EXTENSIONAL TECTONICS OF CENTRAL-NORTHERN MEXICO

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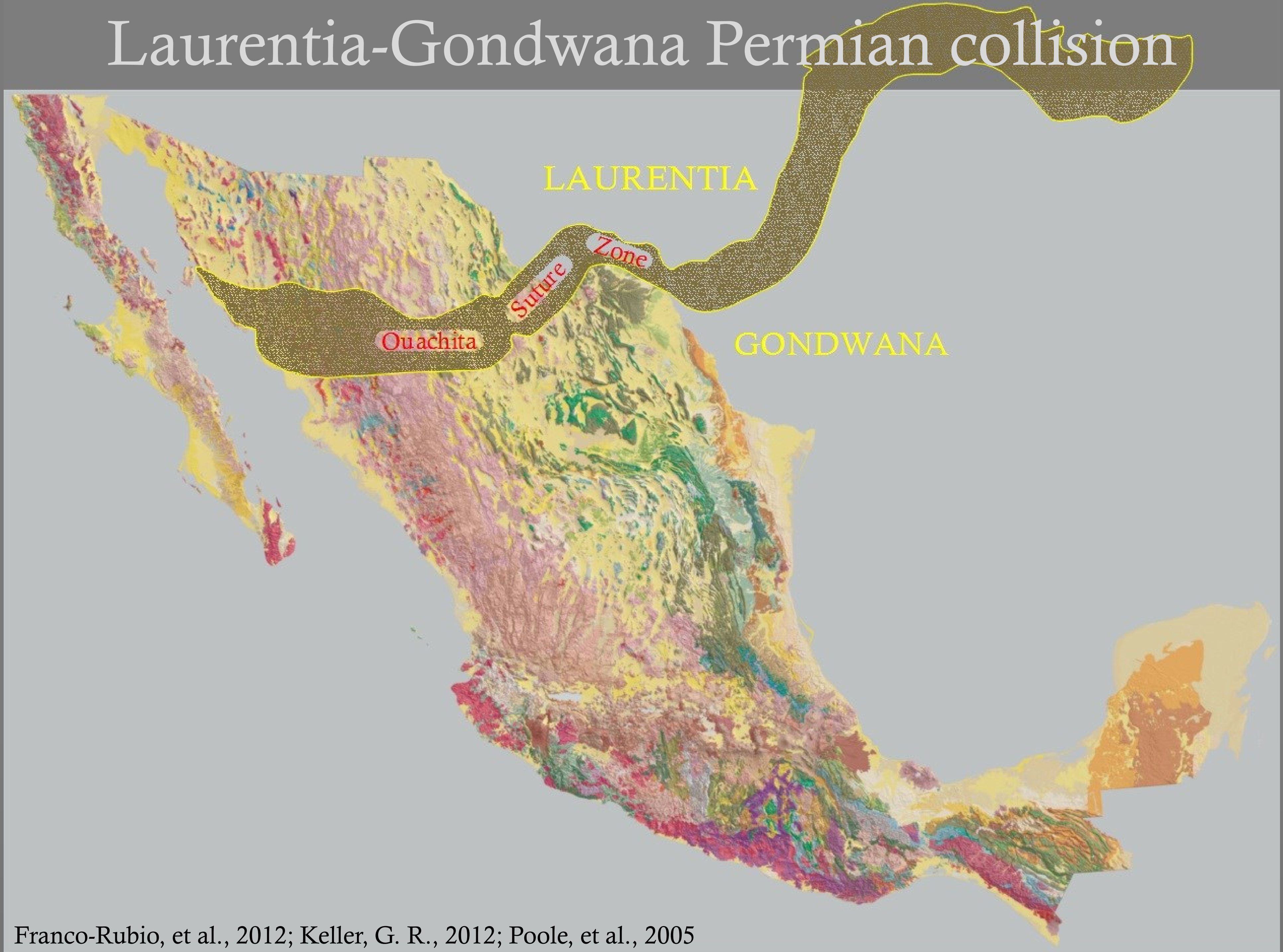
The title Extensional Tectonics of Central-Northern Mexico reflects a fraction of studies on Mexican country, which are summed up in a research sponsored by the Ministry of Education and the National Council for Science and Technology and identified with number 167638.

Tectonic evolution of Mexico

The cartography published by the Mexican Geological Service is here utilized as a special base of tectonic events reflected by lithology and structure we see in Mexico. Some of the concepts in this place expressed are new ideas to be extensively explained and discussed through papers for further publication.

Laurentia-Gondwana Permian collision

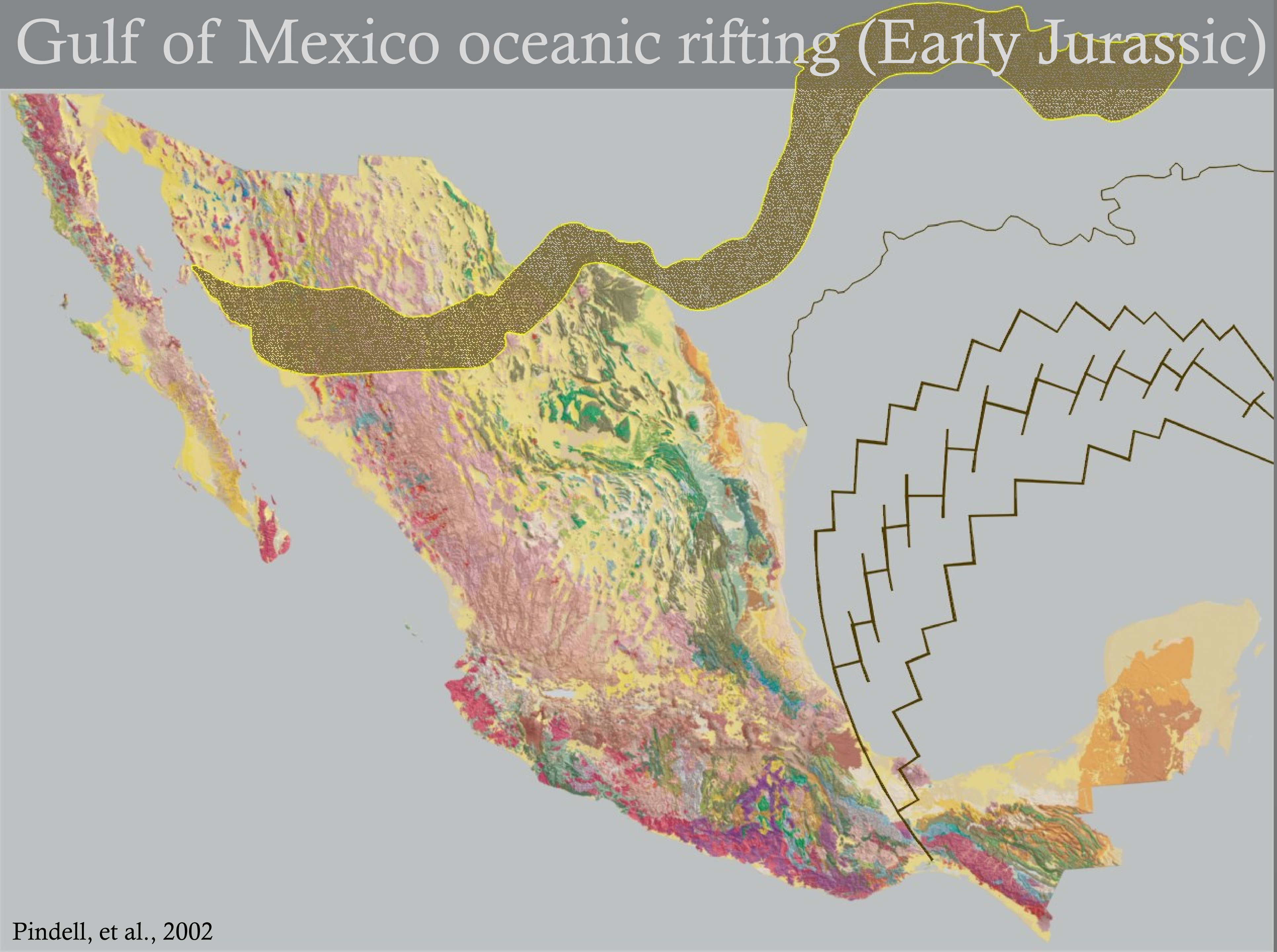


Franco-Rubio, et al., 2012; Keller, G. R., 2012; Poole, et al., 2005

A collision between Laurentia and Gondwana occurs in late Paleozoic time.

As a result, the Ouachita suture zone appears in Mexico running through the Coahuila, Chihuahua and Sonora Mexican states.

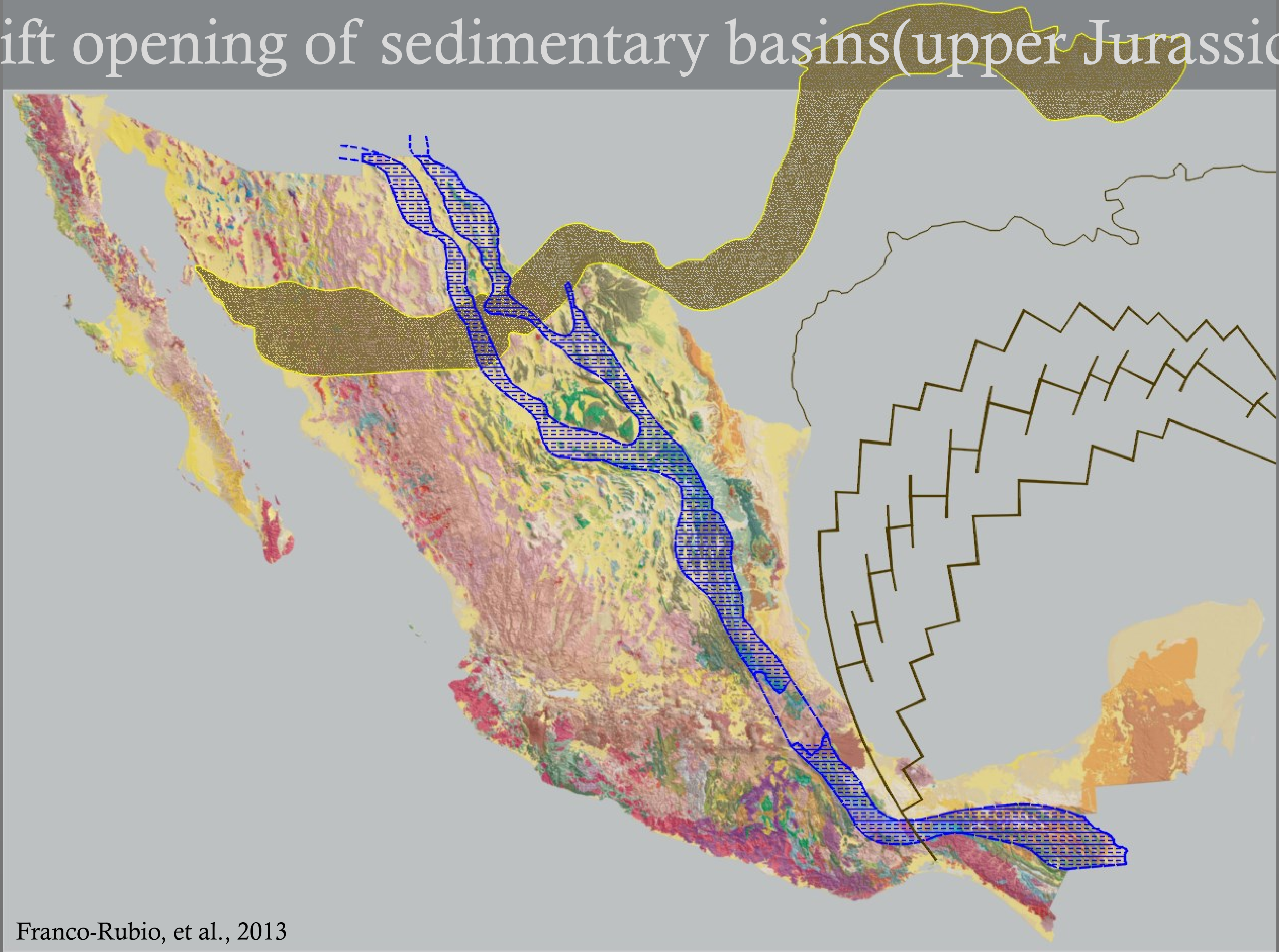
Gulf of Mexico oceanic rifting (Early Jurassic)



Pindell, et al., 2002

The breakup of Pangea opened the Gulf of Mexico since Early Jurassic times, separating the Maya block.

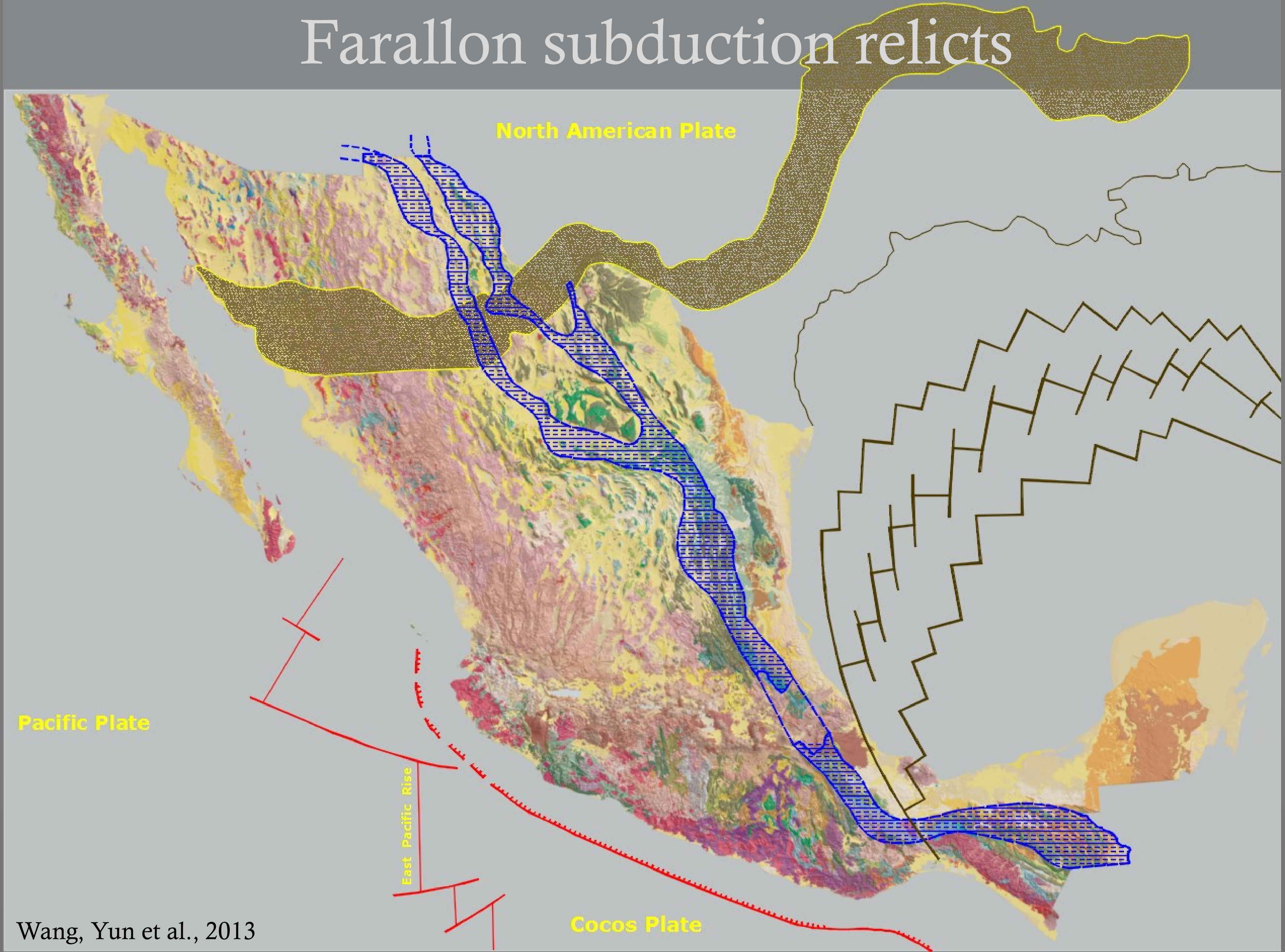
Rift opening of sedimentary basins(upper Jurassic)



Franco-Rubio, et al., 2013

Under the continental rift model, the easterly sedimentary basins from México were opened since Oxfordian time. By this way, those basins like Sierra Madre Del Sur, Sierra Madre Oriental, Mexican Sea, Sabinas, Central Chihuahua, Eastern Chihuahua and Intermedia were created.

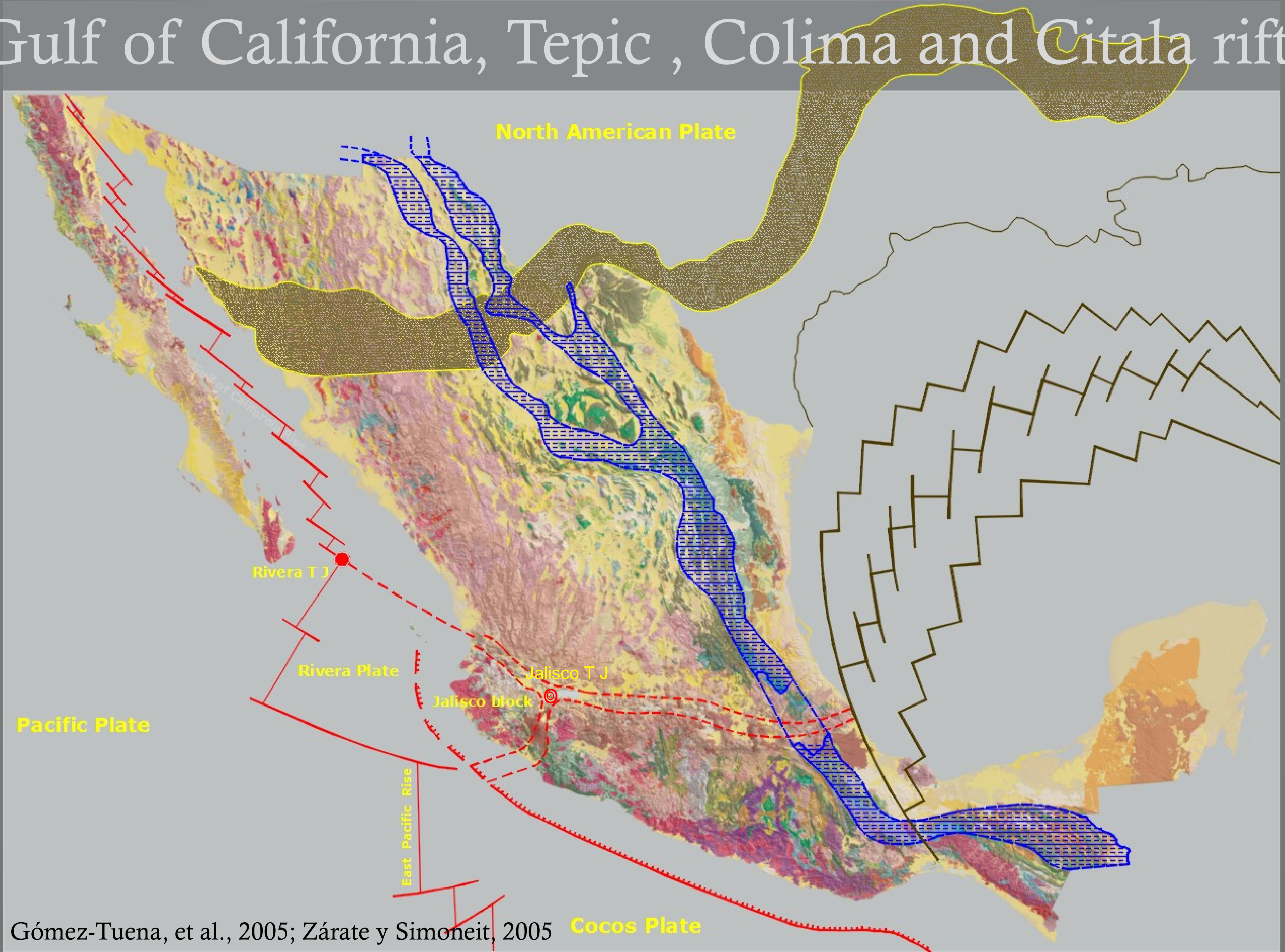
Farallon subduction relicts



Wang, Yun et al., 2013

To the west, remnants of the Farallon Plate, as the Cocos plate, applied and still are addressing compressive stresses to the North American Plate by subduction. Between the Mendocino and the Rivera triple junctions, lateral movements are activated by transform - transcurrent faults.

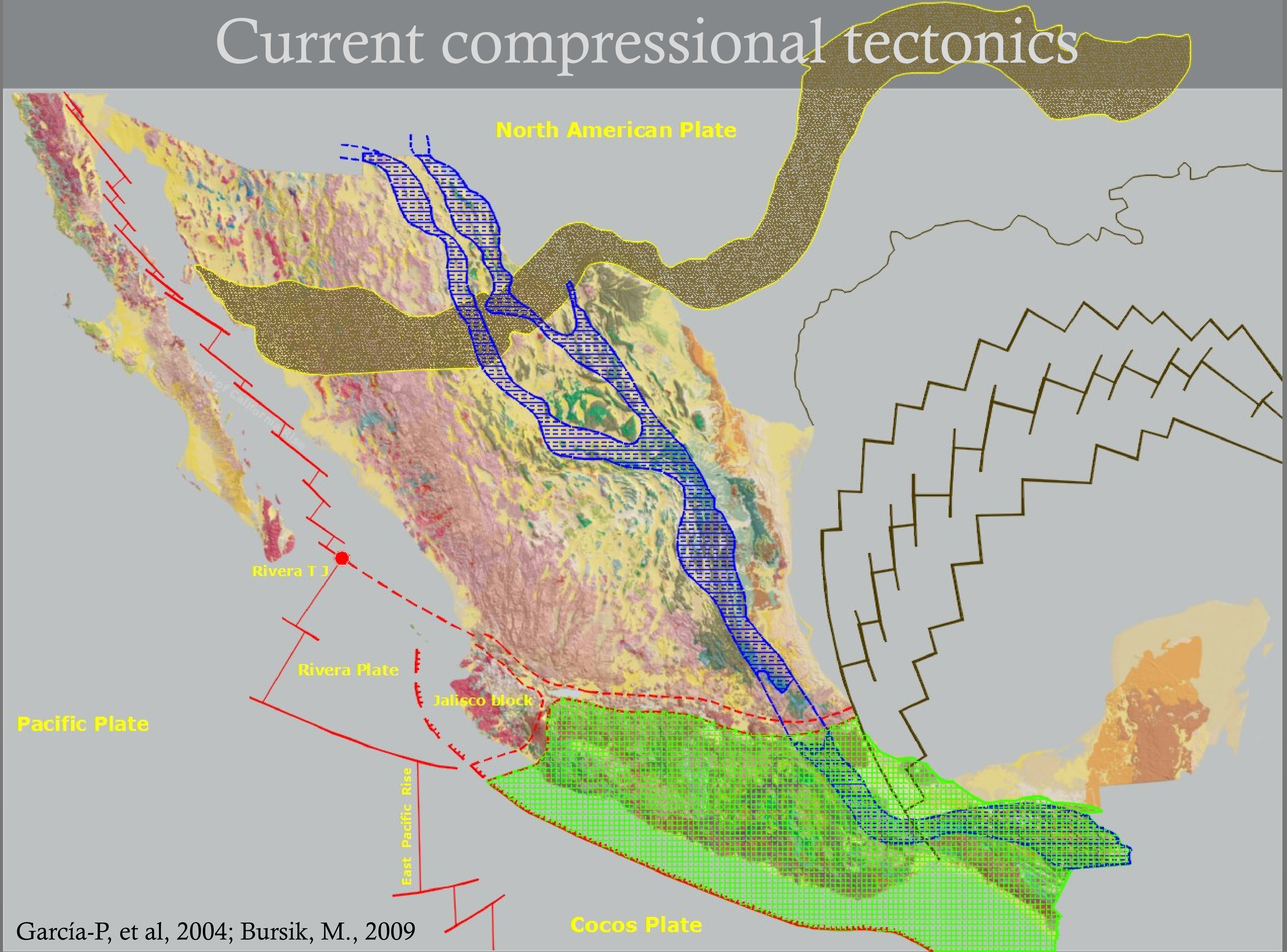
Gulf of California, Tepic , Colima and Citala rifts



Gómez-Tuena, et al., 2005; Zárate y Simoneit, 2005

Breakup of the North American Plate from Neogene to Recent times, incorporates Baja California to the Pacific Plate by oceanic rifting, and developing the Gulf of California Rise. Current opening of the Tepic, the Colima and the Citala continental rifts are restricted by the applied compression scheme of the Rivera and the Cocos plate's subductions.

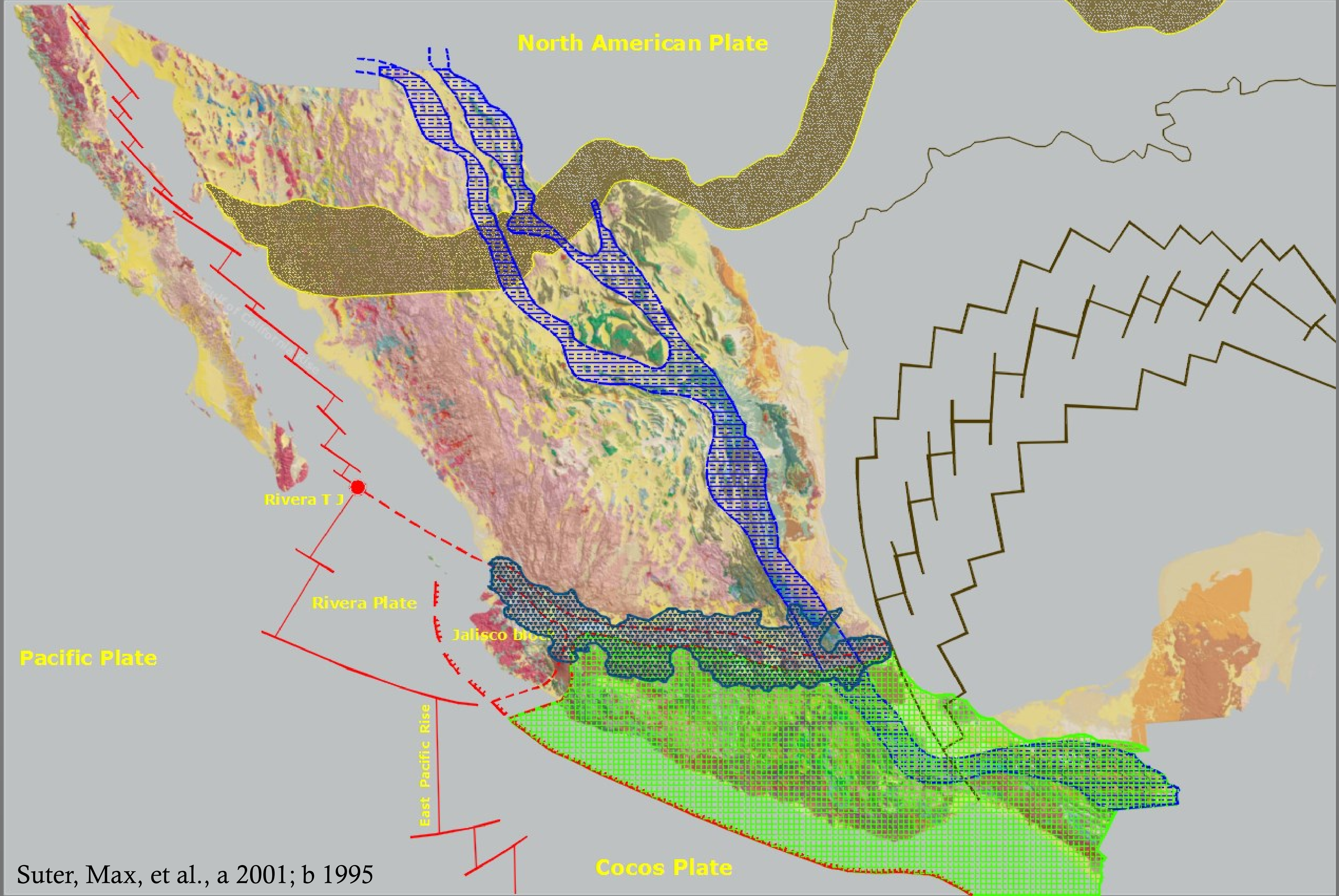
Current compressional tectonics



García-P, et al, 2004; Bursik, M., 2009

South of the Colima and the Citala continental rifts, compressive stresses activated by the Cocos Plate subduction characterizes this southern Mexican region. That tectonic mechanism generates the Mexican Volcanic Arc, whose main representatives are the Nevado de Colima, the Iztacihuatl, the Popocatepetl, the Malintzin, the Xinantecatl, the Chichonal, and some others.

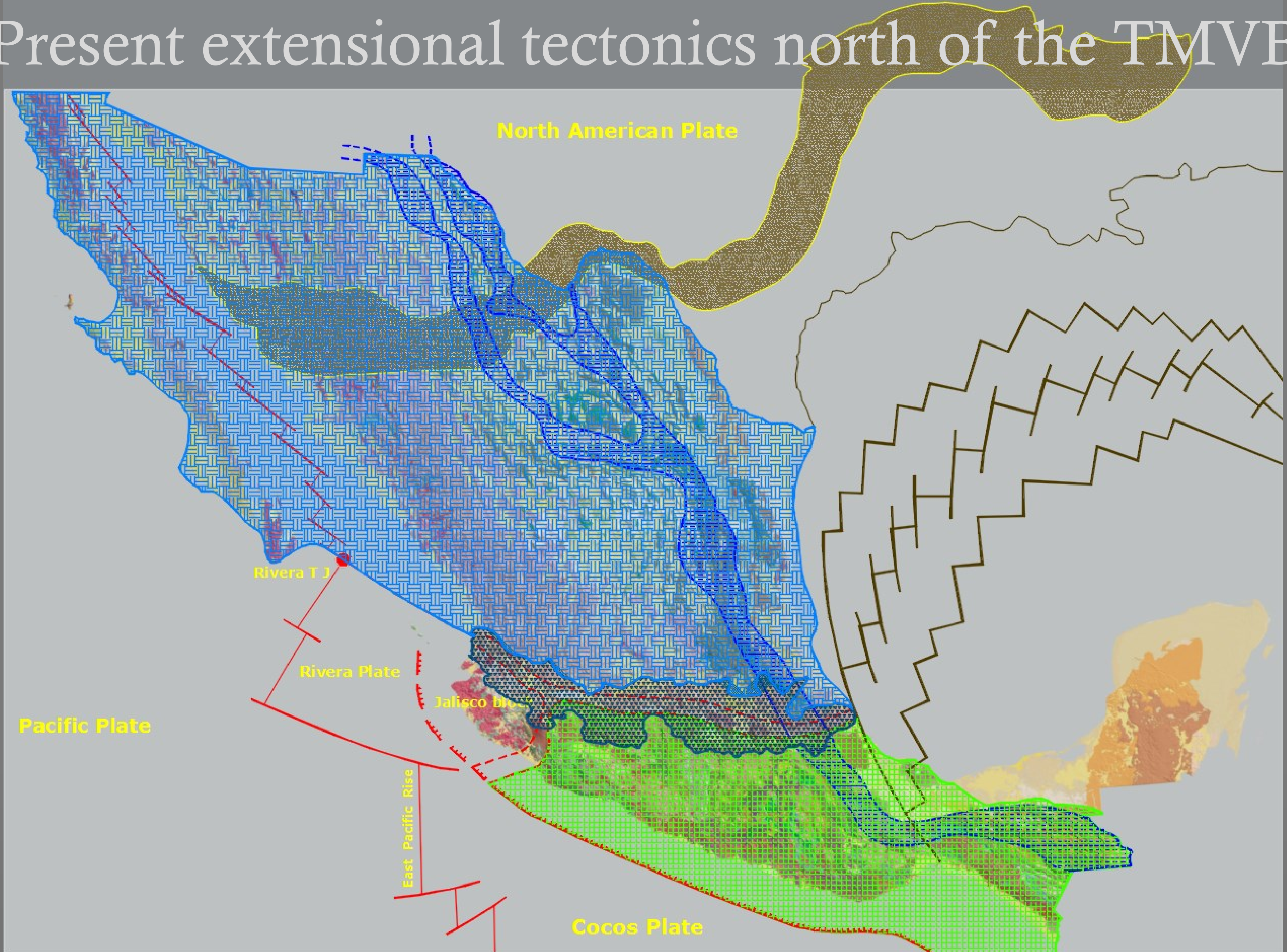
The Transmexican Volcanic Belt (TMVB)



Suter, Max, et al., a 2001; b 1995

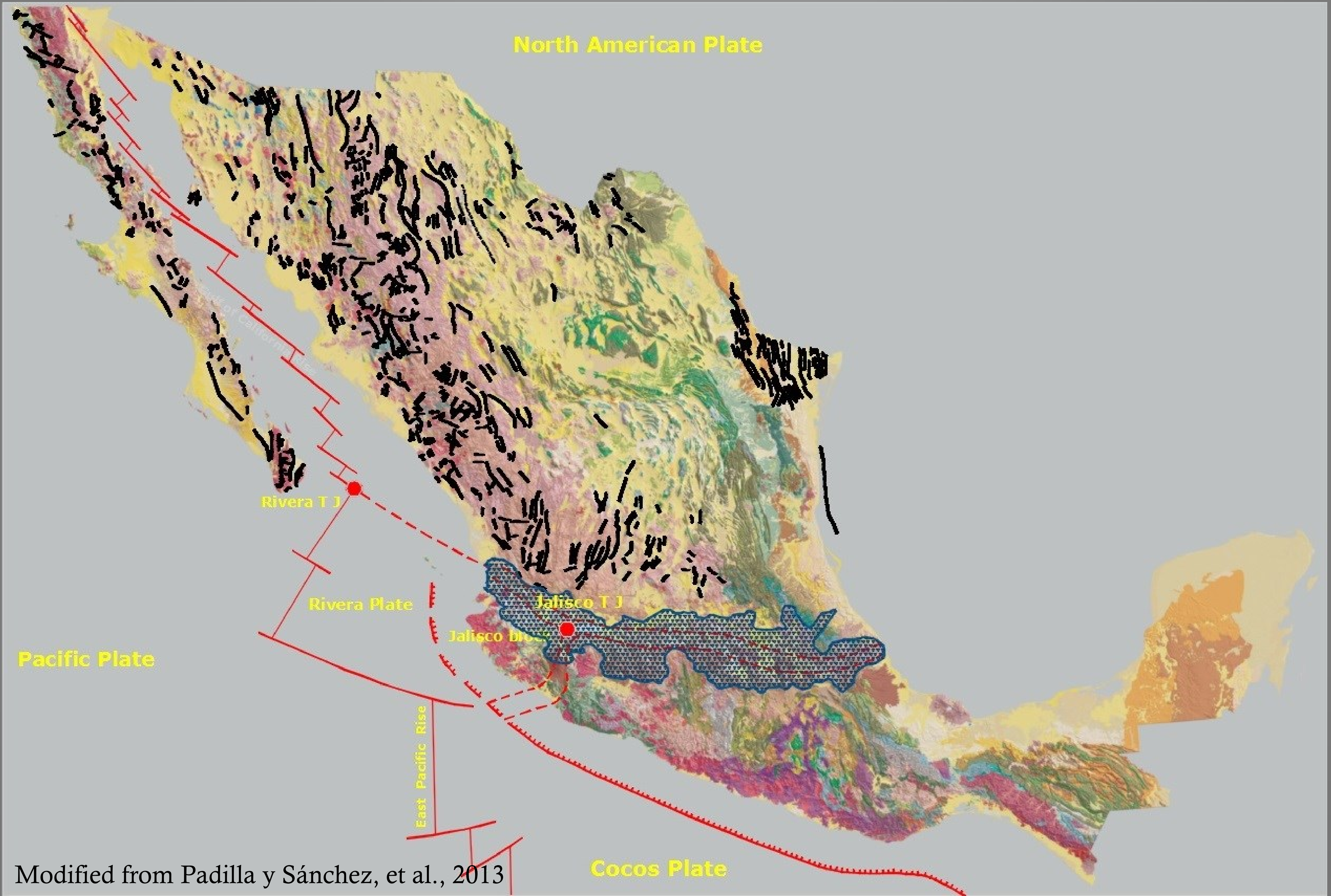
The Trans-Mexican Volcanic Belt is a chain of volcanoes located in south-central Mexico, and crossing near the 19th parallel of north latitude. Particularly important is the modern emergence of the Paricutin Cinder Volcano .

Present extensional tectonics north of the TMVB



Extensional tectonics is affecting the entire central and northern Mexican region, which is of importance to exhibit normal faulting, earthquakes, volcanic-cinder structures and geothermal anomalies.

Normal faults north of the TMVB



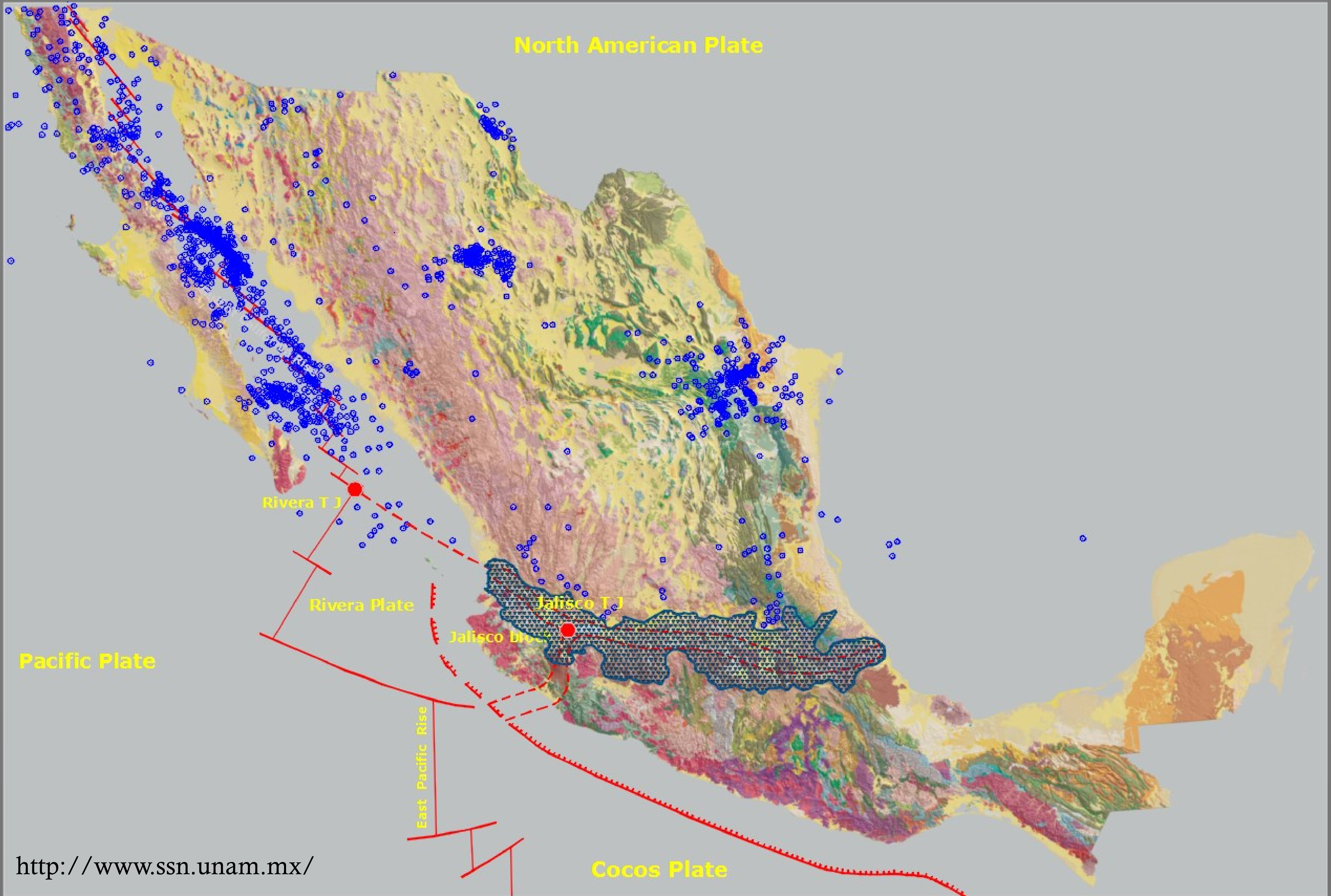
Modified from Padilla y Sánchez, et al., 2013

As a result of the Baja California Peninsula break up, normal faults of NW-SE strike are the dominant structure of the Sonoran Desert, Sierra Madre Occidental, Basin and Range, Central Plateau and Sierra Madre Oriental physiographic provinces.

Cracks on alluvial valleys cutting dirt roads

Normal faults, that bound crustal tilted blocks, are also evident in the valleys where the alluvial cover is regularly affected by cracks reaching the surface. Right side photograph was taken 30 years ago.

Seismic epicentres north of the TMVB



Seismic epicentres registered in central and northern regions of Mexico, presumably were caused by block crustal movements, which are tilted along normal faults. This tilting is observed in response to detachment of the Baja California Peninsula by accretion activity of the Gulf of California Rise.

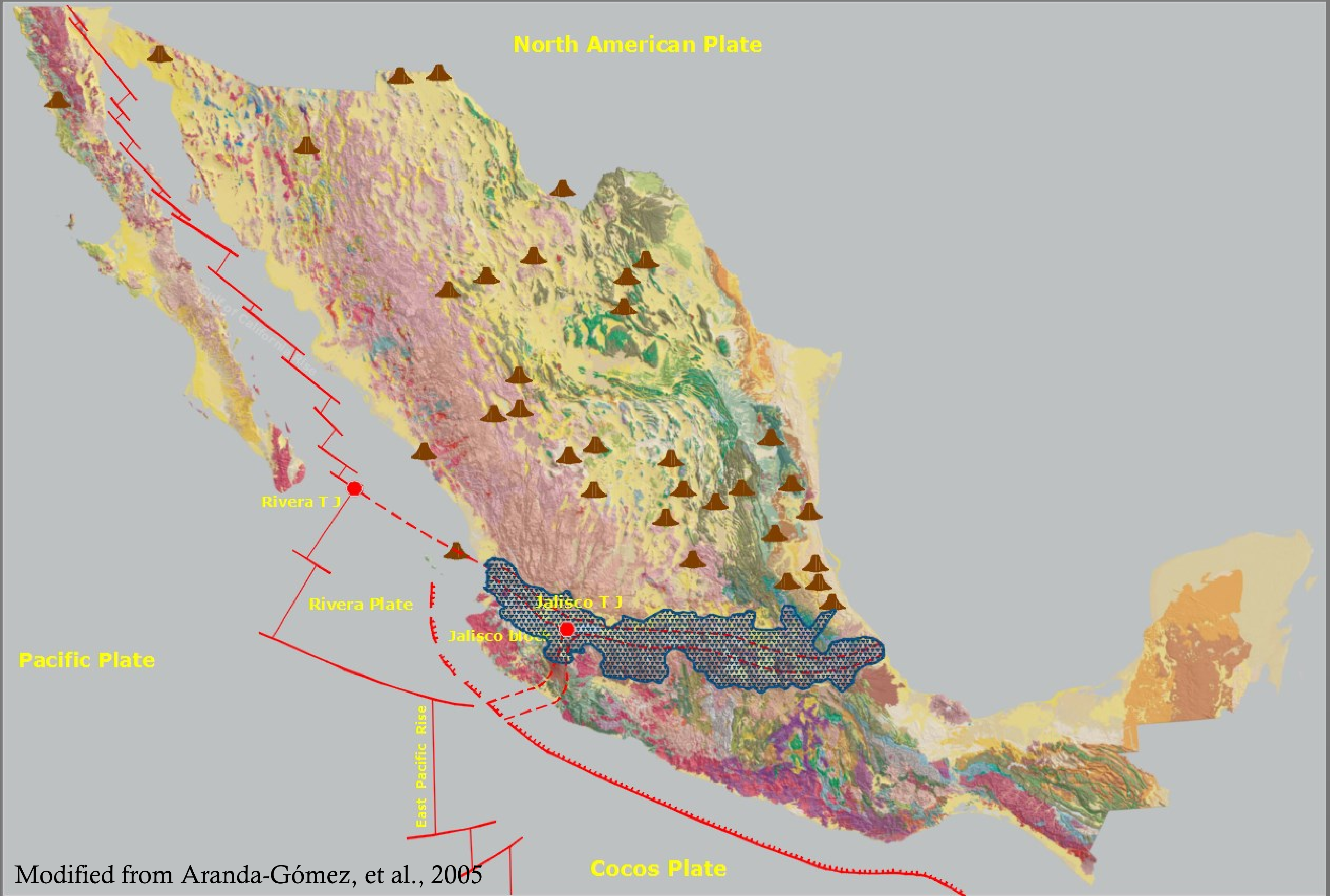
Tilted blocks of continental crust

Northeast dipping Churuguayvo tilted block

Southwest dipping Santa Eulalia tilted block

In this region of the North American Plate, continental crust displacements are related with tilted blocks bounded by steep dipping normal faults. Despite most blocks-fault are dipping from the northeastern to the eastern direction, there exist a few crustal blocks with opposing- and no-tilting direction. The most Cenozoic tuff and ignimbrite pseudo strata, as well as lacustrine beds are confident elements for measuring angular inclination of tilted blocks.

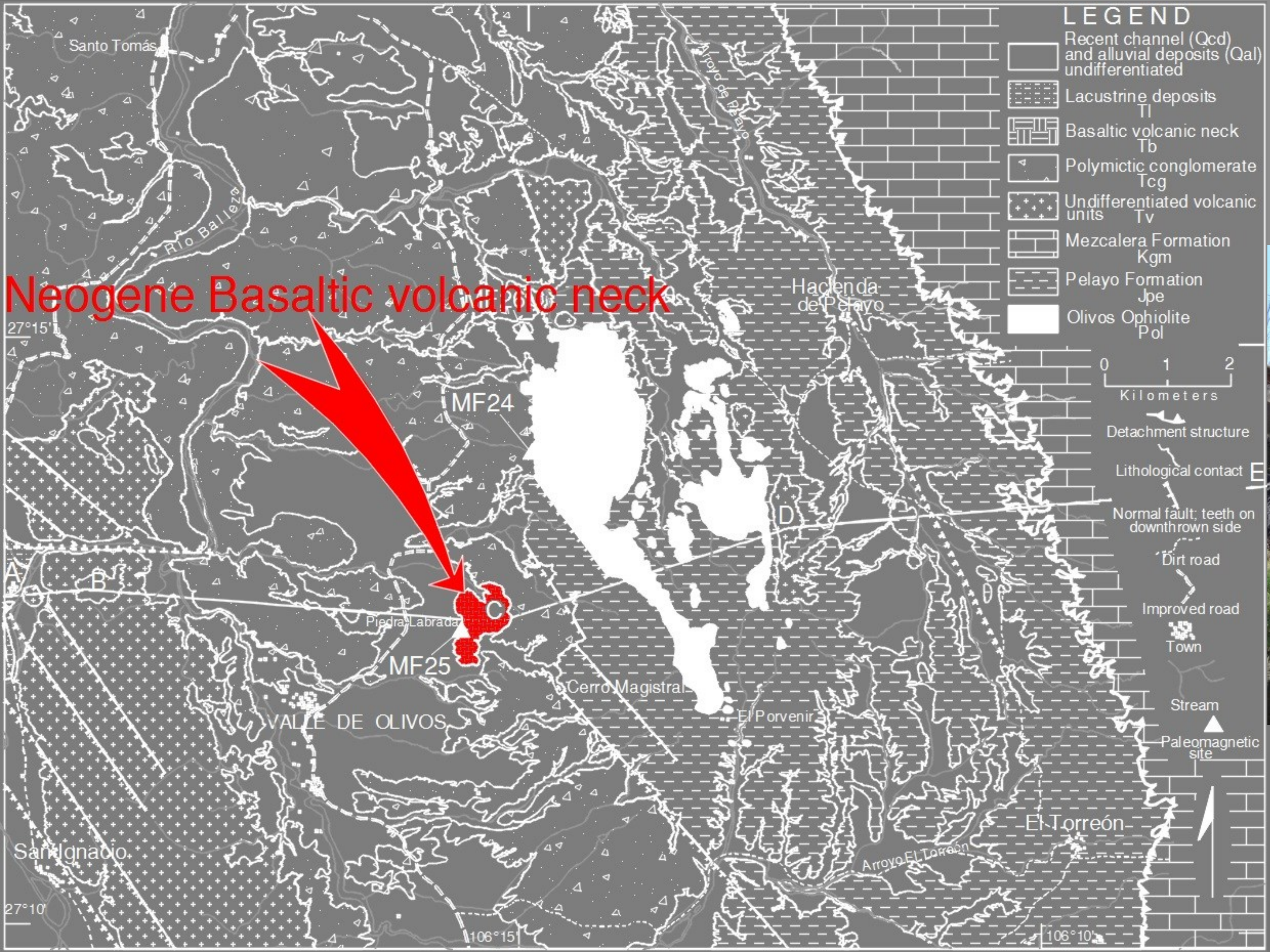
Cinder volcanic structures north of the TMVB



Modified from Aranda-Gómez, et al., 2005

In central and northern regions of Mexico, cinder volcanic structures like necks, cones, and dikes, are associated with areas of normal faulting that limit tilted crustal blocks.

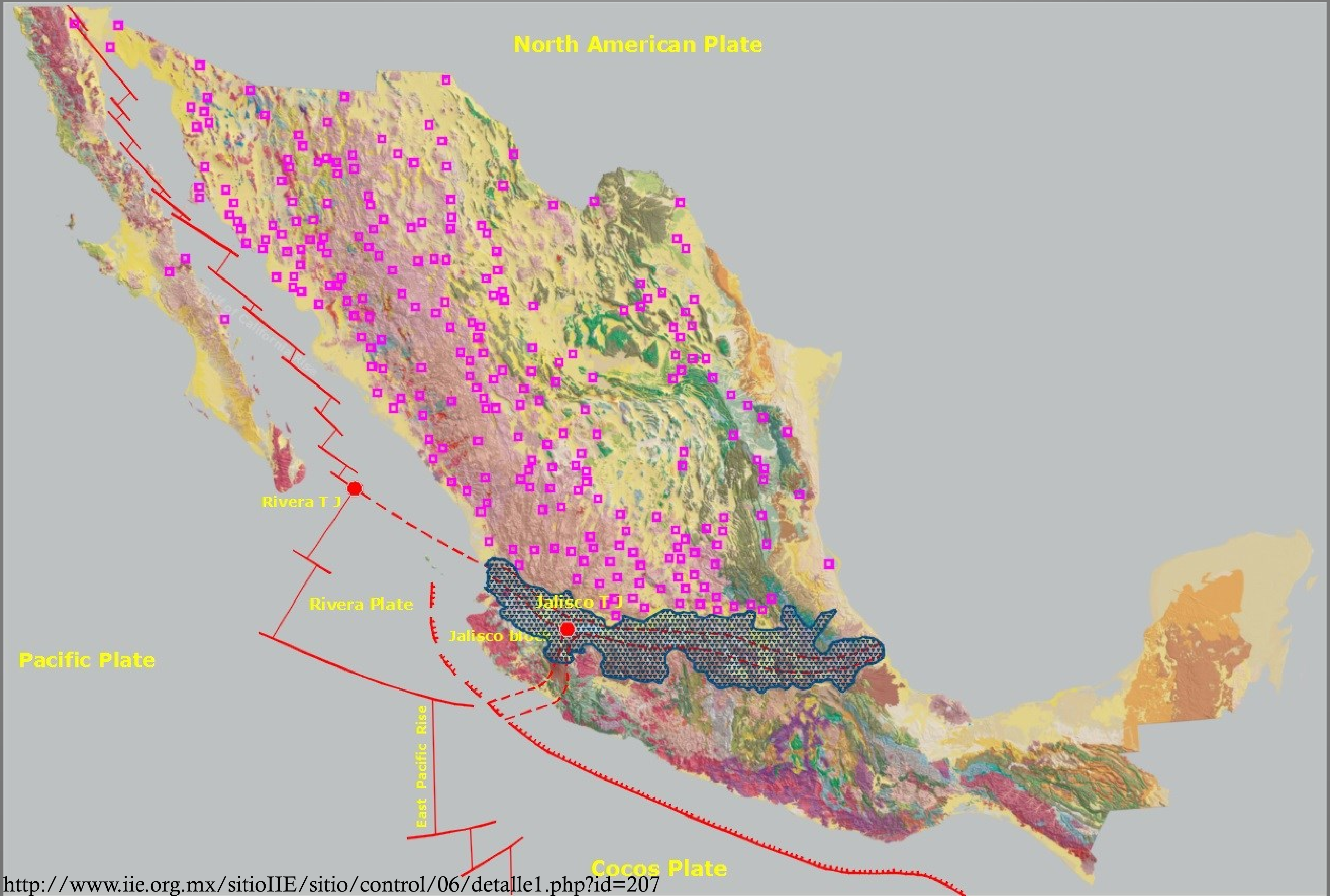
Olivos volcanic neck



Franco-Rubio, et al., 2007

As an example, inside Valle-de-Olivos area, south of the Mexican State of Chihuahua, there is a Neogene volcanic-neck basalt associated with normal faults, limiting the tilted Sierra-de-Olivos range, which contains oceanic crust olistostromes of 257 Ma.

Geothermal anomalies north of the TMVB



http://www.iie.org.mx/sitioIIE/sitio/control/06/detalle1.php?id=207

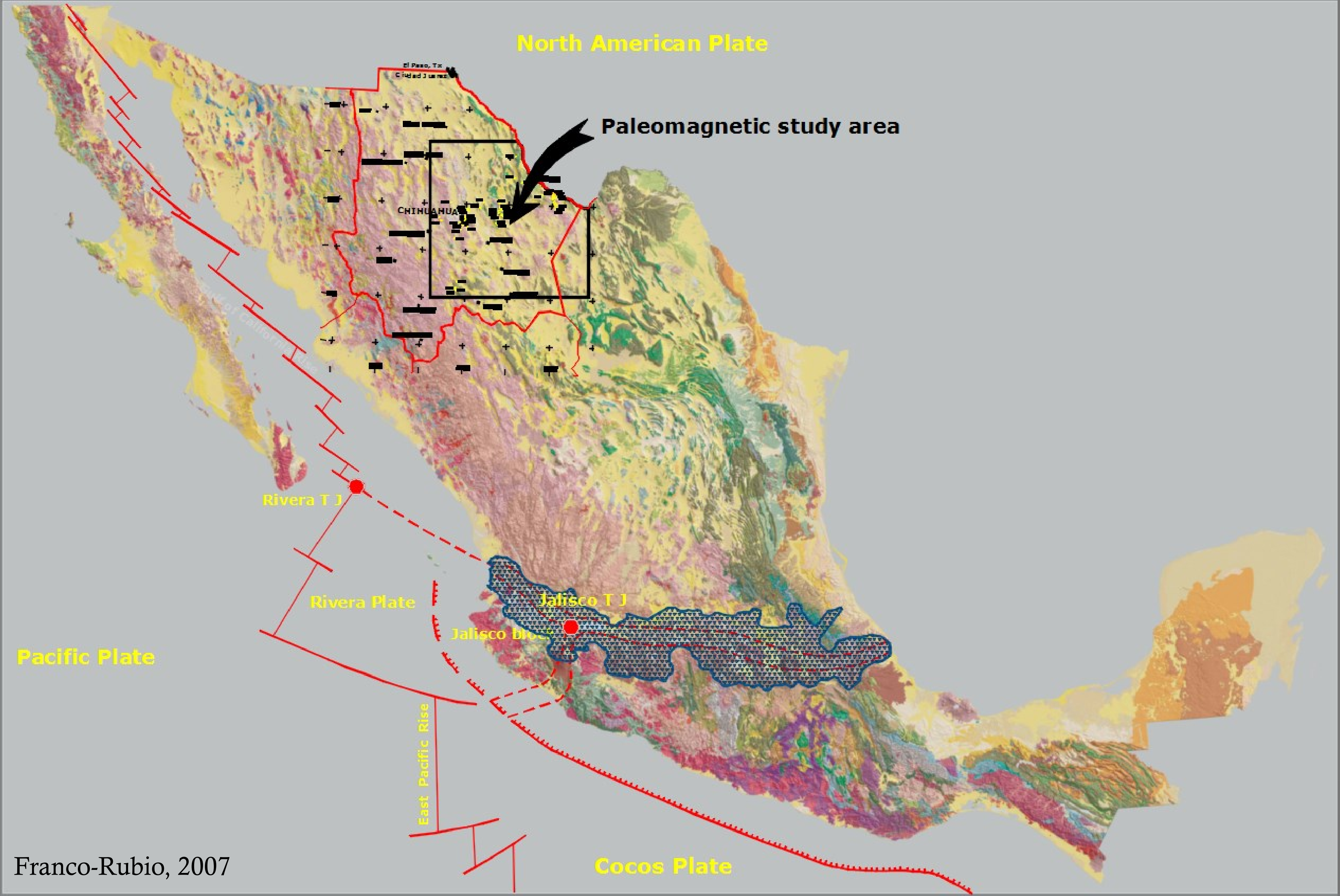
Geothermal anomalies located in central and northern regions of Mexico, are associated with normal faulting areas of tilted crustal blocks.

Naica's Crystals Cave with hydrothermal selenite

http://nadanoslibradeescorpio.blogspot.mx/2010/10/las-fascinantes-cuevas-de-los-cristales.html

An example of hydrothermal activity associated with normal faulting is the tilted Sierra de Naica range in Chihuahua, where selenite megacrysts are being precipitated as an open-space filling within the Glen Rose and the Edwards formations of Albian age.

Paleomagnetic behavior



Franco-Rubio, 2007

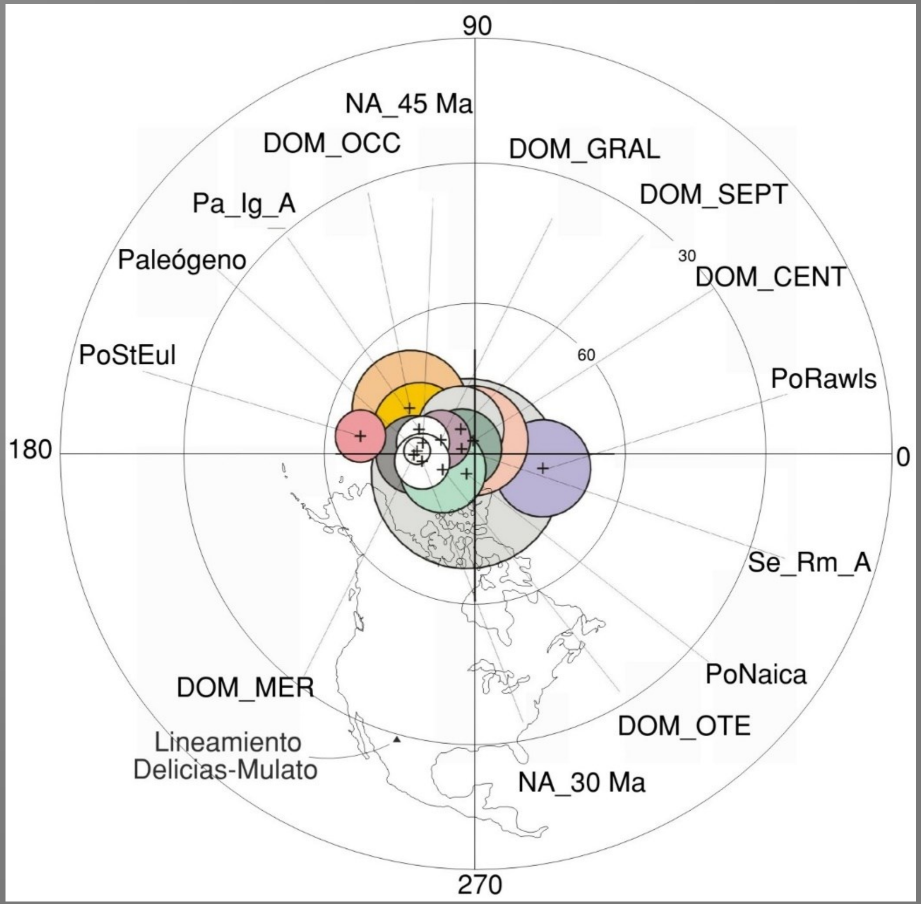
Paleomagnetic studies conducted on the eastern region of Chihuahua, were concerned with crust movement behavior between both elements of the North American Plate, the Laurentia Craton and the Ouachita Suture Zone along the Alamitos Lineament.

PALEOMAGNETIC RESULTS

Tectonic movements were rotational and latitudinal.

Paleomagnetic parameters indicating tectonic movements, show minimum values in the eastern domain [Clockwise rotation (R) + 5.03º ± 9.6, flattening (F) of -1 º ± 8.16, and poleward transport (w) -0.92º. ± 8.0].

Central and western parts of the Alamitos Lineament, exhibit values of R = + 9.91 ± 11.47º, F = 8.87 ± 6.22º , p = 8.82 ± 5.31º and -3.44º R = ± 10.09, F = 9.31 ± 11.16º, p = 9.26 ± 9.07º for the Paleogene paleomagnetic reference pole.



Translational movements of continental crust less than 300 km are almost imperceptible to paleomagnetism, and the eastern Chihuahua region seems to be the case.

THANK YOU VERY MUCH
FOR YOUR ATTENTION

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