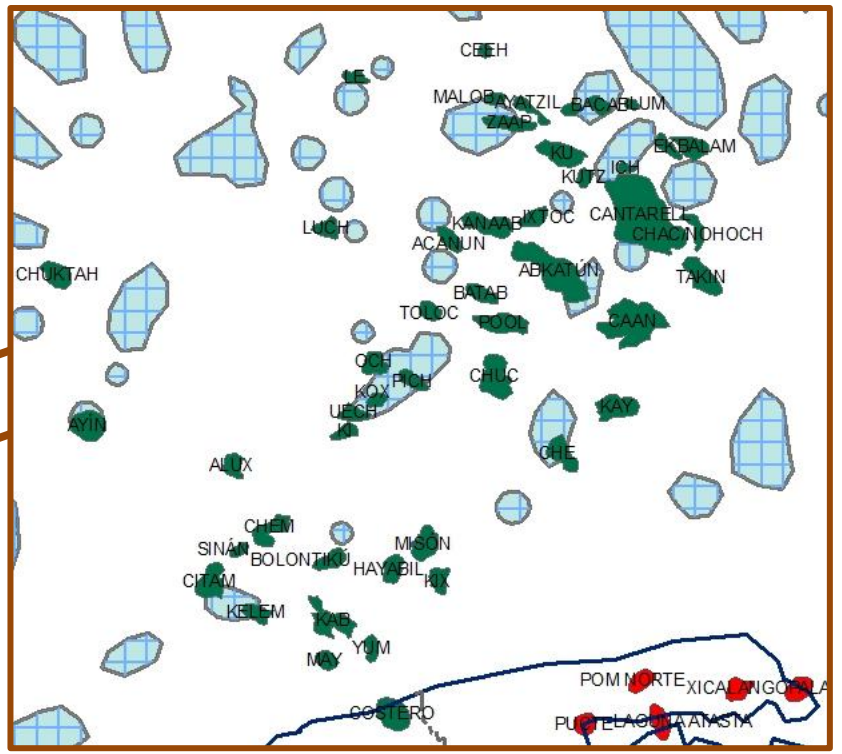


Padilla y Sánchez et.al., 2013, AAPG Datapages

Major oil & gas reservoirs in Mexico

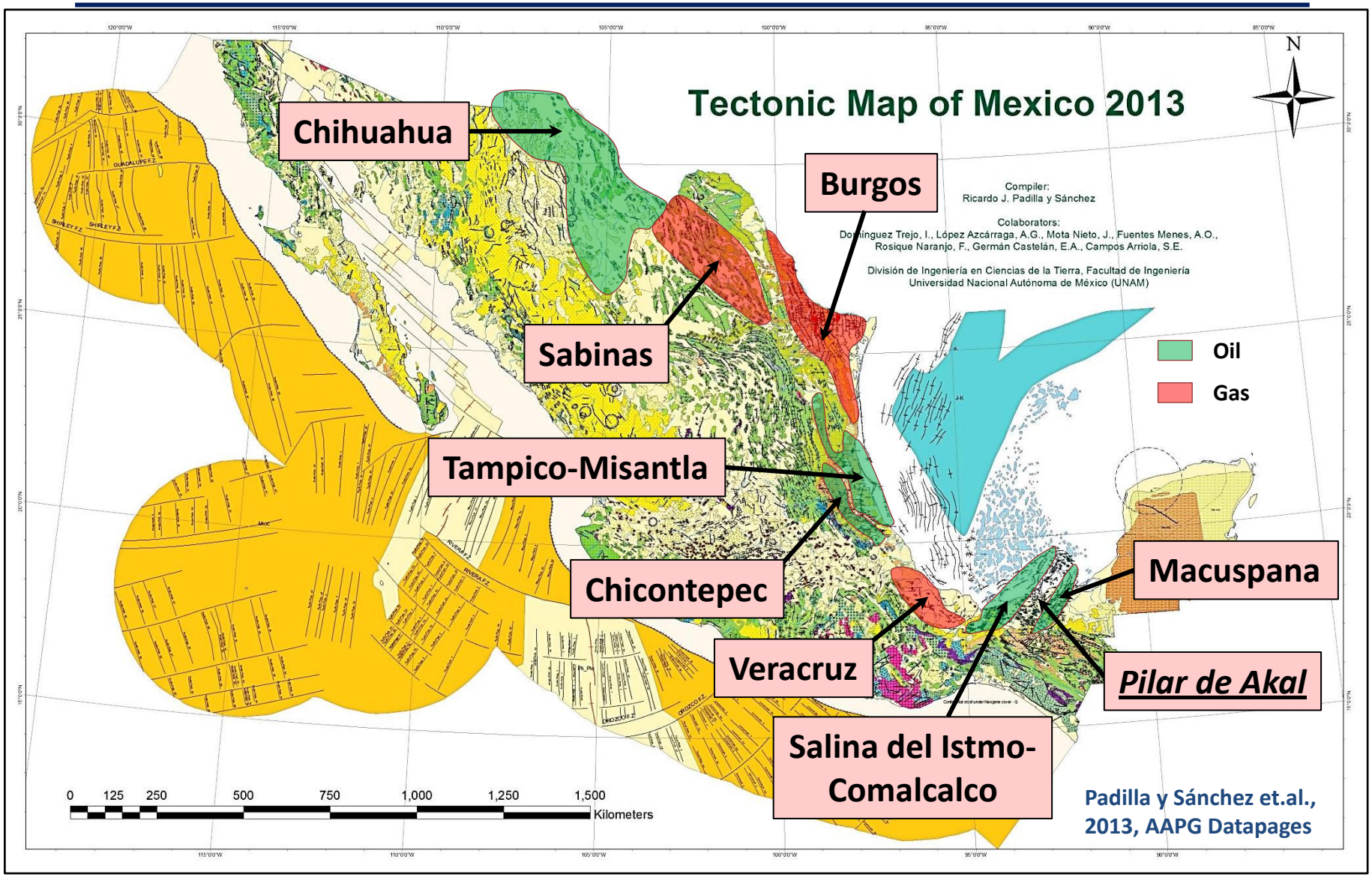
Región Marina



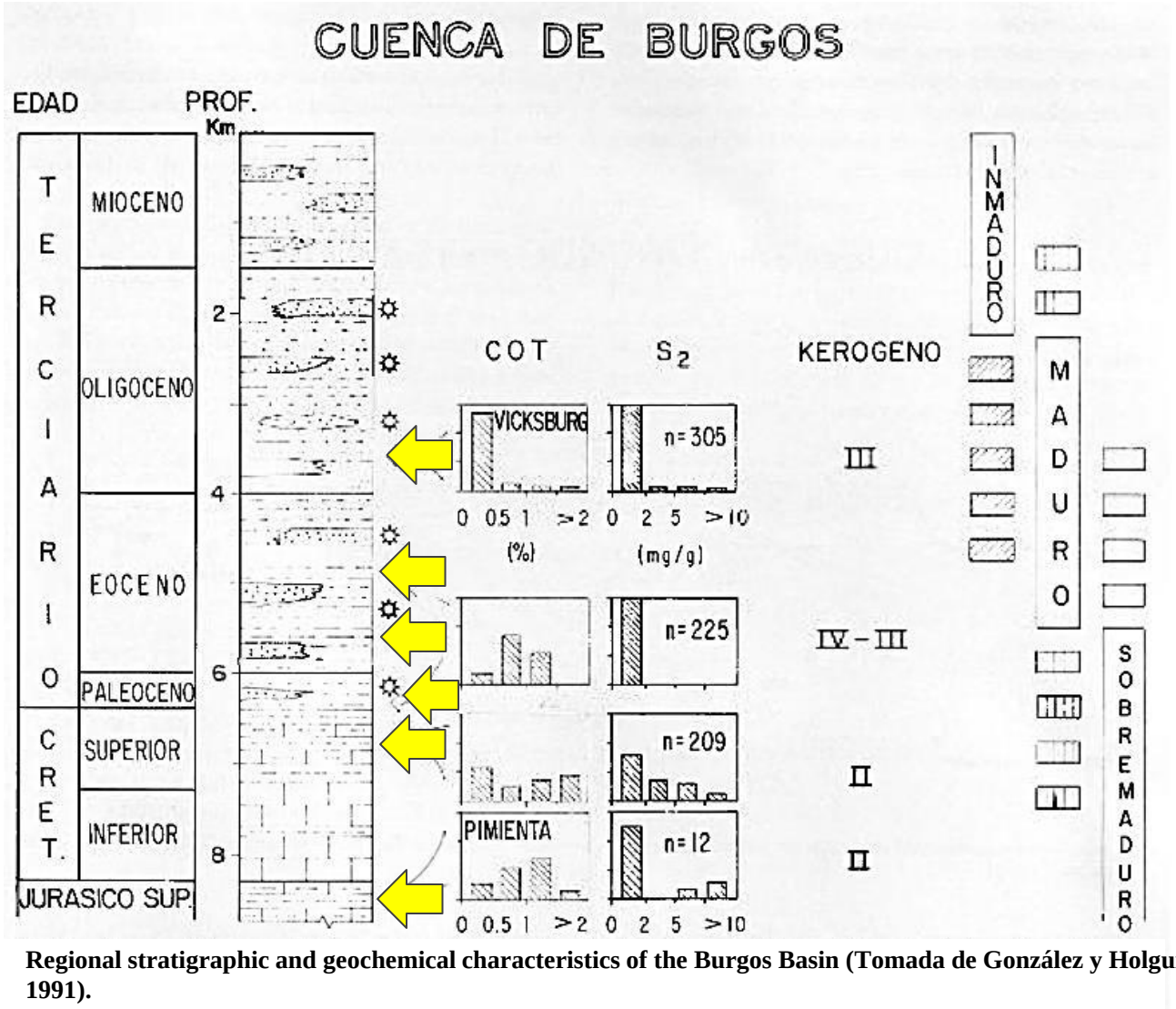


Padilla y Sánchez et.al., 2013, AAPG Datapages

Petroleum basins of Mexico



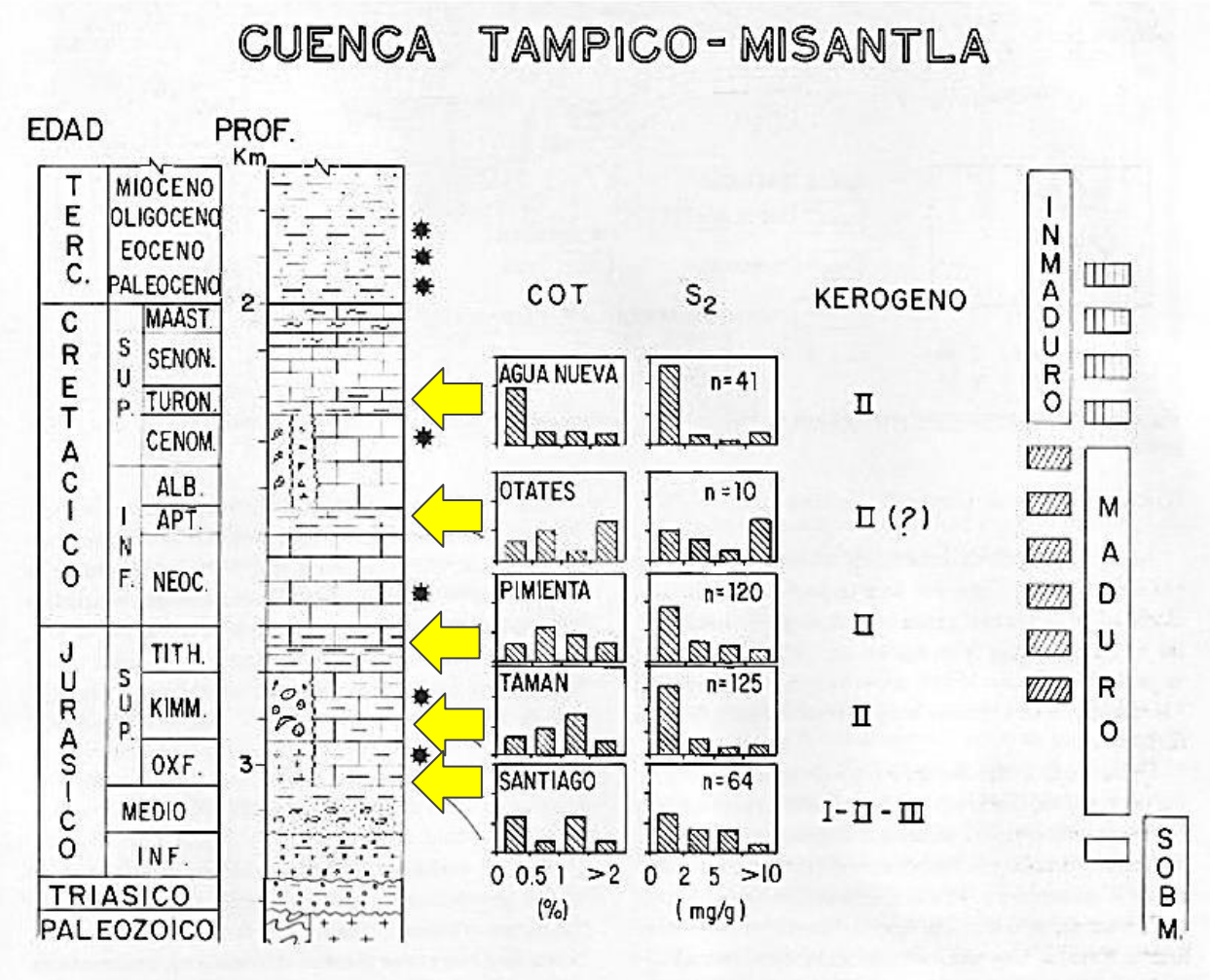
Source rocks



Regional stratigraphic and geochemical characteristics of the Burgos Basin (Tomada de González y Holguin, 1991).

González y Holguín, 1992

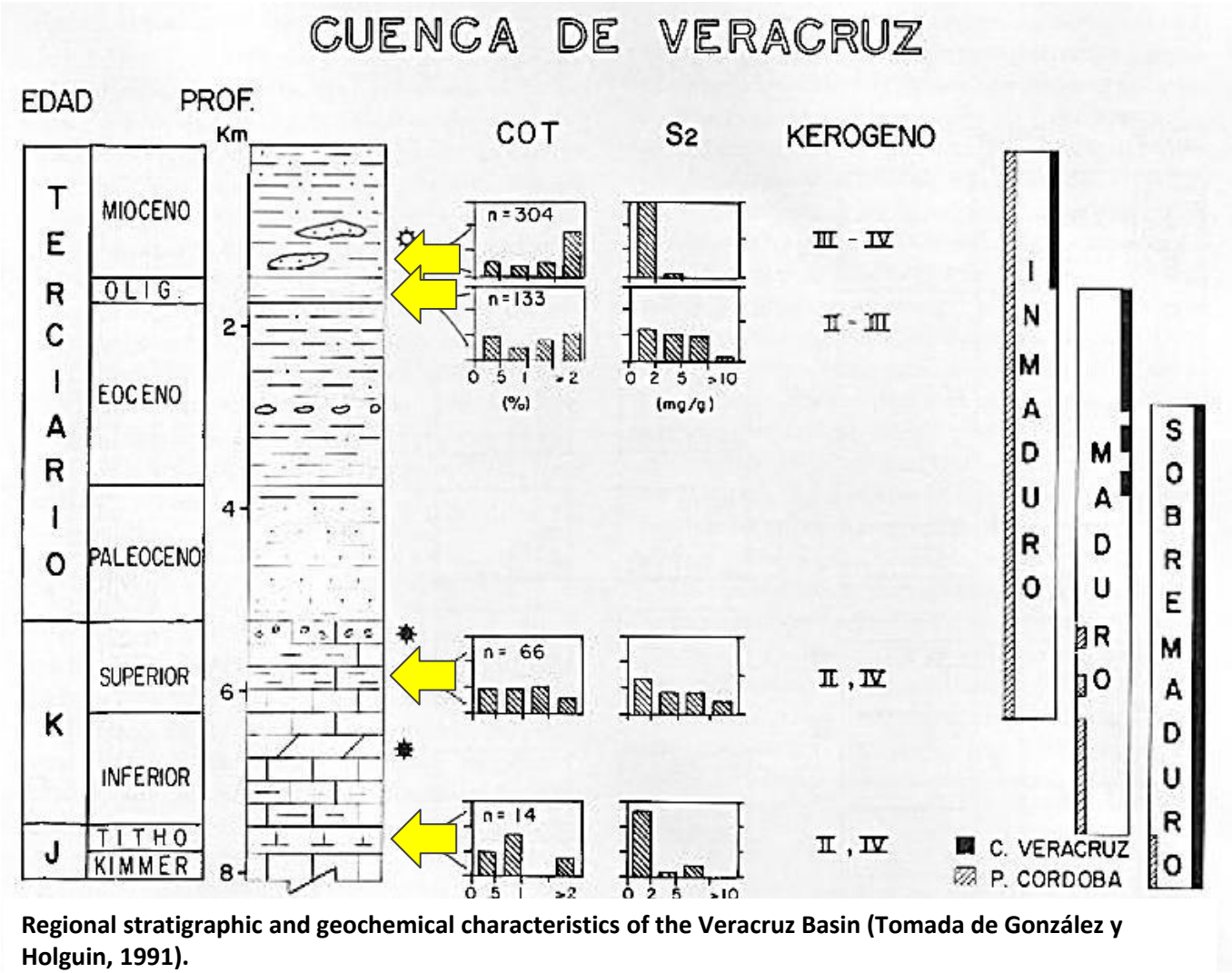
Source rocks



Regional stratigraphic and geochemical characteristics of the Tampico-Misantla Basin (Tomada de González y Holguin, 1991).

González y Holguín, 1992

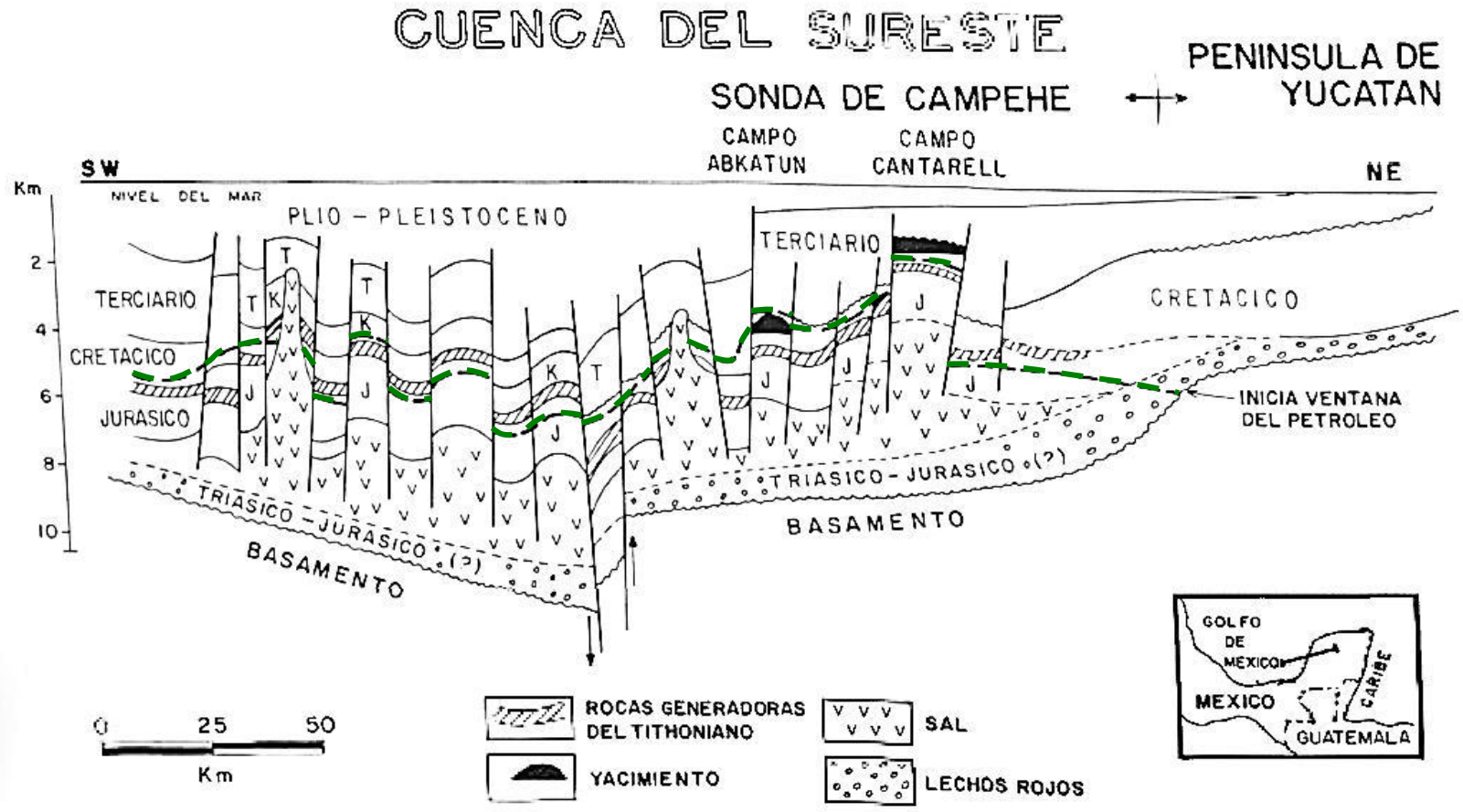
Source rocks



Regional stratigraphic and geochemical characteristics of the Veracruz Basin (Tomada de González y Holguin, 1991).

González y Holguín, 1992

Source rocks



Simplified cross section and maturity of the Sureste Basin (Tomada de González y Holguin, 1991).

González y Holguín, 1992

Petroleum systems

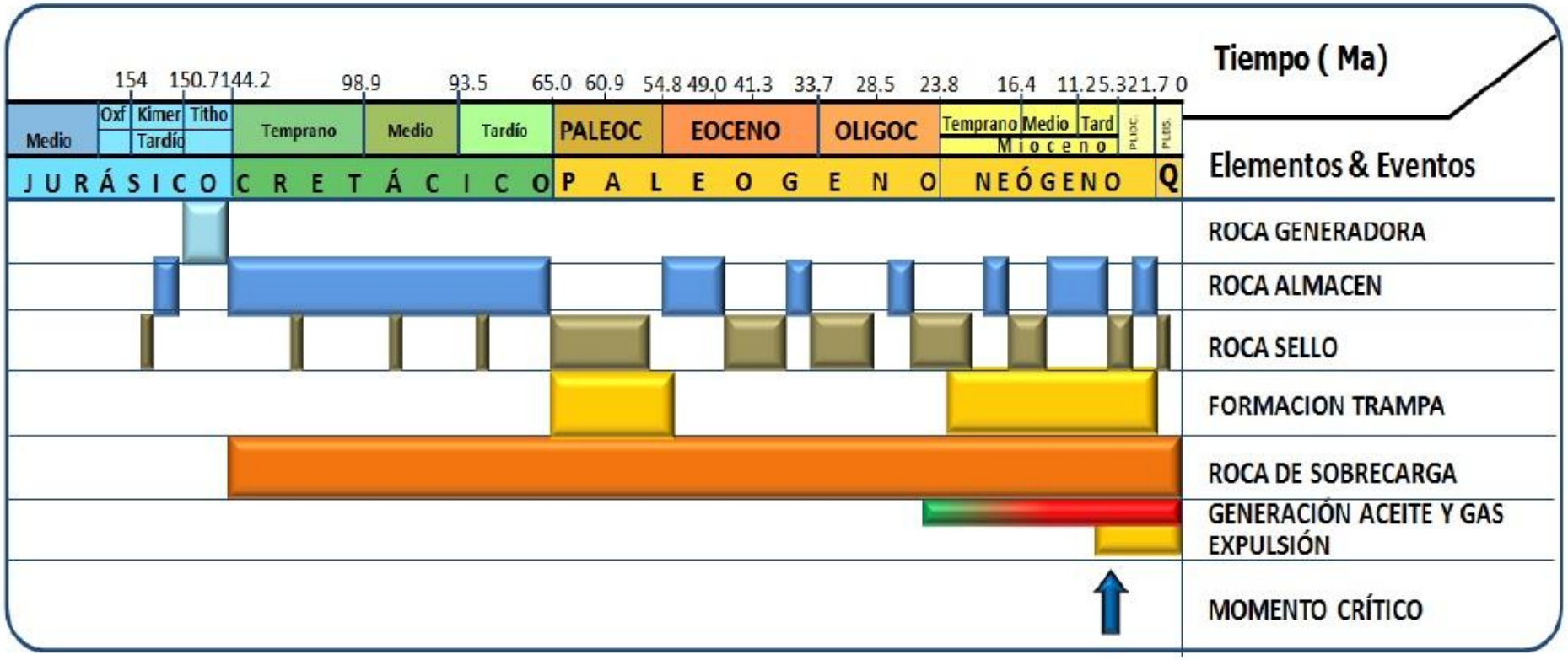


Diagram of the events of the Tithonian-Kimmeridgian-Cretaceous-Paleogene-Neogene petroleum systems.

PEMEX, 2013a

Petroleum system

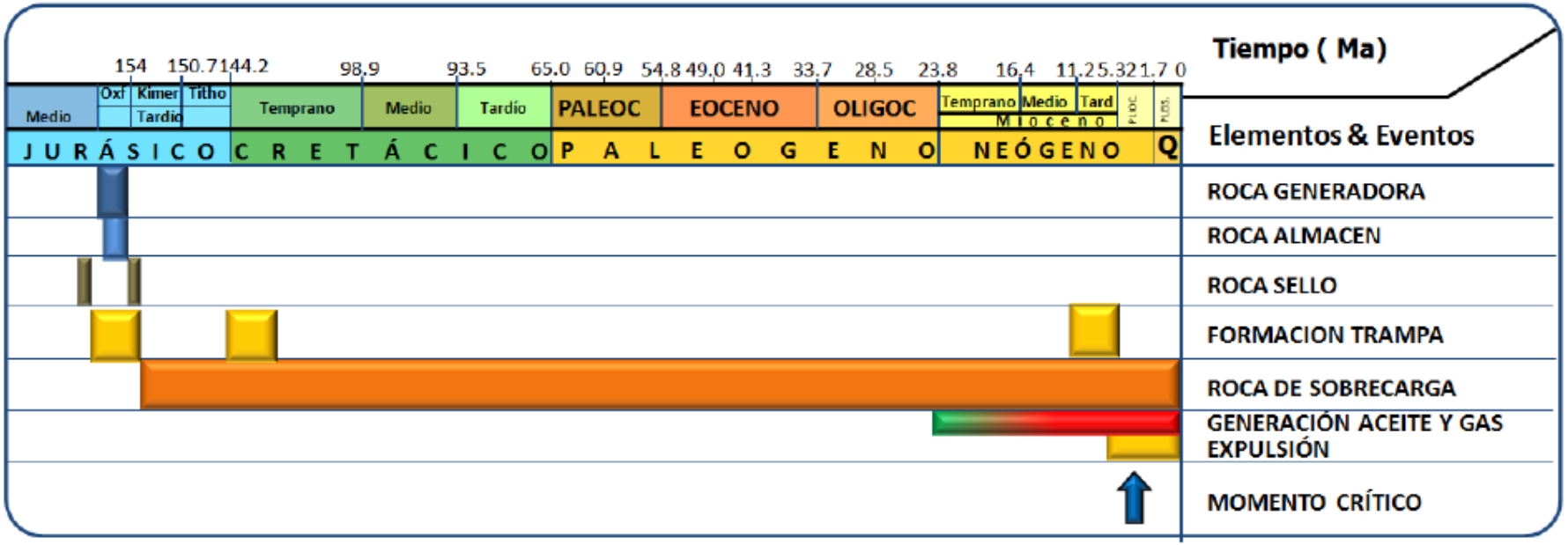


Diagram of the events of the Oxfordian petroleum system, representative of the terrestrial and marine parts of the Sureste petroleum province.

PEMEX, 2013a

Petroleum system

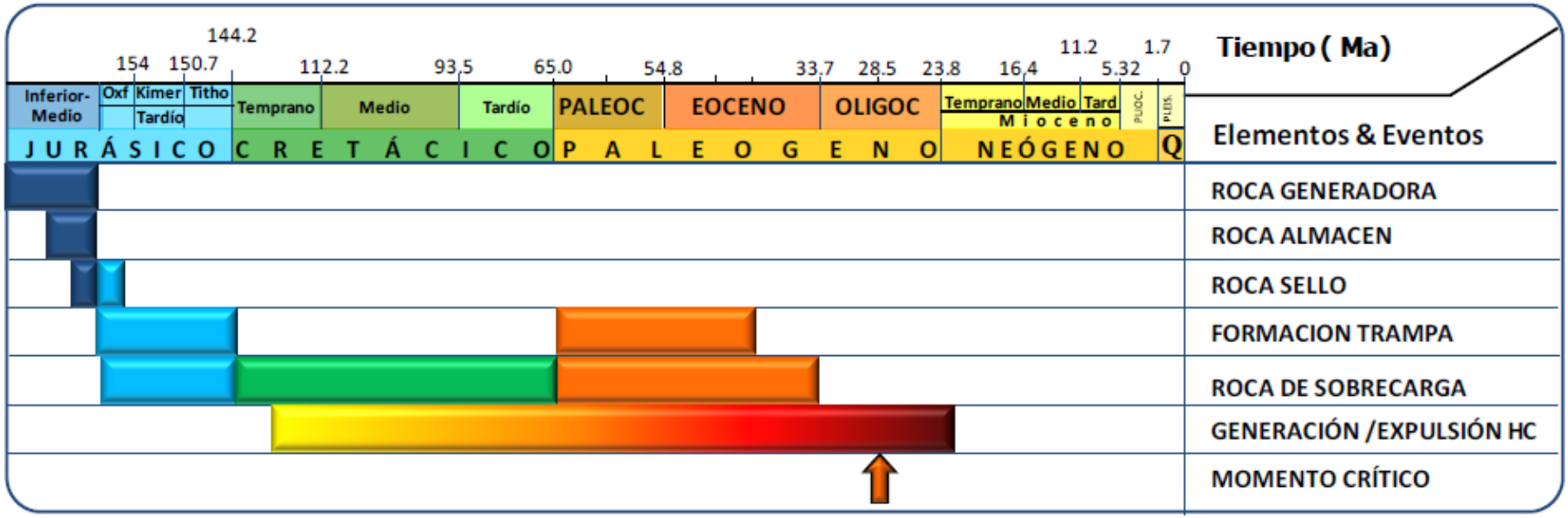


Table of the elements and events of the Lower-Middle Jurassic petroleum system of the Tampico-Misantla petroleum province.

PEMEX, 2013b

Petroleum system

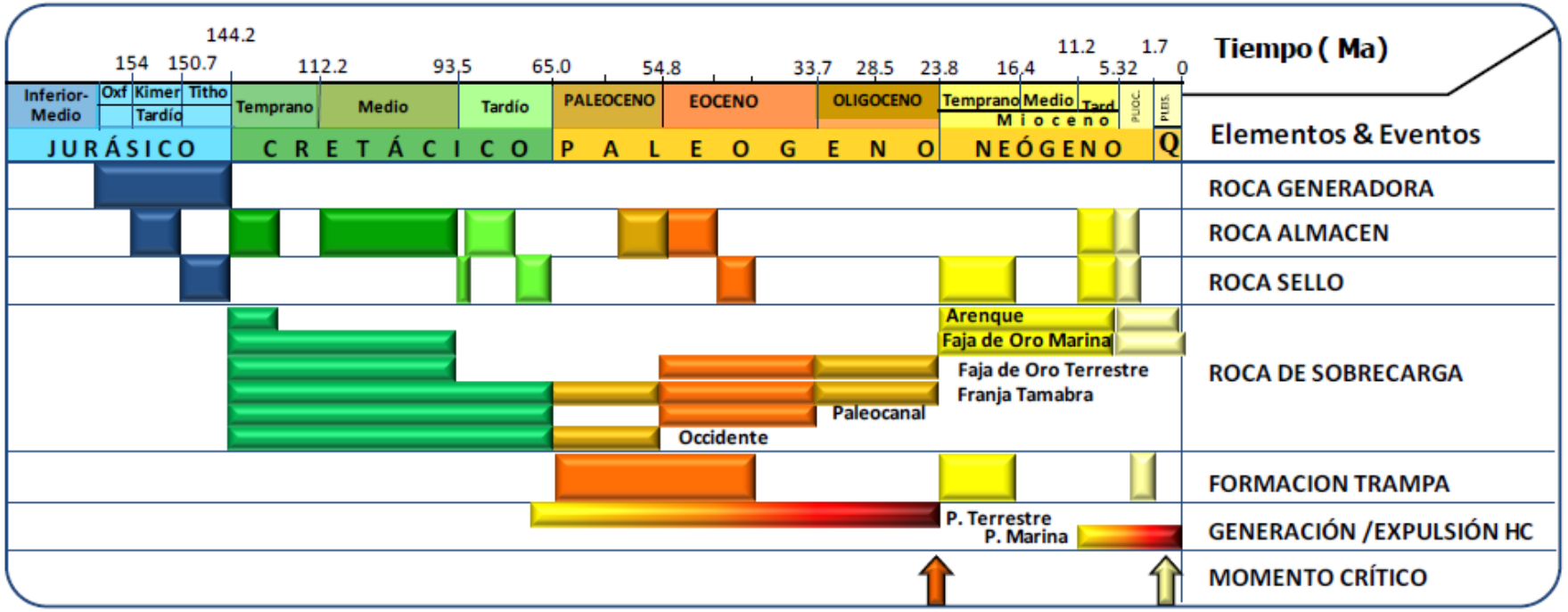


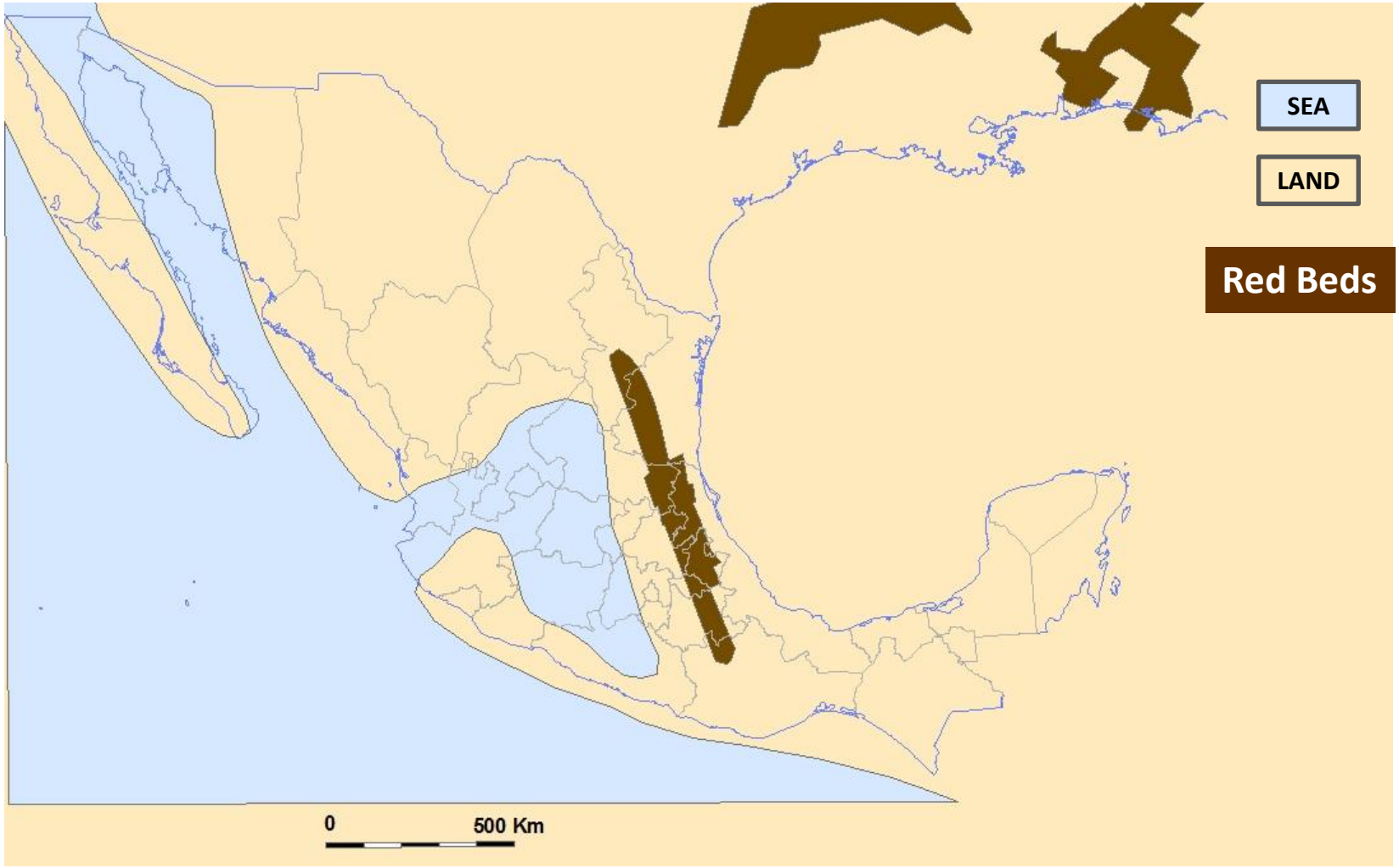
Table of the elements and events of the petroleum system associated with Upper Jurassic source rocks.

PEMEX, 2013b

Paleogeographic evolution of NA

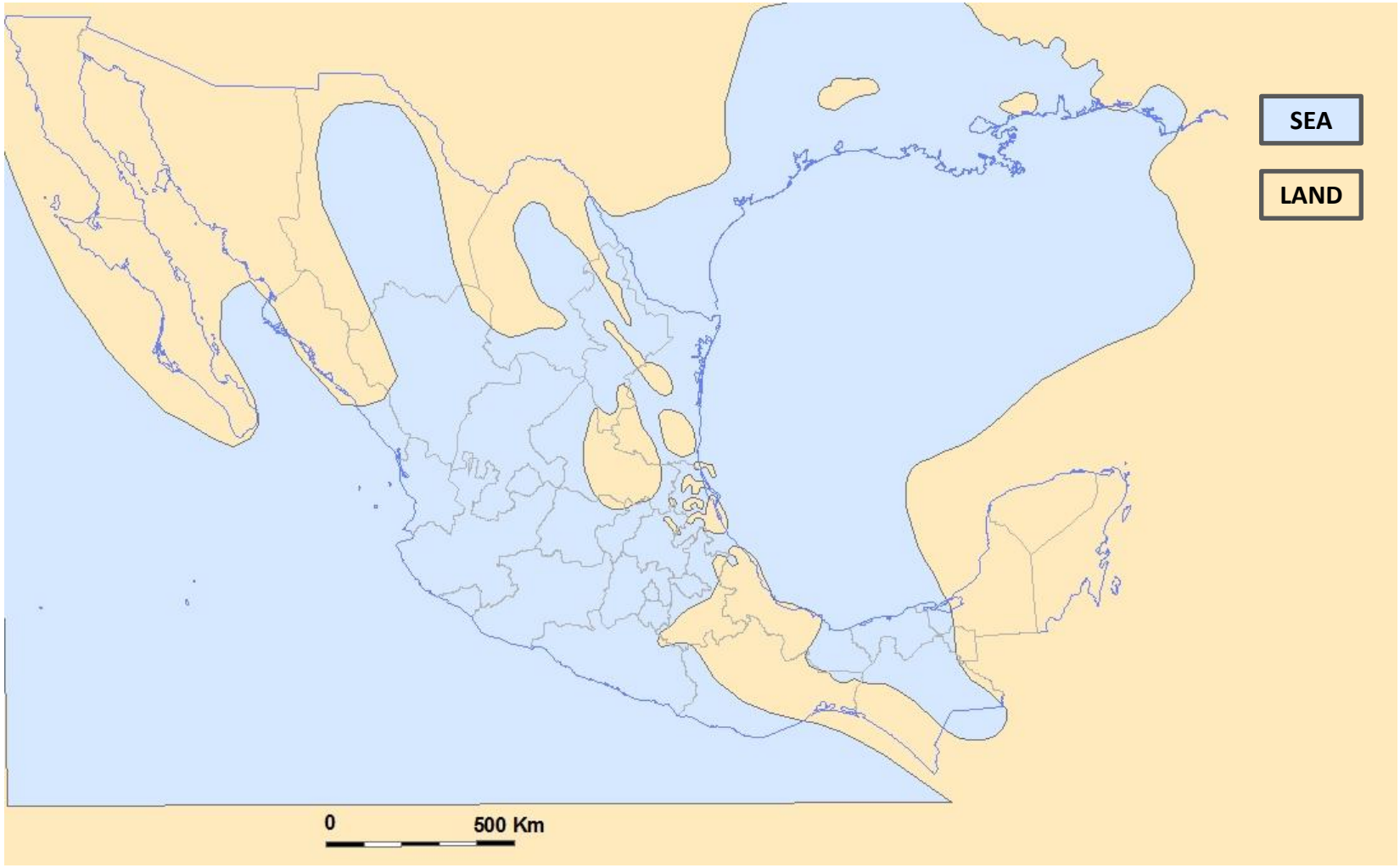
Ronald Blakey, 2013

Late Triassic paleogeography

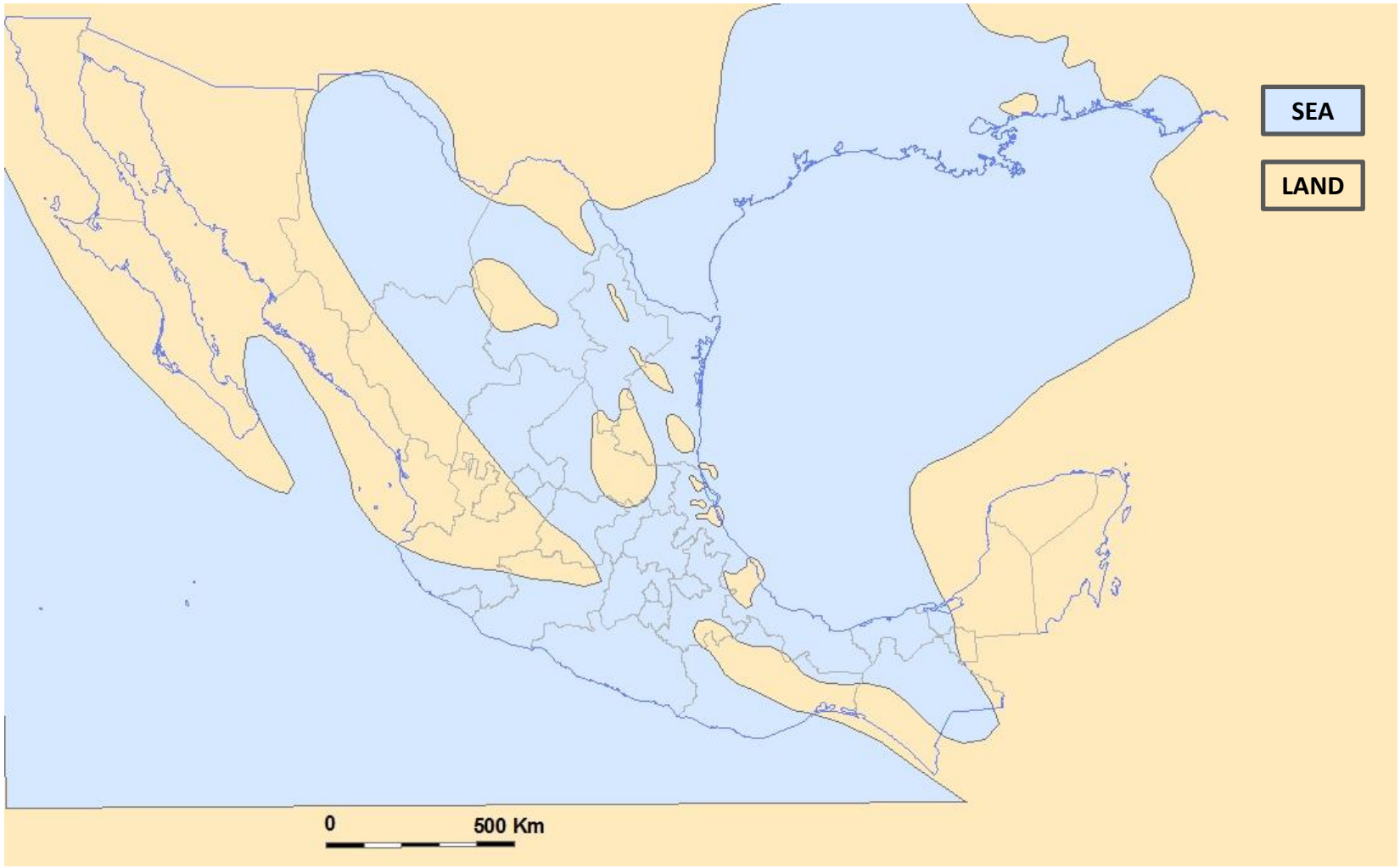


Callovian paleogeography

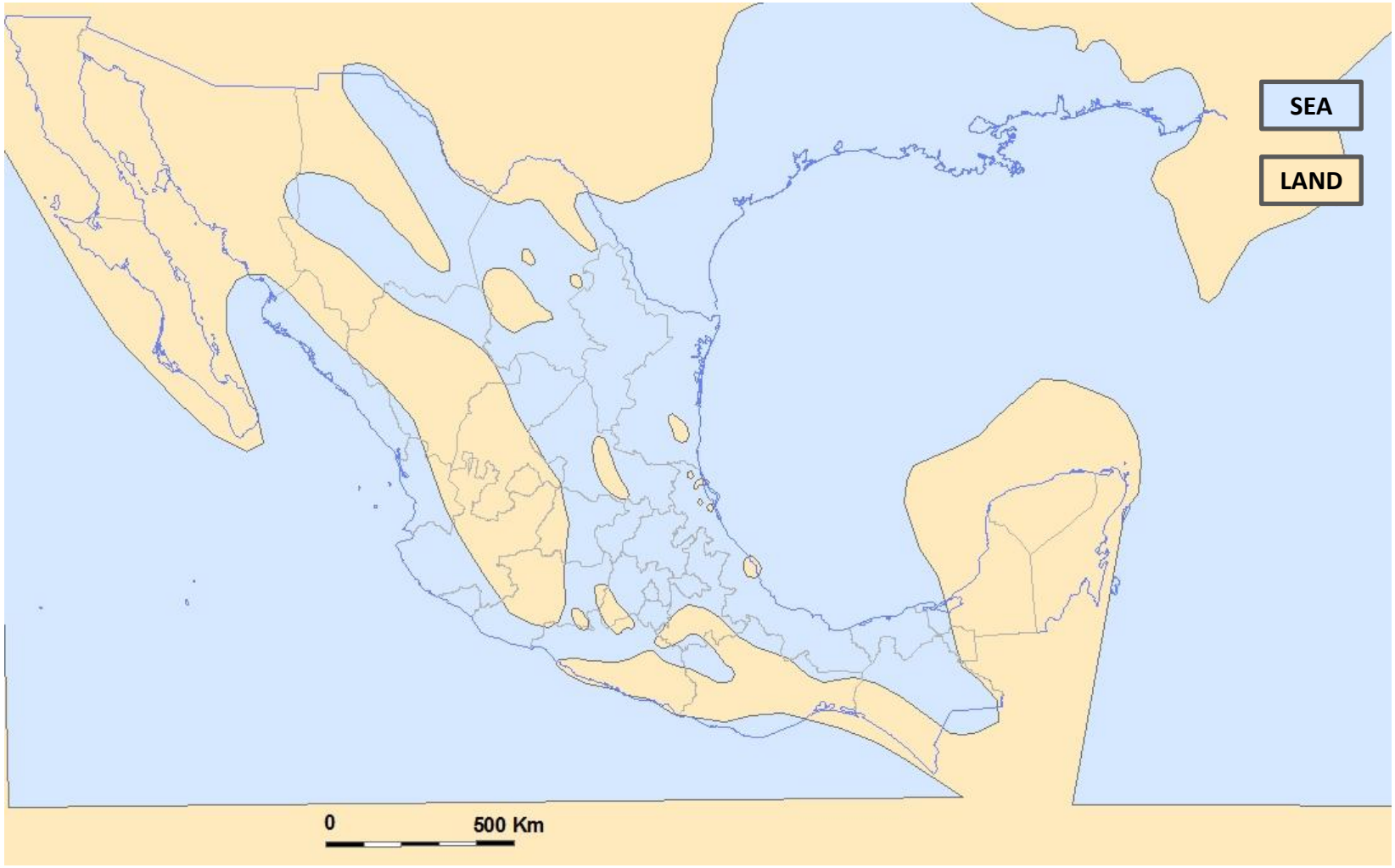
Oxfordian paleogeography



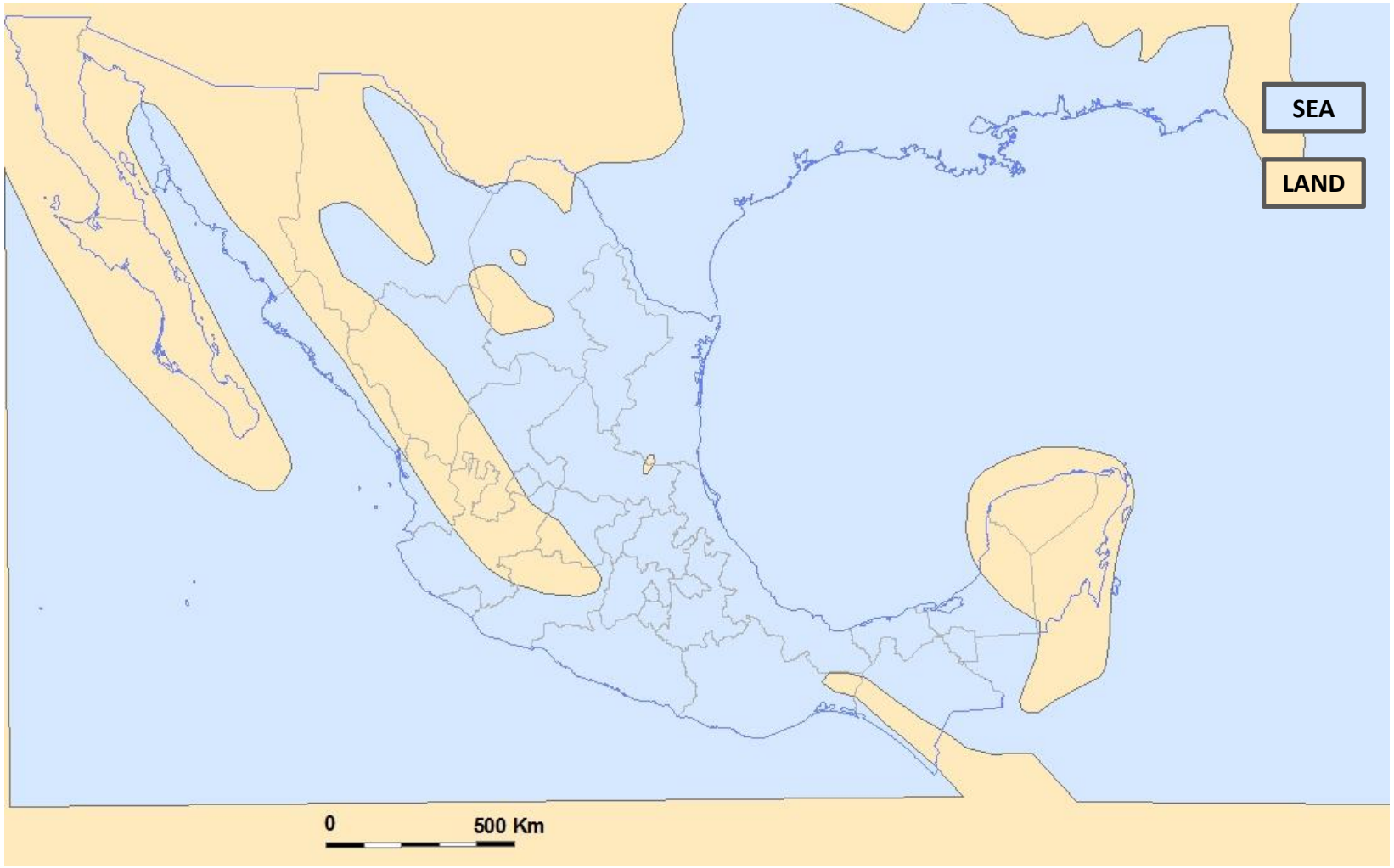
Kimmeridgian paleogeography



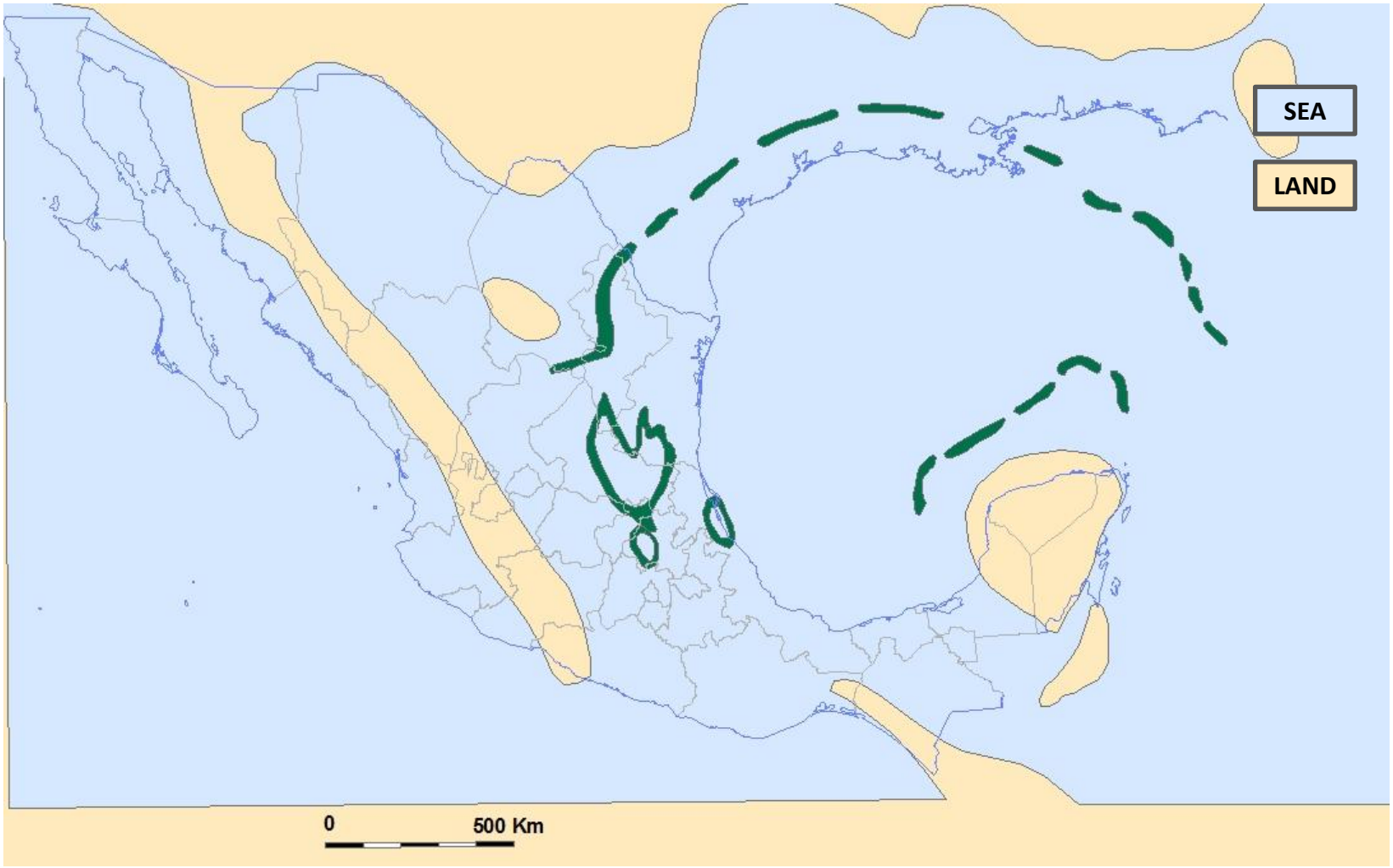
Tithonian paleogeography



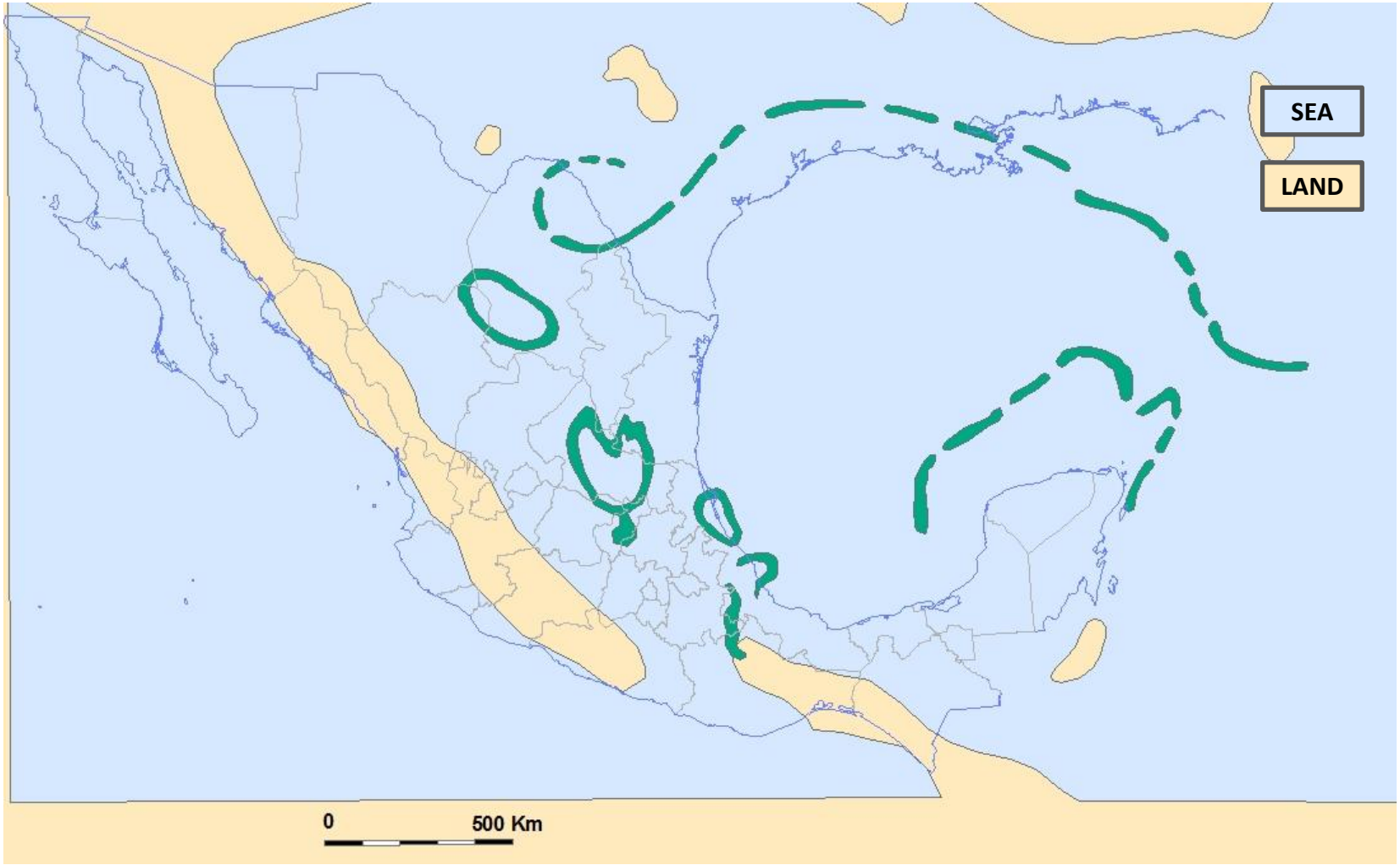
Early Cretaceous paleogeography



Barremian paleogeography

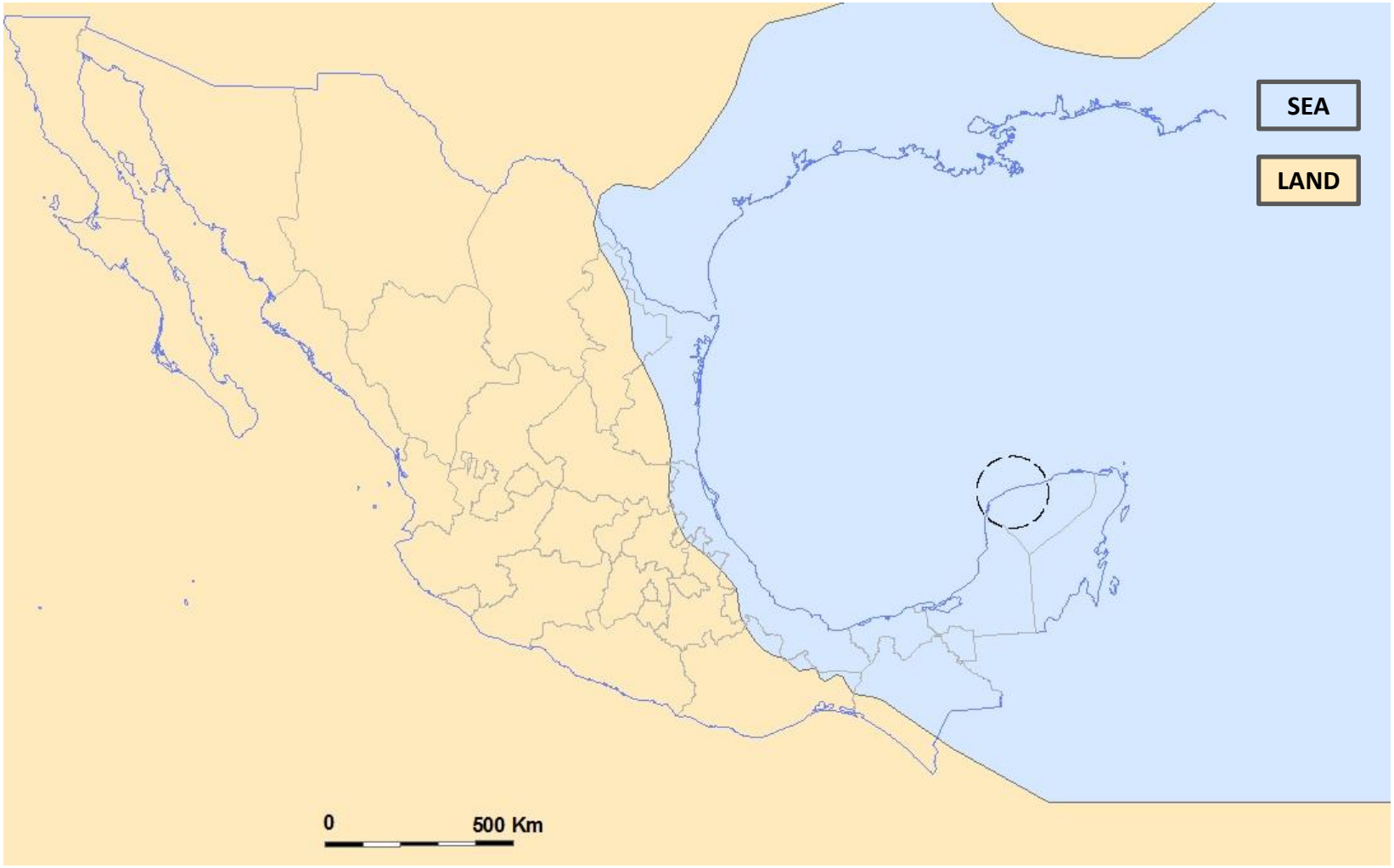


Albian paleogeography

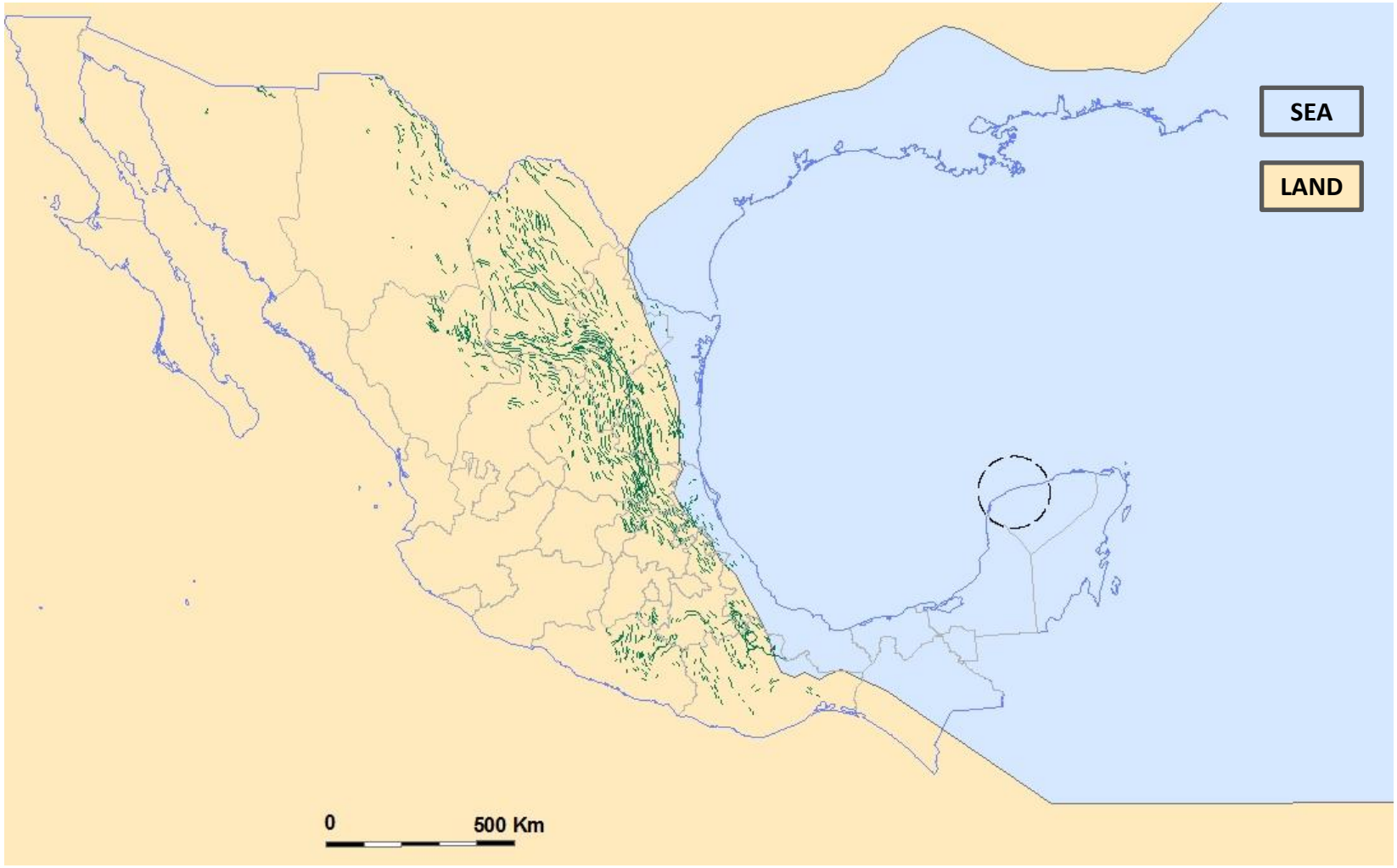


Late Cretaceous paleogeography

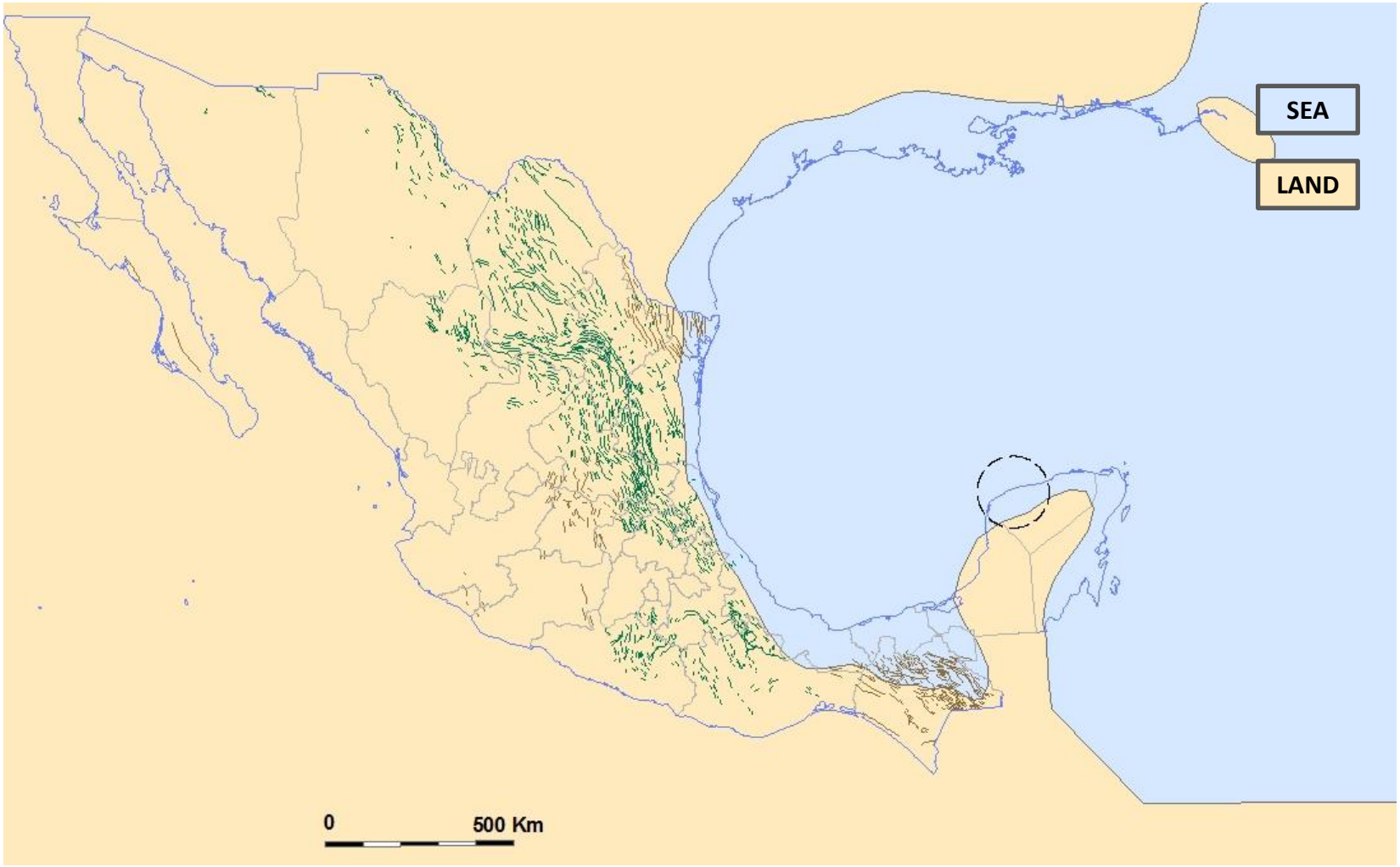
Early Paleocene paleogeography



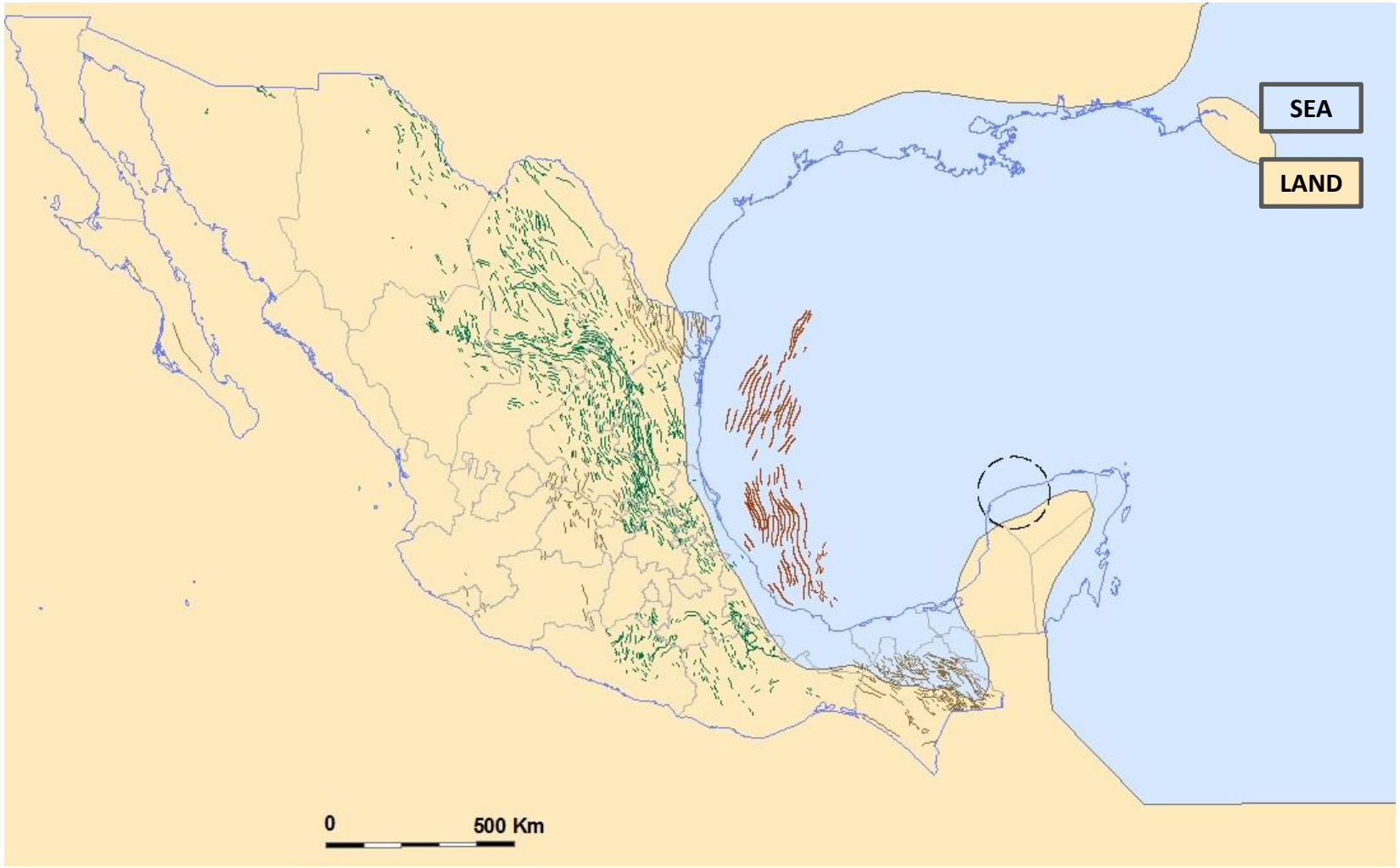
Late Eocene paleogeography



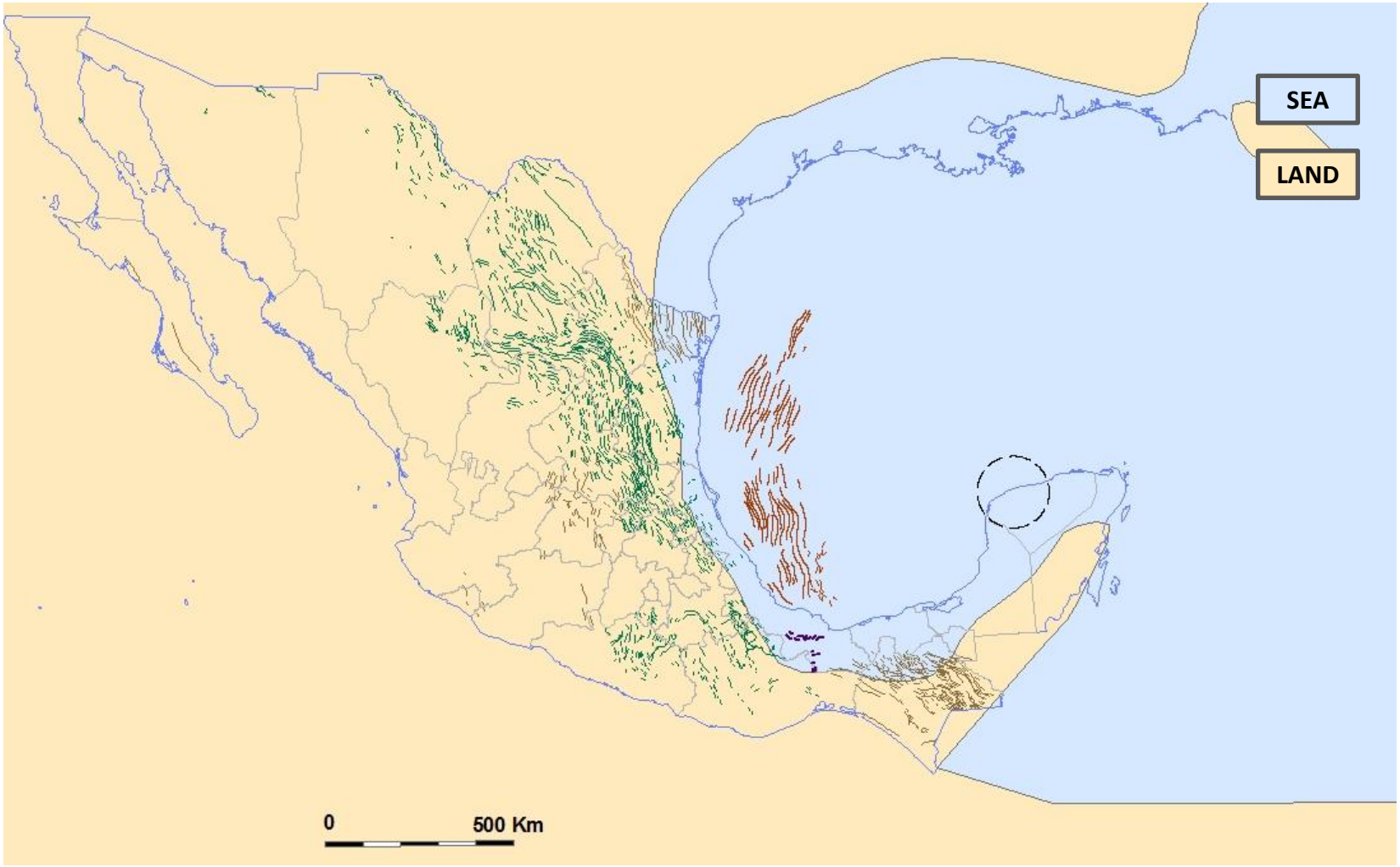
Miocene paleogeography



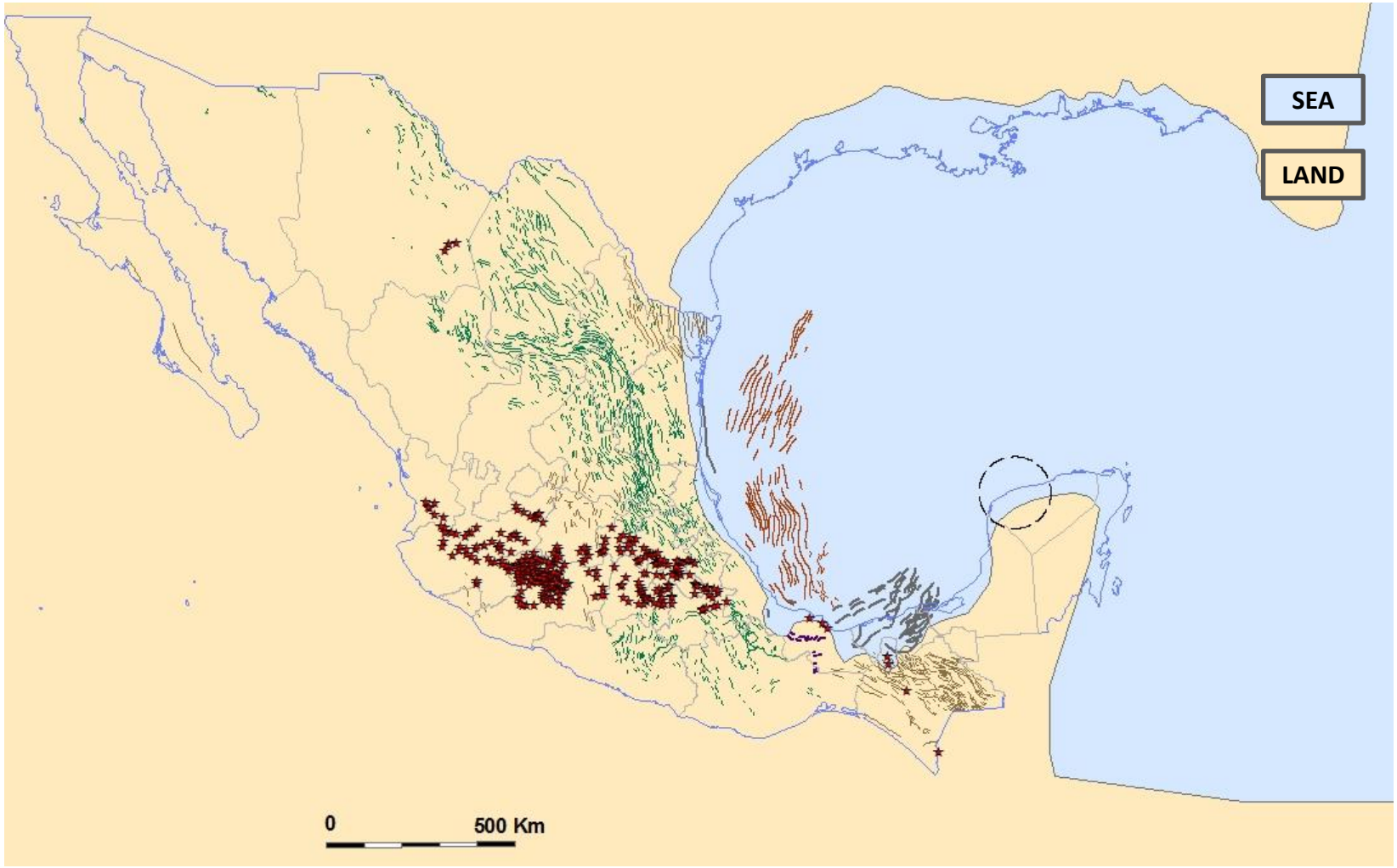
Late Miocene paleogeography



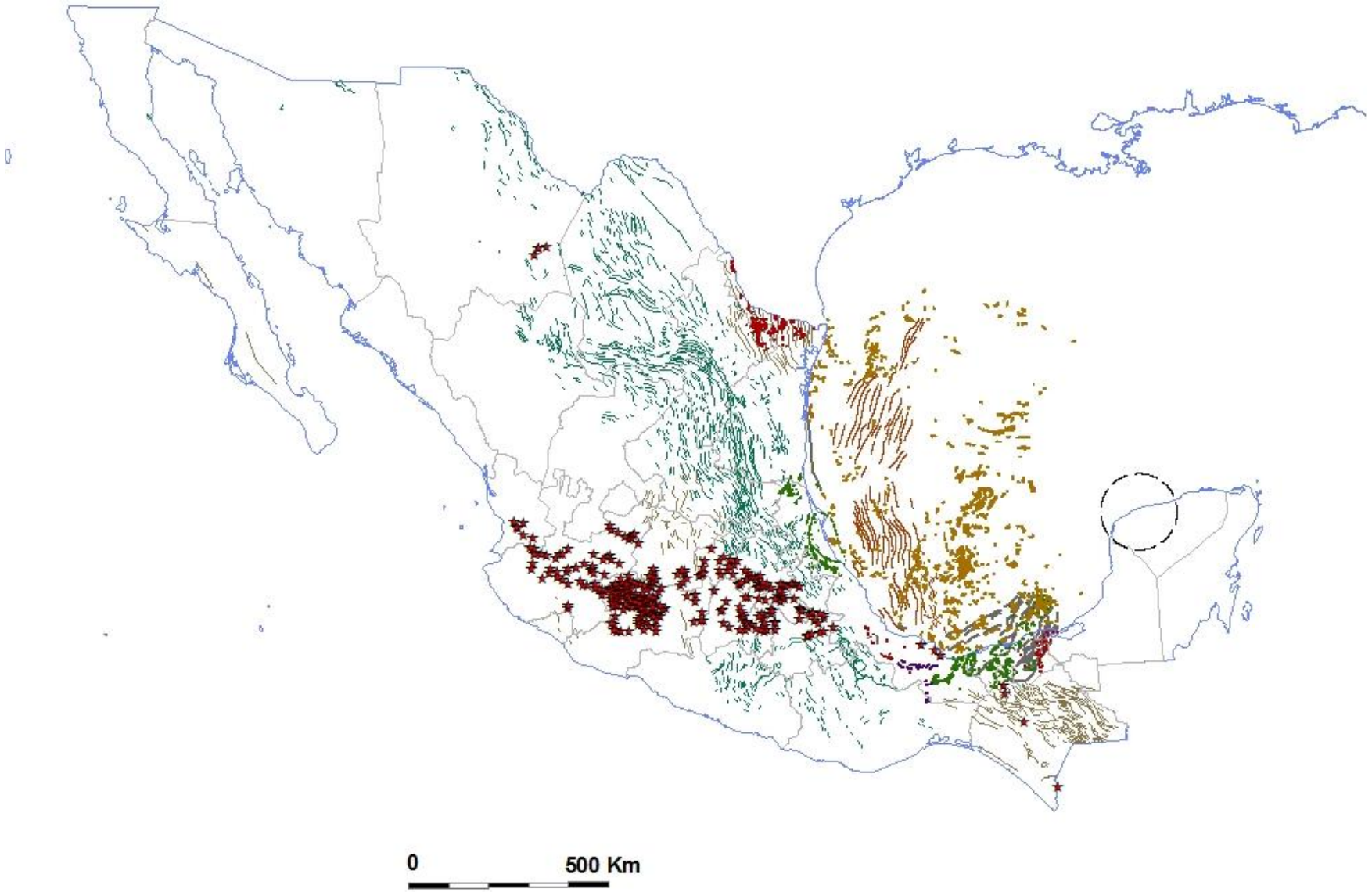
Oligocene paleogeography



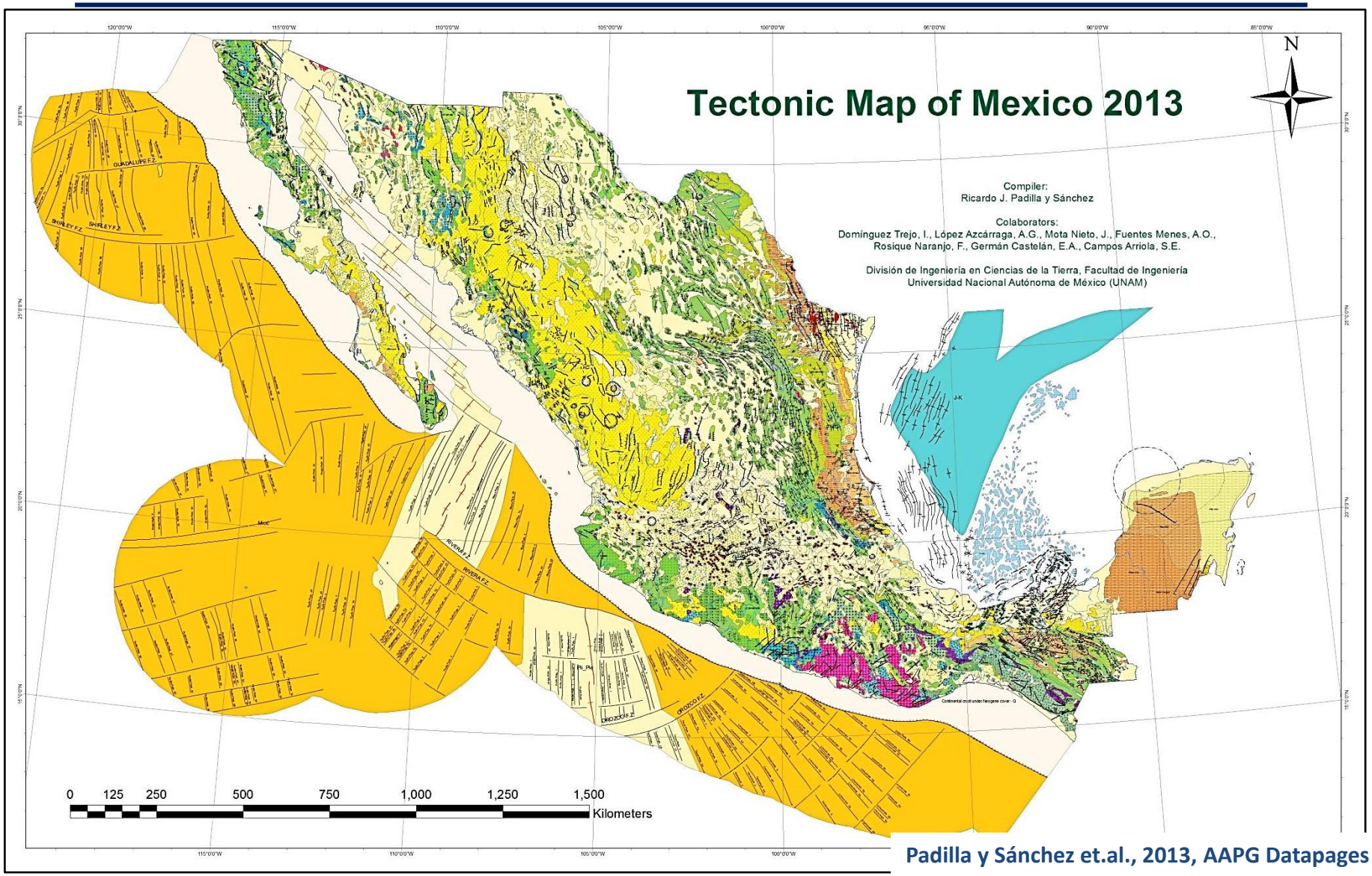
Plio-pleistocene paleogeography



Holocene paleogeography

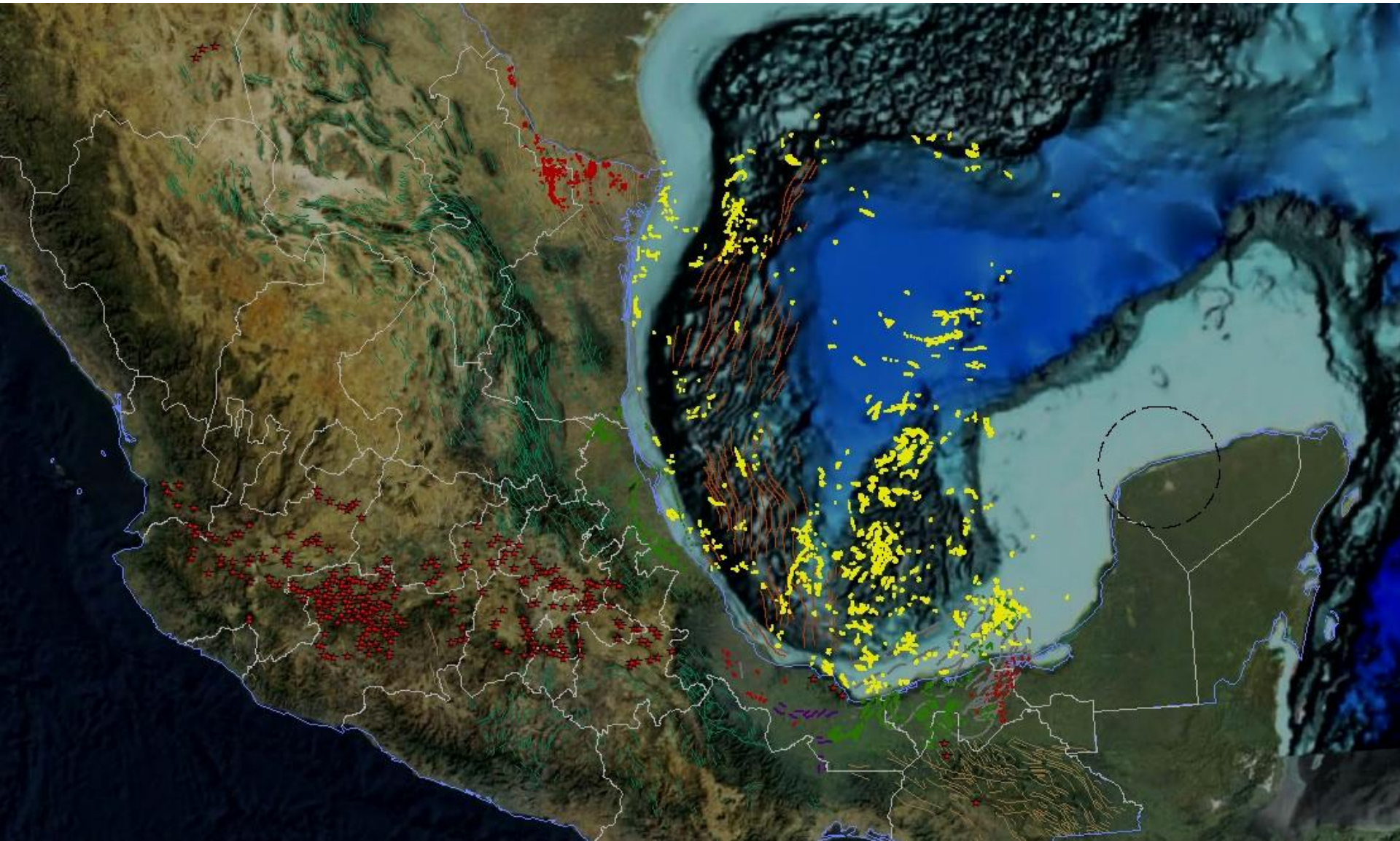


Today

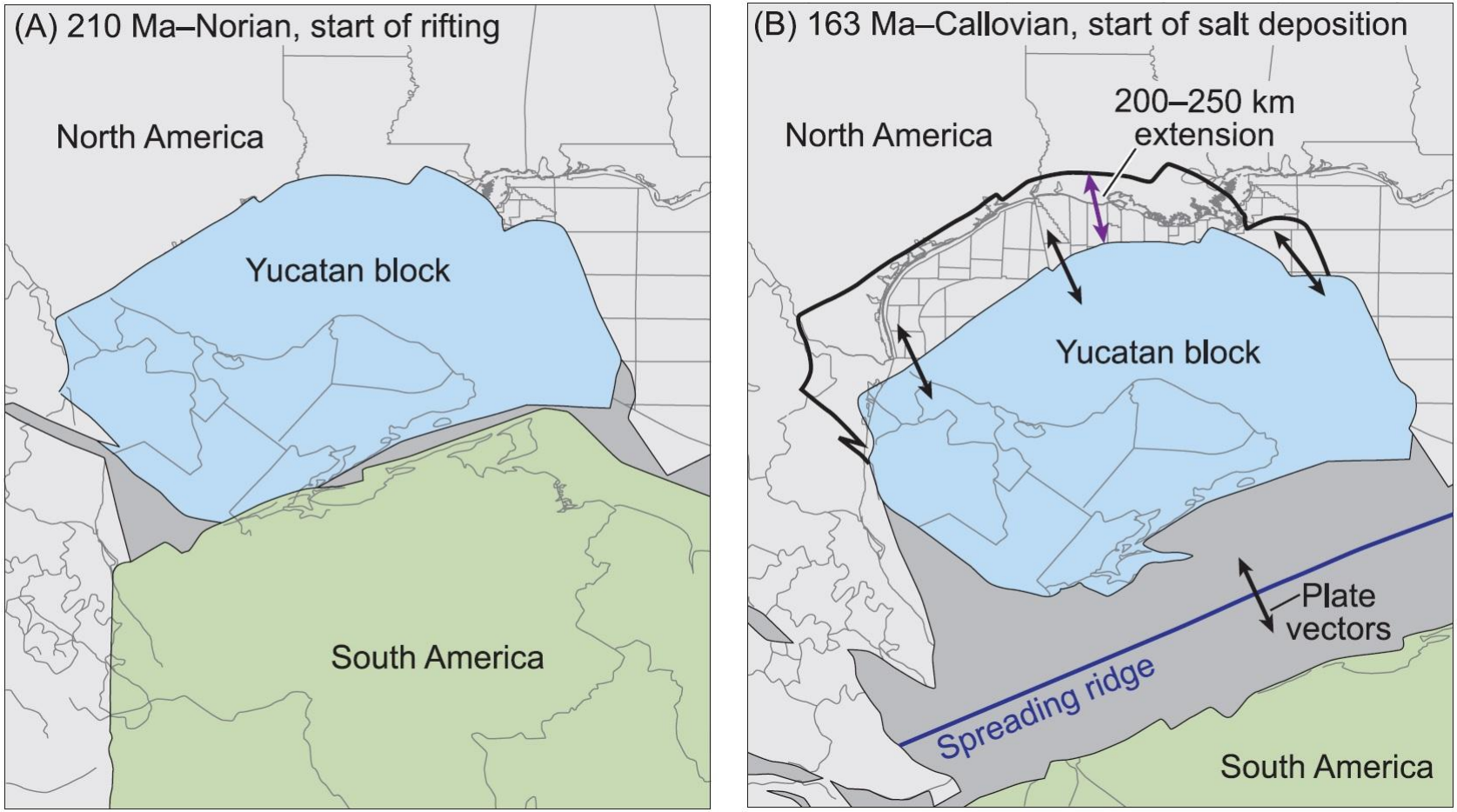


Padilla y Sánchez et.al., 2013, AAPG Datapages

Today

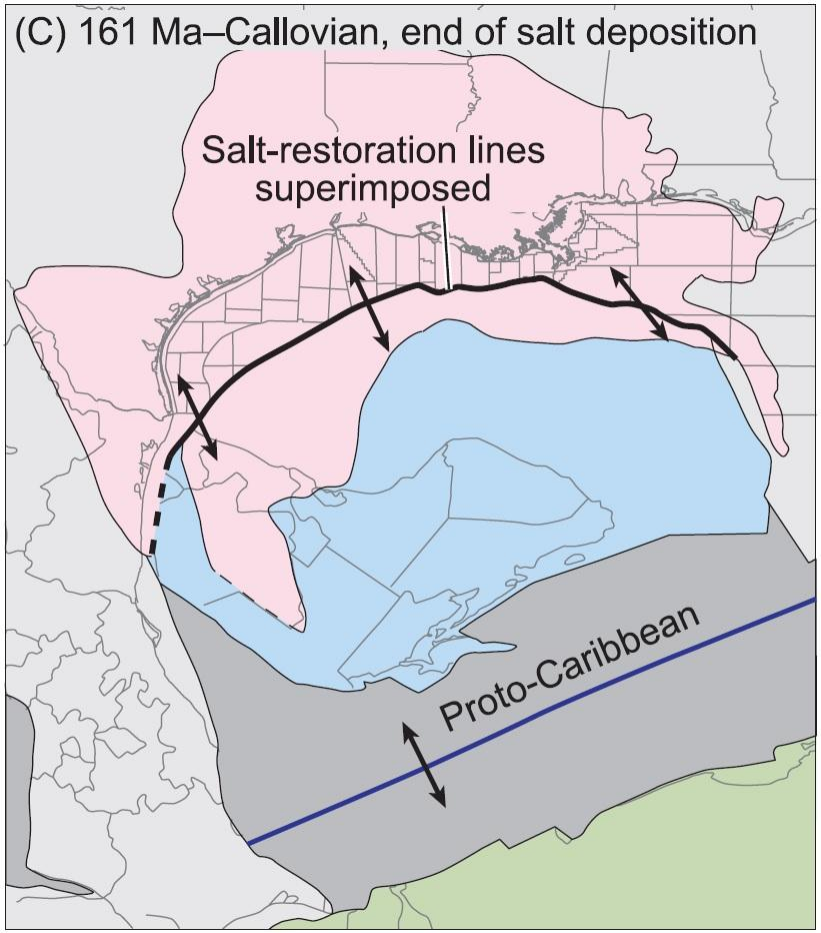


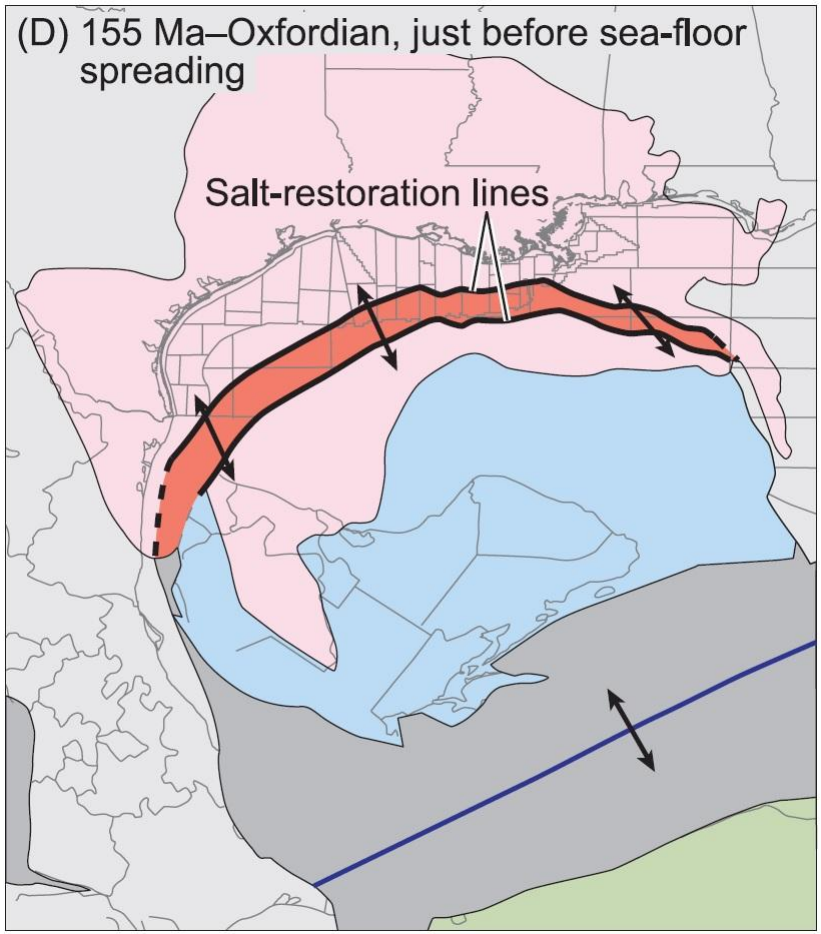
Opening of the Gulf of Mexico



Hudec et al., 2013

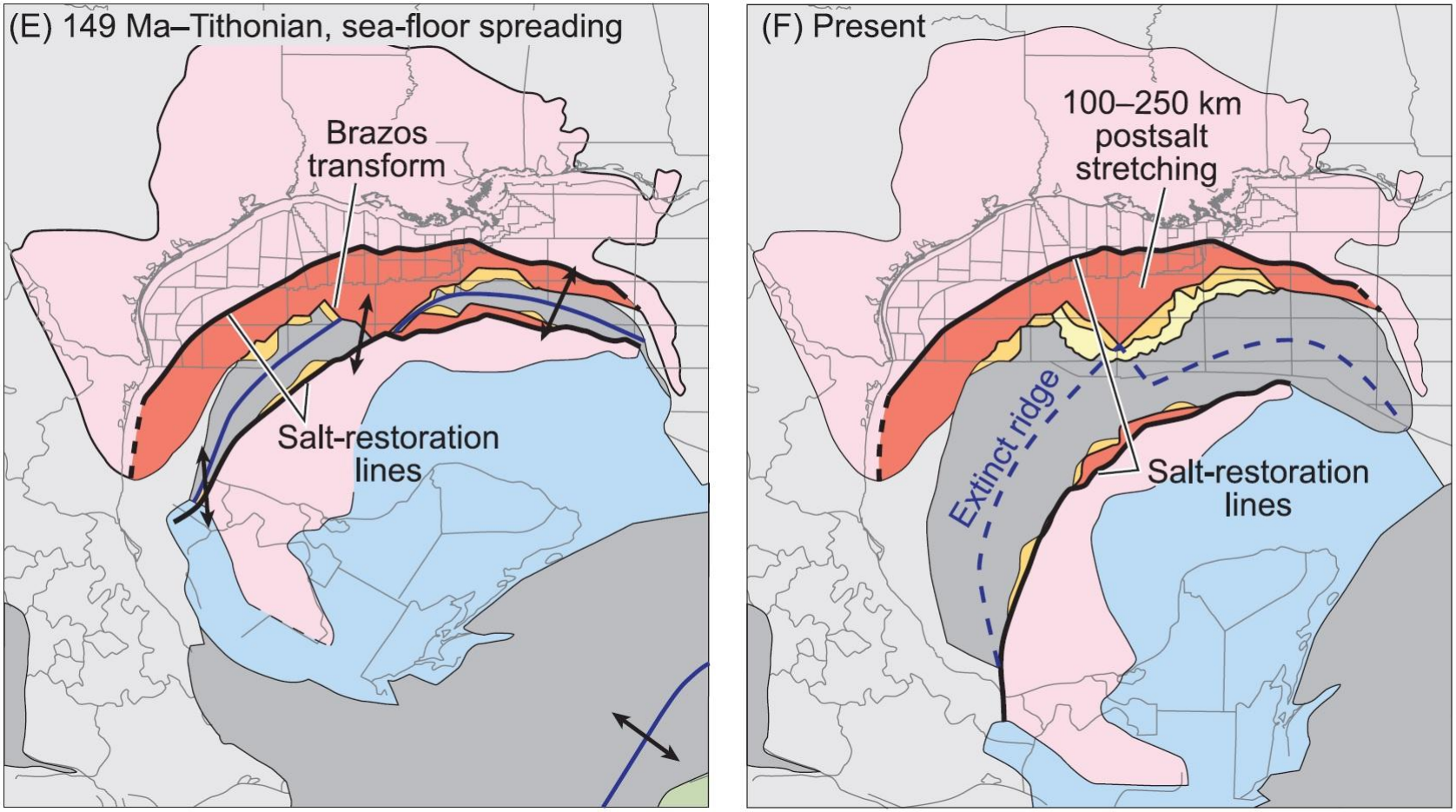
Opening of the Gulf of Mexico





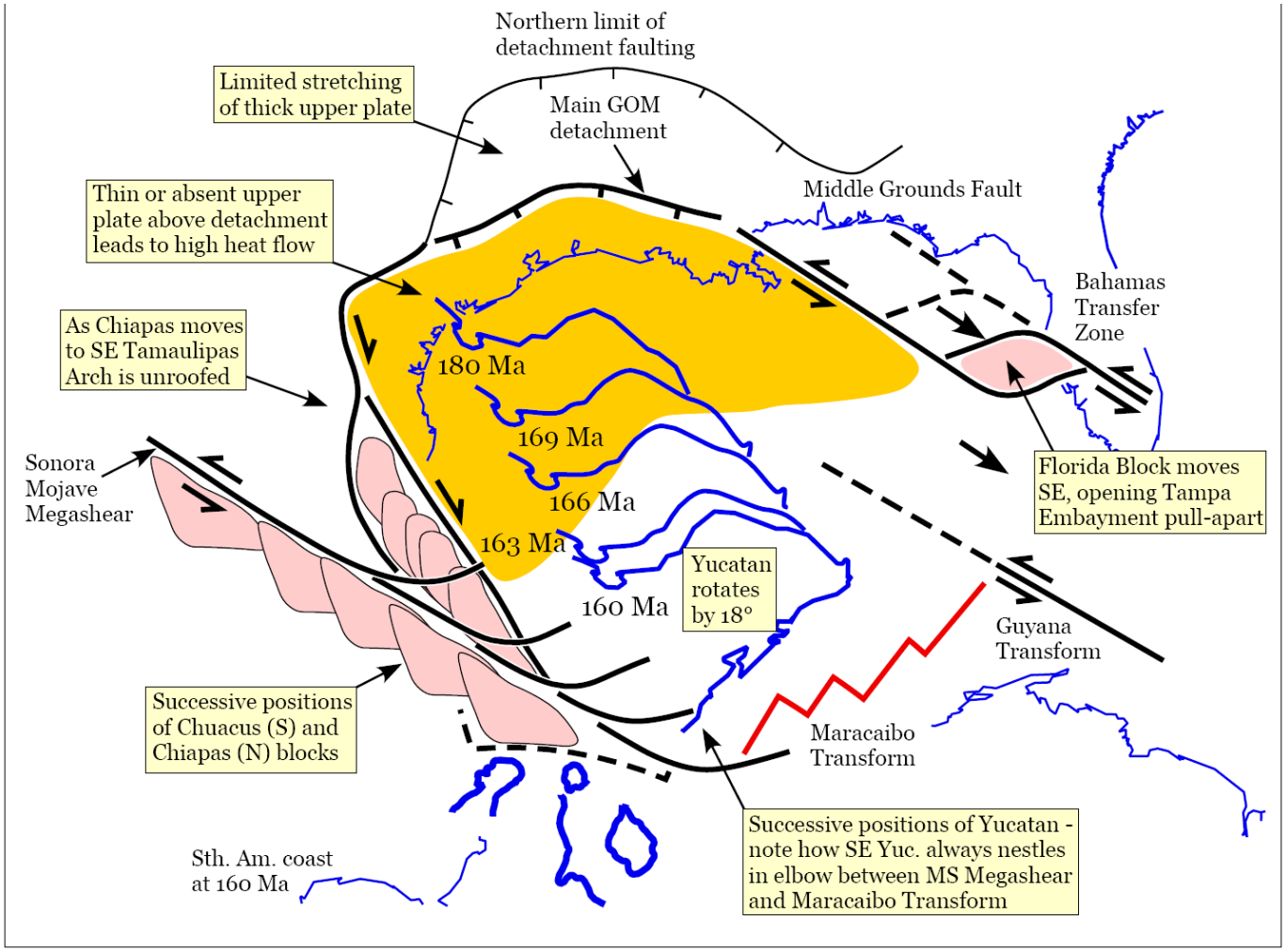
Hudec et al., 2013

Opening of the Gulf of Mexico



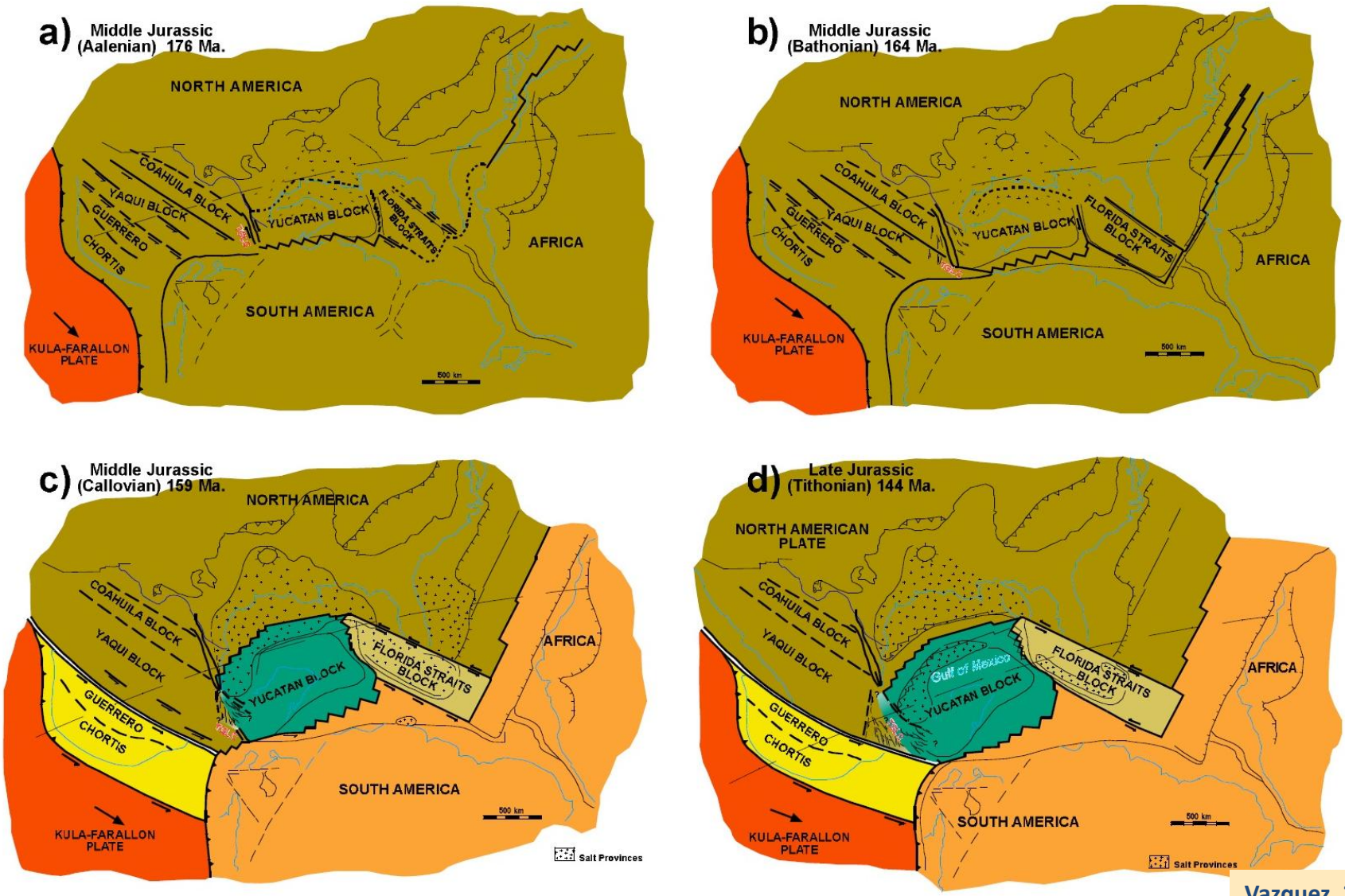
Hudec et al., 2013

Opening of the Gulf of Mexico



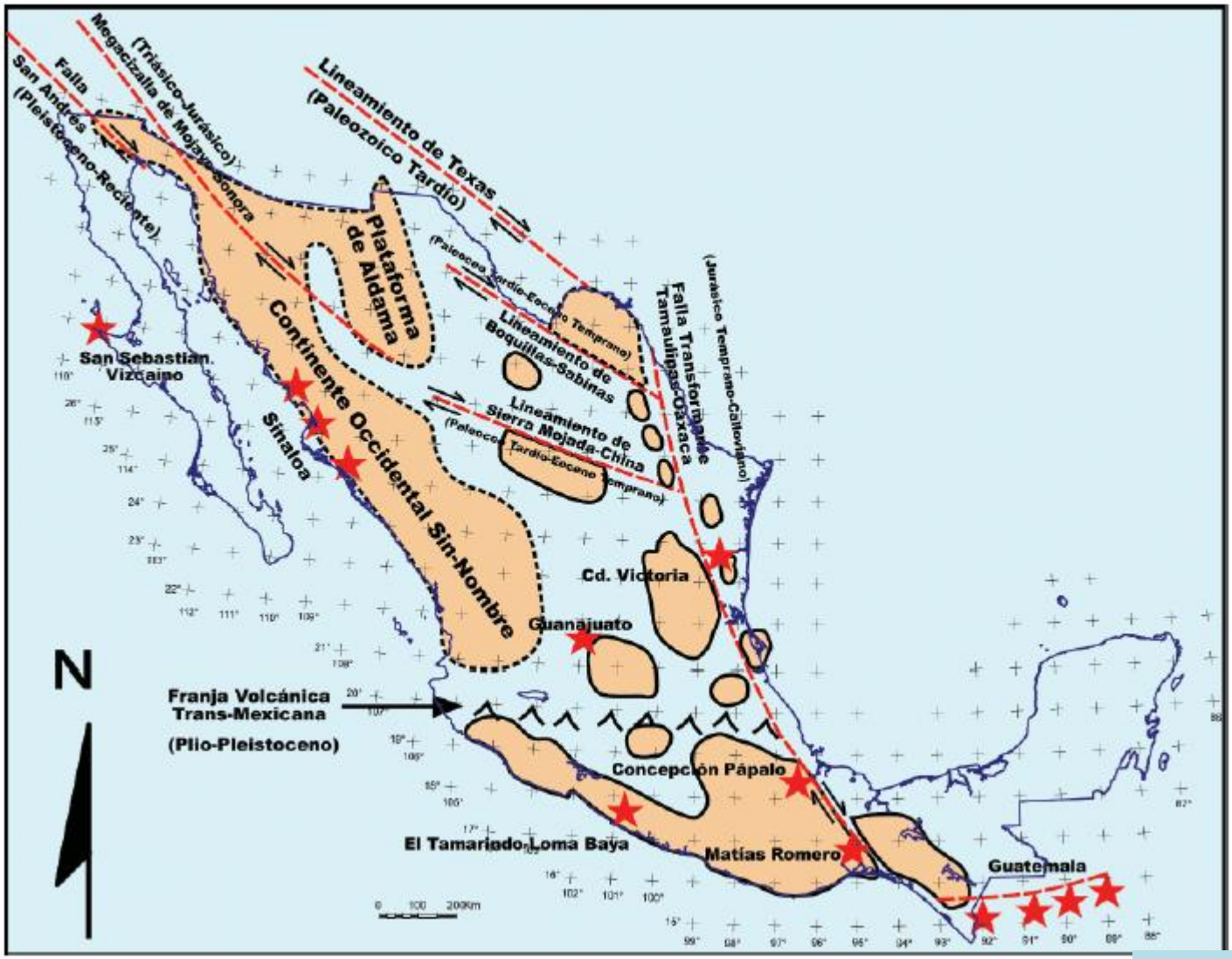
Pindell and Kennan, 2001

Opening of the Gulf of Mexico



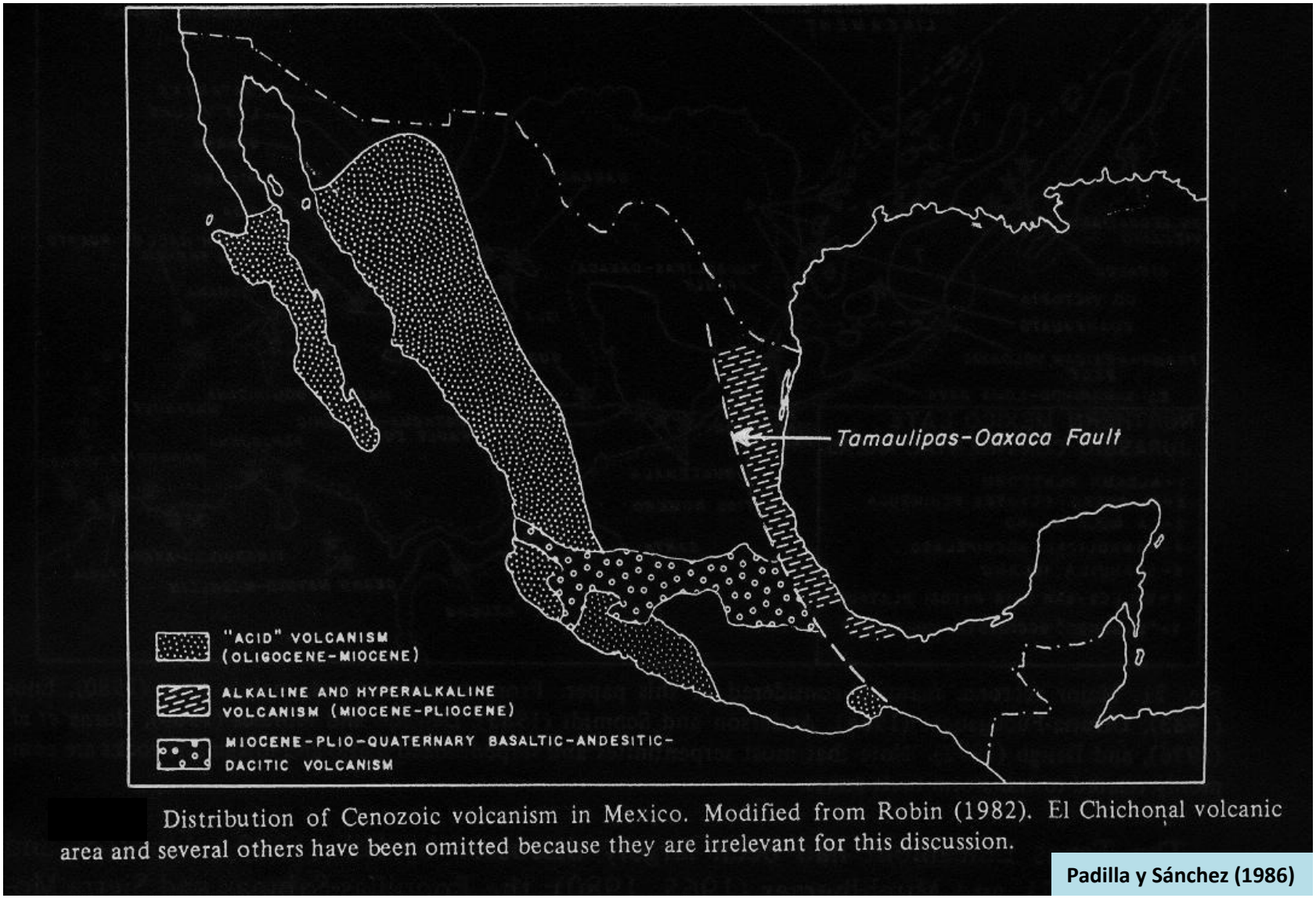
Vazquez, 2005

Mayor tectonic features of Mexico



Padilla y Sánchez, 2007

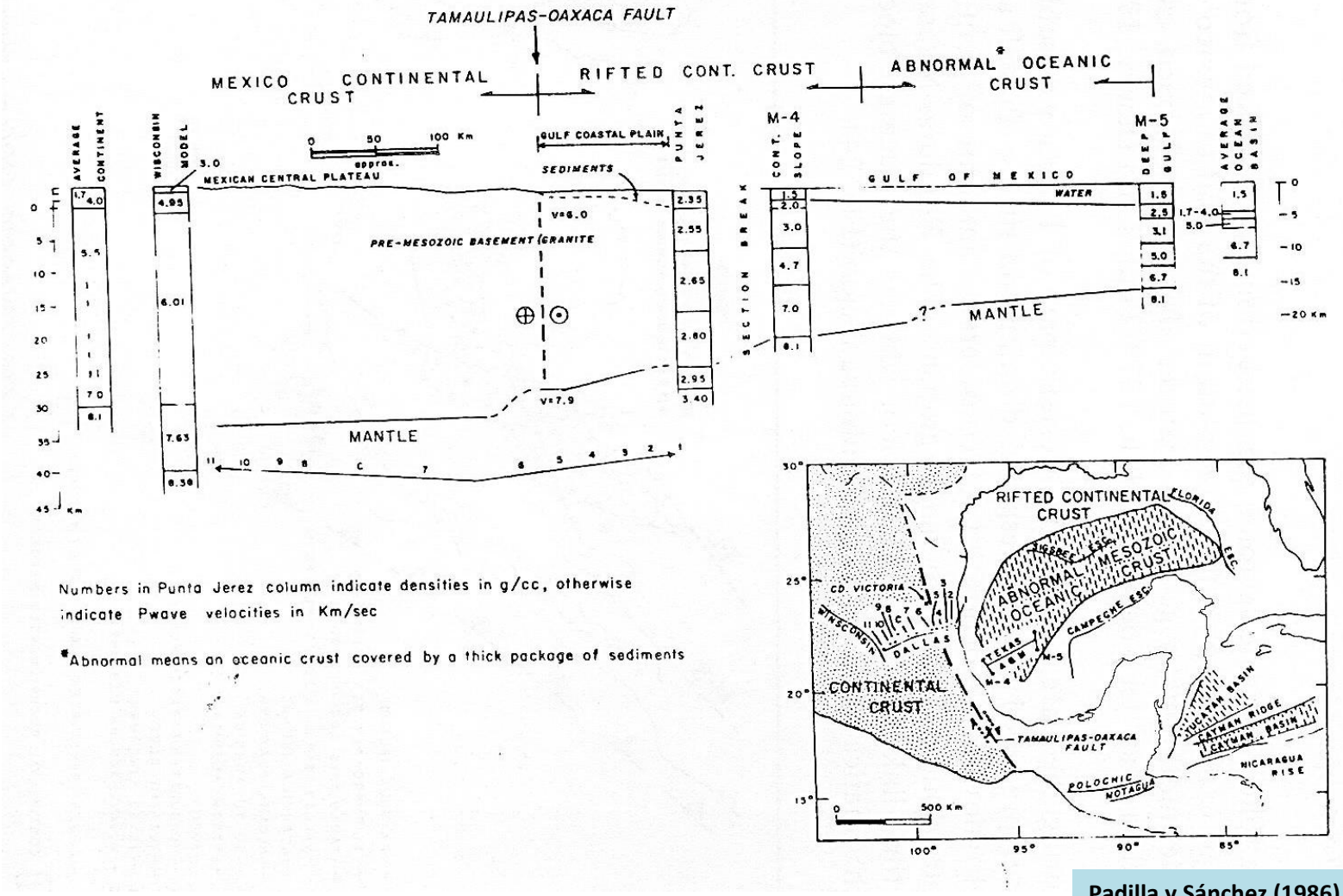
Cenozoic volcanism in Mexico



Distribution of Cenozoic volcanism in Mexico. Modified from Robin (1982). El Chichonal volcanic area and several others have been omitted because they are irrelevant for this discussion.

Padilla y Sánchez (1986)

Crustal model of eastern Mexico



Numbers in Punta Jerez column indicate densities in g/cc, otherwise indicate Pwave velocities in Km/sec

*Abnormal means an oceanic crust covered by a thick package of sediments

Padilla y Sánchez (1986)

Tamaulipas-Oaxaca Fault

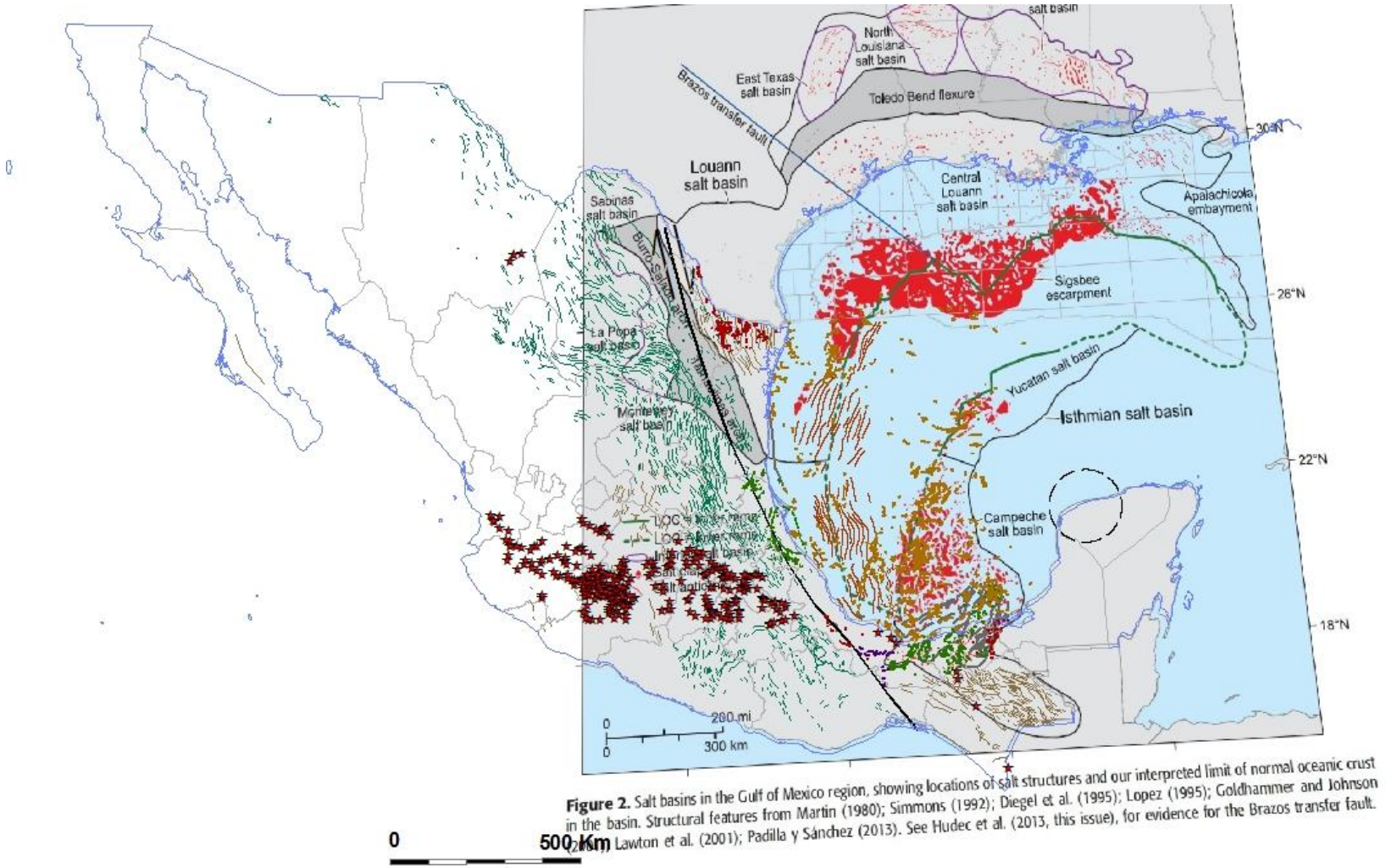
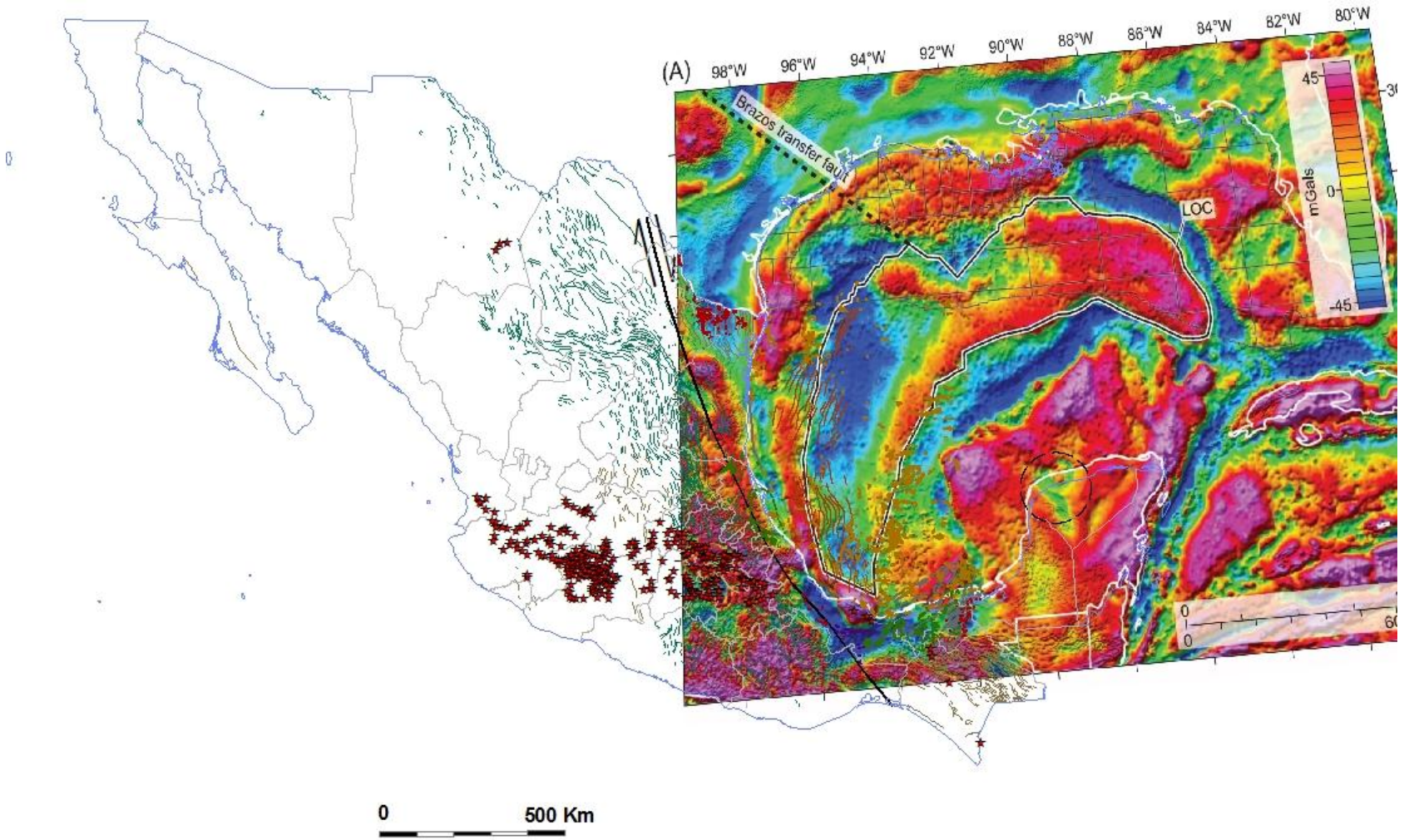


Figure 2. Salt basins in the Gulf of Mexico region, showing locations of salt structures and our interpreted limit of normal oceanic crust in the basin. Structural features from Martin (1980); Simmons (1992); Diegel et al. (1995); Lopez (1995); Goldhammer and Johnson (2001); Lawton et al. (2001); Padilla y Sánchez (2013). See Hudec et al. (2013, this issue), for evidence for the Brazos transfer fault.

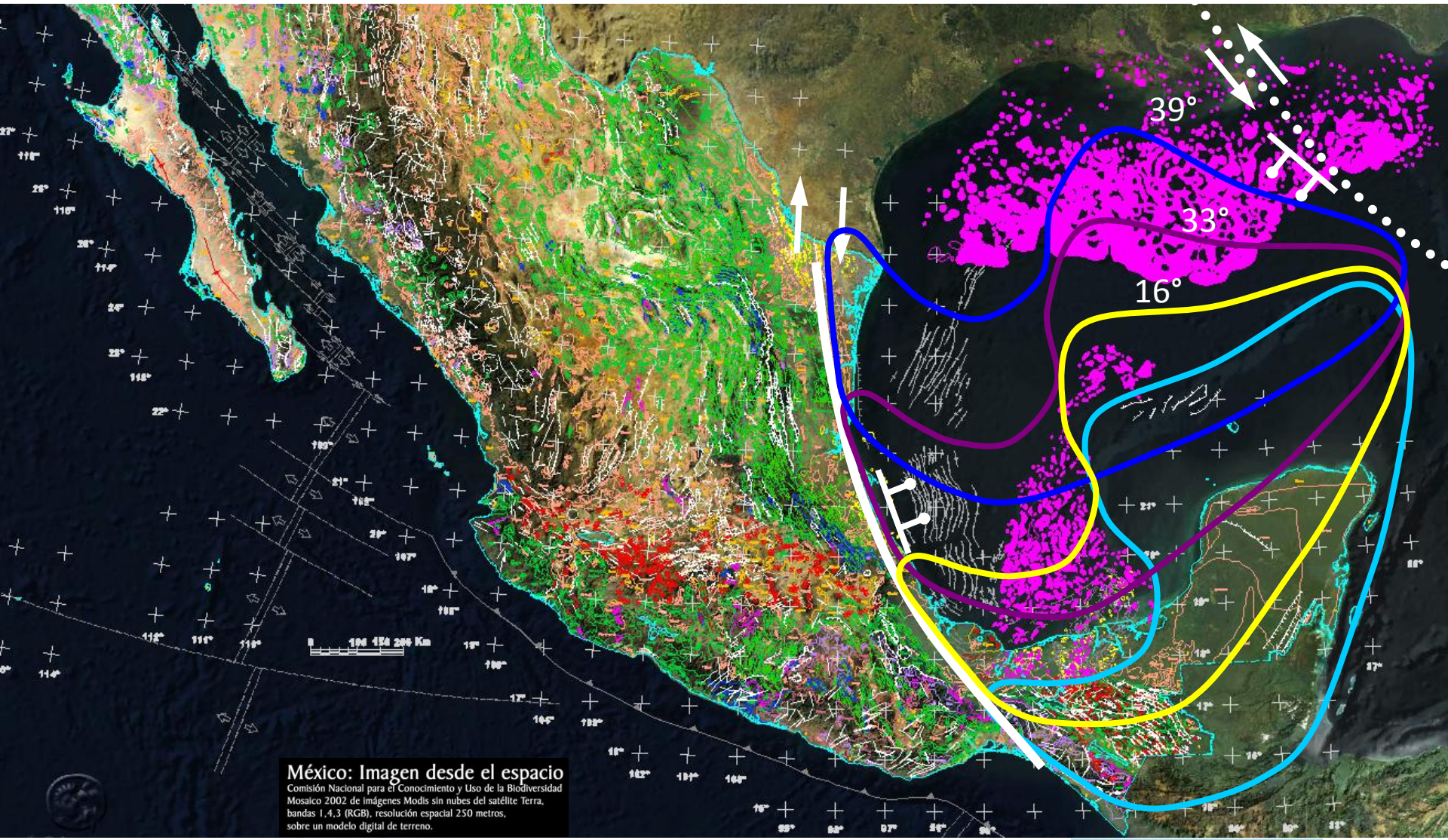
Hudec et al., 2013

Gravity Map of the GOM



Hudec et al., 2013

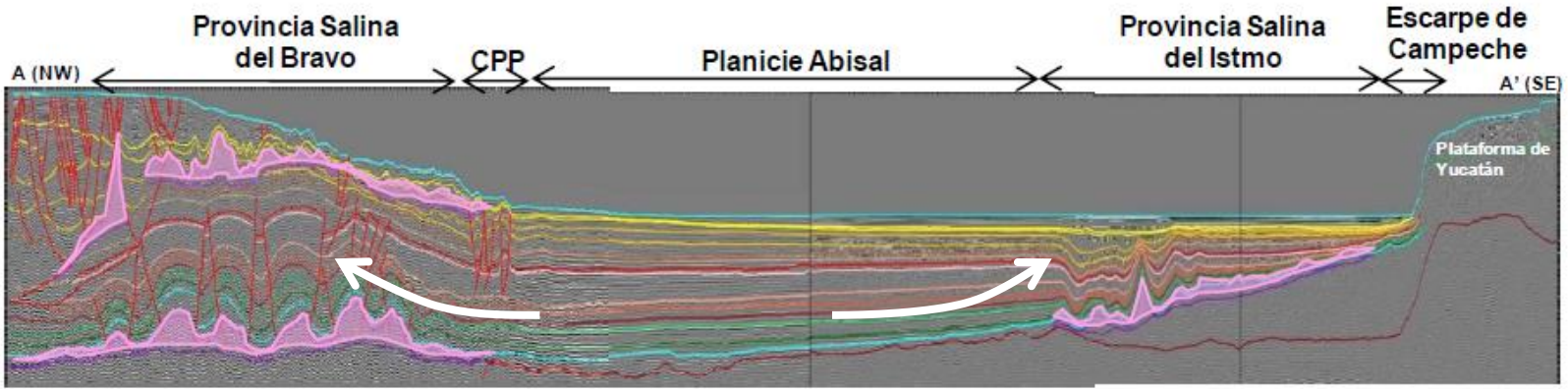
Yucatan Block path (183-164 ma)



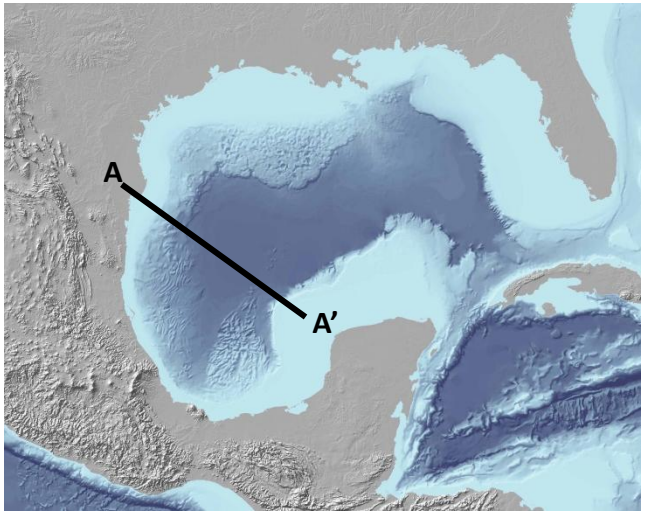
Padilla y Sánchez (1986)

5.26 cm/year = 1,000 km/19 ma

Regional migration trends



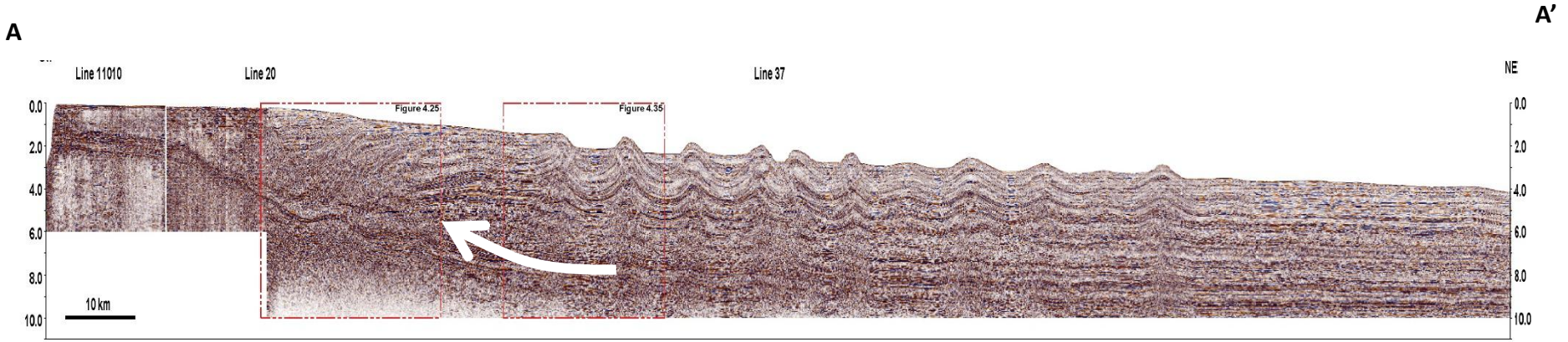
Geologic provinces of the Mexican part of the deep Gulf of Mexico. The section is an example of the structural styles of some of the provinces.

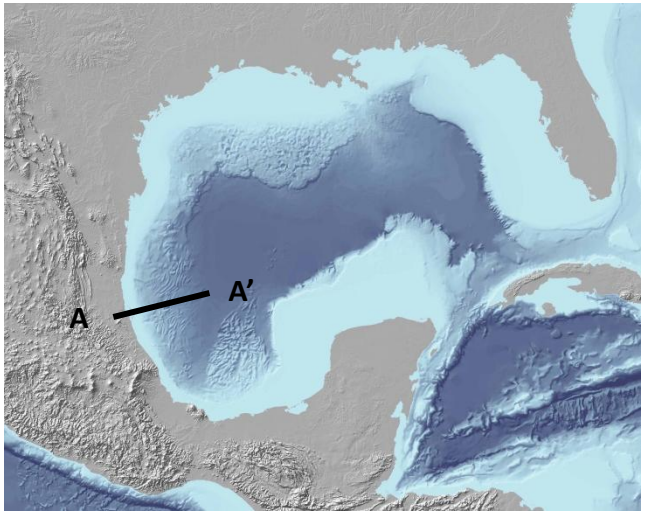


The regional migration trend for the hydrocarbons generated by these sources came most probably from east to west, from the deepest part of the Gulf of Mexico, upward to the final traps, in different times.

Escalera, 2010

Regional migration trends

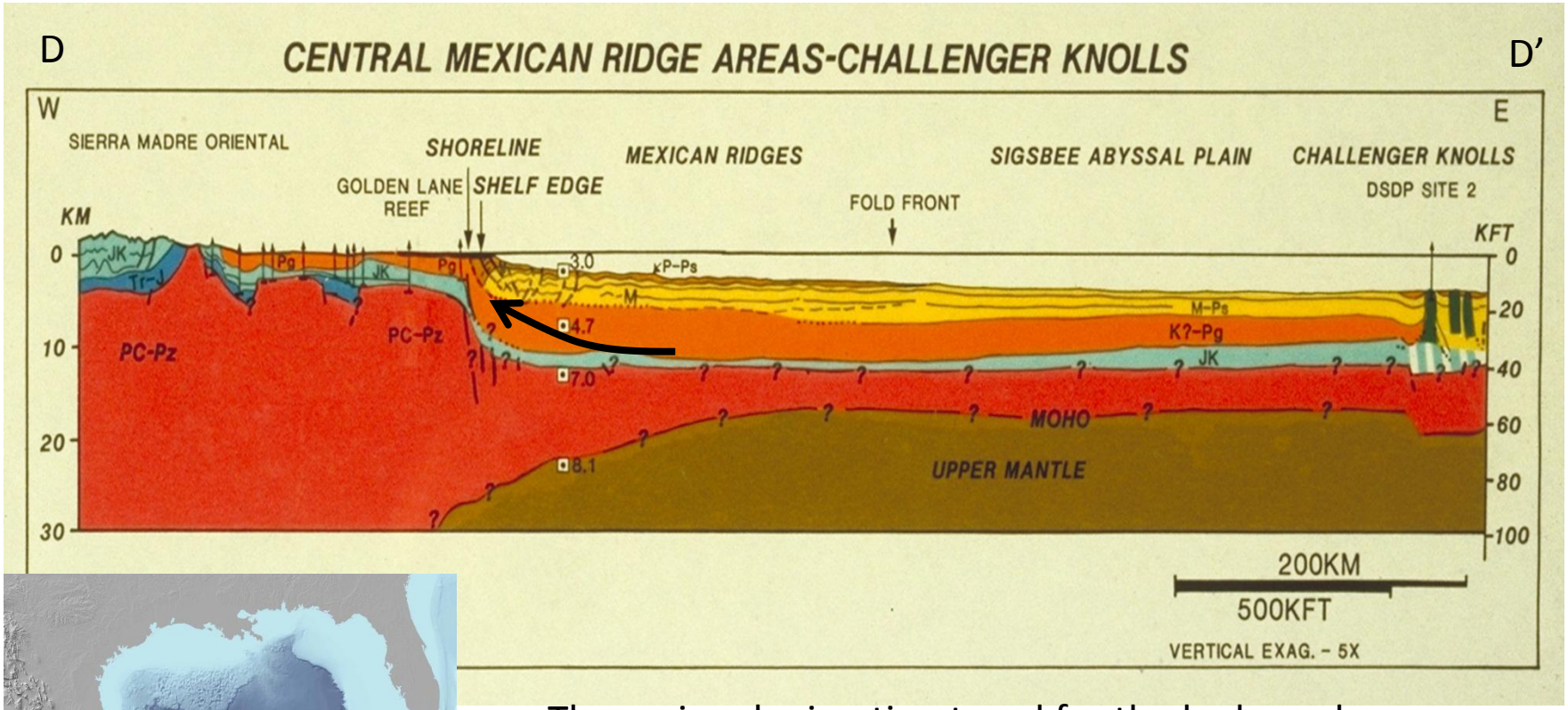


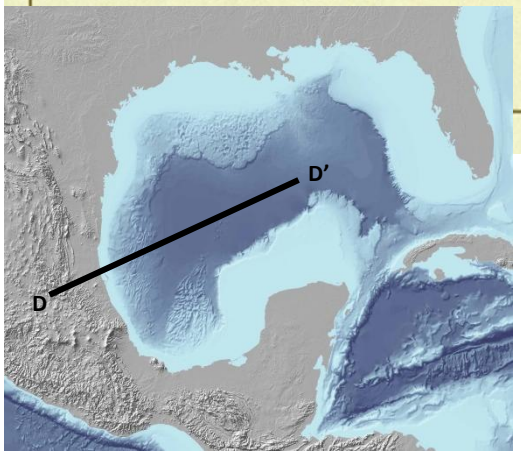


The regional migration trend for the hydrocarbons generated by these sources came most probably from east to west, from the deepest part of the Gulf of Mexico, upward to the final traps, in different times.

Vazquez, 2005

Regional migration trends





The regional migration trend for the hydrocarbons generated by these sources came most probably from east to west, from the deepest part of the Gulf of Mexico, upward to the final traps, in different times.

Bally and Tari, 2004, AAPG Winter Education Conference

Reserves in Mexico

Thousands of billions of barrels of oil equivalent						
Basin	Cum. Prod	Reserves			Prospective Resources	
		1P (90%)	2P (50%)	3P (10%)	Conv.	Unconv.
Southeast	45.4	12.1	18.0	24.4	20.1	
Tampico Misantla	6.5	1.2	7.0	17.4	2.5	34.8
Burgos	2.3	0.4	0.5	0.7	2.9	15.0
Veracruz	0.7	0.1	0.2	0.3	1.6	0.6
Sabinas	0.1	0.0	0.0	0.1	0.4	9.8
Deep waters	0.0	0.1	0.4	1.7		26.6
Yucatan plattform					0.5	
Total	**55.0**	**13.9**	**26.2**	**44.5**	**28.0**	**86.8**

Mexico's cumulative production, 1P, 2P and 3P reserves, and conventional and unconventional resources. There are more than 200 billion barrels of oil equivalent associated to the 44.5 billion boe of 3P, as the historic cumulative production is just 55 billion boe, (Source: PEMEX, 2013).

Rangel, 2014

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Thanks