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Application of glauconite and fossil palynomorphs in reconstructing the Liassic paleogeography just before the opening of the Gulf of Mexico (Part II)

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Abstract

In (Part I), it was stated that red beds, conglomerates and salt were considered azoic and problematic rocks, but Paleopalynology and Inorganic Geochemistry proved to be useful for placing them in time and space. In the early last century, in Mexican NE region, only three Mesozoic red bed units were differentiated, dated as Late Triassic to Late Jurassic. It was important stratigraphically to place them properly as they were considered to be the basement of the marine petroliferous sequence in some Mexican Gulf of Mexico sub-basins. Palynostratigraphic studies since 1969, and X- ray analyses since 1989 allowed to place, in time and space, the Cahuasas, Huizachal, La Joya, and La Boca red bed units, outcropping at the Huizachal-Peregrina and Huayacocotla anticlinoria and, recently, the Rosario, Conglomerado-Prieto and Cuarcítica-Cualac units at the Tlaxiaco Anticlinorium.

In this (Part II) it is described the method used for reconstructing the paleogeographic distribution of these red beds. Their correlation permitted to place the Liassic units as deposited in a half- graben connected to an Epicontinental Sinemurian Sea. This sea, during the Middle Jurassic, was invaded by the Tethysian waters through the Hispanic Corridor formed across the new Gulf of Mexico, which was originated by a hot spot with a triple junction.

Keywords: *Glauconite, Palynostratigraphy, X- ray analyses, Gulf of Mexico Origin.*

4. PALEOGEOGRAPHIC CONCLUSIONS

Finally, it was possible to find glauconite in the Liassic red bed sequences at almost all the canyons from the Huizachal-Peregrina Anticlinorium (see Fig. 16) showing the presence of marine waters among red beds. On the other hand, all the X- ray data were used for knowing the paleoclimatic and tectonic conditions during the origin of red bed units and the related marine transgressive-regressive sediments. All these data were also used for reconstructing the paleogeographic distribution of these red beds, correlating them with other known Liassic sequences from the S and SW of Mexico (Fig. 20).

Initially, Los San Pedros Allogroup was followed in subsurface toward SE, but it disappeared at the NW Tampico-Misantla border (Fig. 21), where a different sedimentary sequence is present, characterized at its base by the presence of Palygorskite and Sepiolite, two authigenic fibrous clays formed in alkaline environments from restricted basins, at the base of the Rosario Formation (Fig. 21).

The displacement of the Huizachal-Peregrina block through the Tampico-Lázaro Cárdenas Megashear originated the Tampico-Misantla Basin with an initial lacustrine-early marine sedimentation to the north, where the Rosario Formation was deposited, characterized by the presence of these fibrous clays, associated with gypsum and halite evaporitic minerals.

The continuity of the La Boca Alloformation was found southward in Sinemurian sedimentary sequences drilled at the Huayacocotla Anticlinorim NE border (Fig. 21), previously analysed by Rueda-Gaxiola, [17] and [1]. A general correlation showed that palynozones from the Los San Pedros Allogroup have chronostratigraphic equivalents in the Huayacocotla Group defined by Schmidt-Effing [26], but in a southward stratigraphic sequence which becomes more and more marine (Fig. 22).

These data (Figures 22-23), permitted us to conclude that both the sequences were deposited in the same half-graben basin, after Pangea (Fig. 24), during Late Triassic and Liassic Time (Fig. 25). This half-graben, named the Huayacocotla-El Alamar Basin [3], was considered as the eastern one of two parallel basins which originated during Late Triassic Time. So, it was possible to establish a good correlation between the Jurassic sequences deposited in Huayacocotla-El Alamar and Tampico-Misantla basins (Fig. 23), and also, to know that south-eastward, the dominantly continental Los San Pedros Allogroup sedimentary sequence gradually changes to a more marine sequence, named by Schmidt-Effing, [26] as the Huayacocotla Group (Fig. 22).

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Fig. 20. The Los San Pedros Allogroup was correlated with two other Liassic sequences from the S and SW of Mexico, located at Huayacoctla and Tlaxiaco anticlinoria.

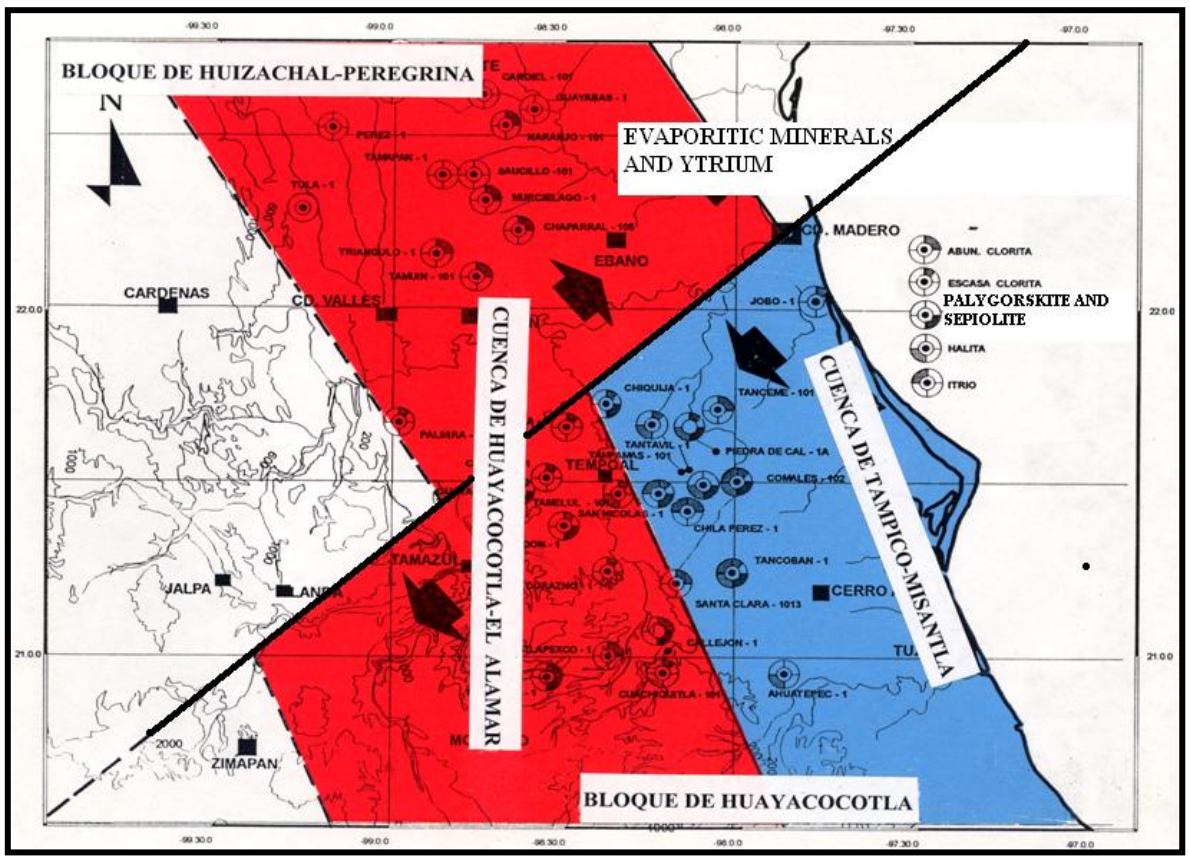

Fig. 21. The Tampico-Lázaro Cárdenas Megashear limited the Huizachal-Peregrina and Huayacocotla blocks. The SW movement of Huayacocotla Block formed the Tampico-Misantla oil basin.

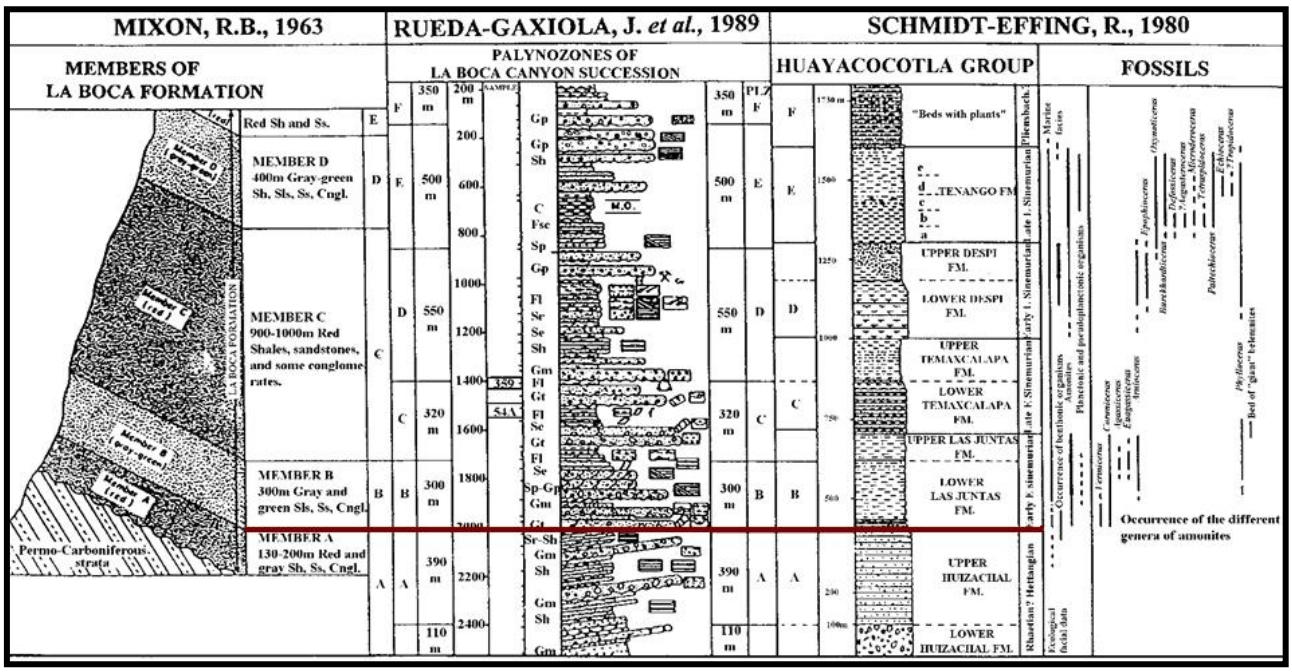

Fig. 22. Correlation of the Liassic in the Huizachal-Peregrina and Huayacocotla anticlinoria.

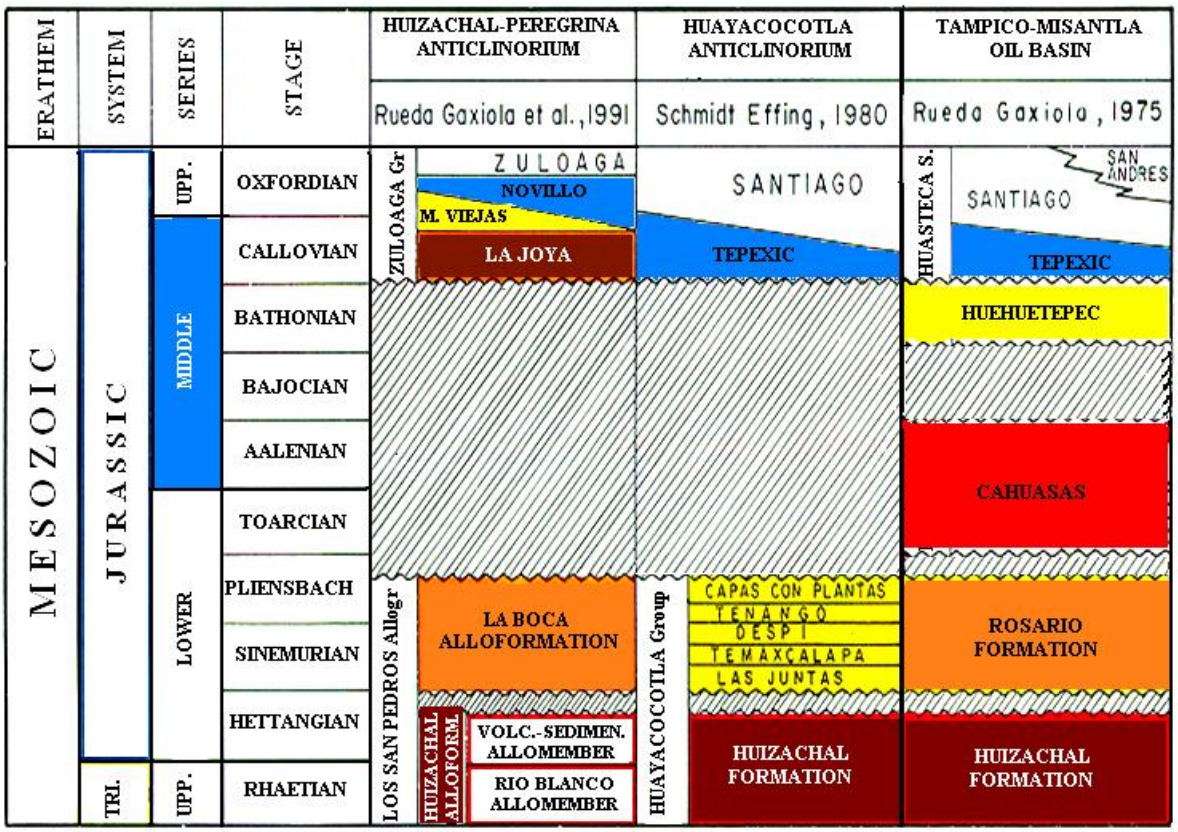

Fig. 23. Correlation of Huizachal-Peregrina and Huayacocotla anticlinoria and Tampico-Misantla Basin.

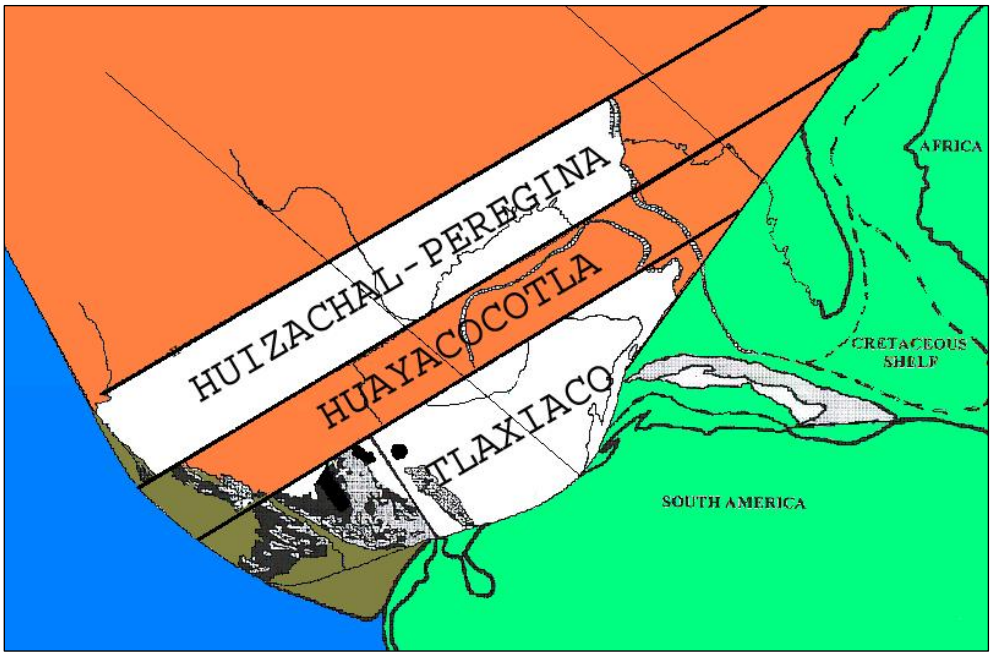

Fig. 24. During Pangea, in Southern North America three main blocks were present, delimited by three Paleozoic faults; also, two pre-Cambrian faults were present. During the Mesozoic all these faults became megashears [27].

Recently, it has confirmed the hypothesis [5] that the Huayacocotla-El Alamar Basin continued more south-eastward up to the Tlaxiaco half-graben basin (Fig. 3) and was also connected to the Portal del Balsas Sea (Fig. 26). The SW-NE Epicontinental Sinemurian Sea, named the Portal del Balsas, was bordered by the two Paleozoic faults (Fig. 27) delimiting the Huizachal-Peregrina, Huayacocotla and Tlaxiaco blocks. During Sinemurian-Pliensbachian Time, an incipient lifting stage, due to a hot spot formation (Fig. 28), began to be evident at the central region of the future Gulf of Mexico.

Erosion of this domed region produced cratonic metamorphic quartz and metamorphic rock debris and a fluvial transport of them to W and SW (Fig. 29). So, these metamorphic fragments appeared in the middle-upper part of La Boca Alloformation, (outcropping at Huizachal-Peregrina Anticlinorium), and in the El Consuelo Group (outcropping at Tlaxiaco Anticlinorium) becoming more abundant upward the sequences. During this Early Liassic time, the North Atlantic Sea was newly formed (Fig. 18 and 27).

Later, during the Toarcian-Aalenian Time, the Huayacocotla-El Alamar Basin was cut by the two Paleozoic faults transformed into the Tampico-Lázaro Cárdenas and Teziutlán-Acapulco megashears when the tectonic blocks (Huizachal- Peregrina, Huayacocotla and Tlaxiaco) moved south-westward (Fig. 29); this movement compressed and lifted, for the fist time, Mesozoic rocks deposited in Huizachal-Peregrina and Huayacocotla portions from Huayacocotla-El Alamar Basin, but in the Tlaxiaco portion sedimentation continued, in communication with the Portal del Balsas (Fig. 26 and 29). A relict from this Jurassic hot spot is still evident in the Geothermal Map of North America (Fig. 28) at the central Gulf of Mexico.

Also, during this Toarcian-Aalenian time (Fig. 29), the Tlaxiaco and the South America blocks were still joined together and, the Atlantic waters flowed into the Gulf of Mexico region due to the separation of North and South Americas north of Cuba. Furthermore, the hot spot developed and the dome continued to lift, increasing the erosive action on the cratonic metamorphic rocks bordered eastward by the orogenic belt intruded by batholithic rocks during the Appalachian-Ouachitan Orogeny at the end of Paleozoic and at the beginning of Mesozoic eras.

The geographic correlation of Liassic and Middle Jurassic sedimentary sequences (Fig. 26) outcropping at the three anticlinoria, showed that, during the Middle Jurassic, due to the initial north-westward drifting and cooling, (mainly of the Texas block) the Epicontinental Sinemurian Sea (Portal del Balsas), was invaded from NE by the Tethysian waters coming through the Hispanic Corridor across the new Gulf of Mexico [27]. It was formed by the widening tectonic evolution of two arms of the triple junction developed during the drifting and sinking tectonic stages (Fig. 30).

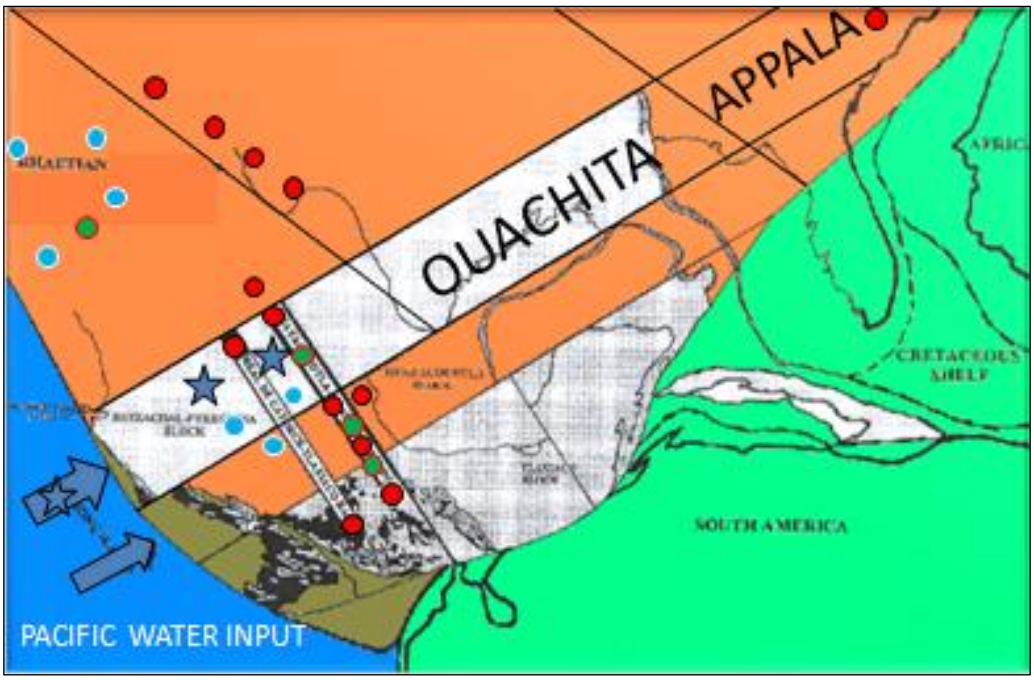

Fig. 25. During the Late Triassic marine influence was only present in SW of North America (see blue circles); the Huizachal-Peregrina and Huayacocotla blocks permitted the Pacific Ocean transgression [27]**.** The first one was a deeper epicontinental sea and ammonites (stars) were present there. Later, two graben basins originated in parallel position to the Pacific coast, and were filled with volcanic and fluvial sediments (red and green circles).

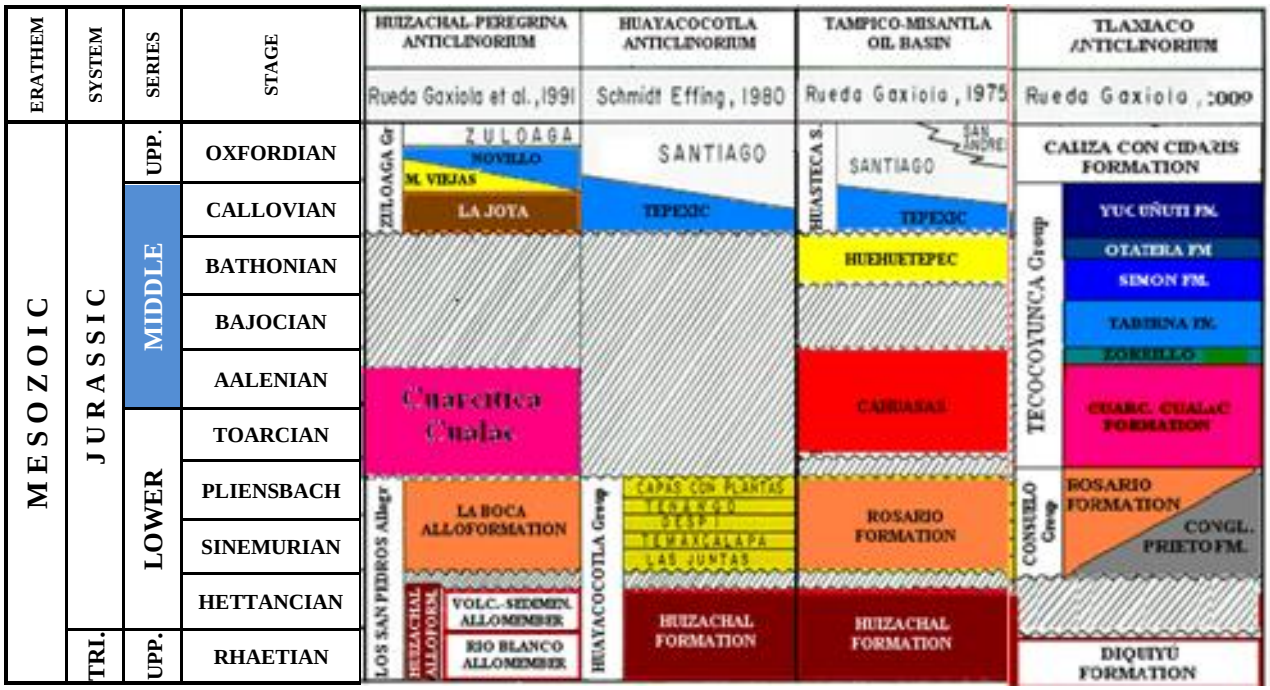

Fig. 26. Recently, it was possible to know that in Tlaxiaco and Huizachal-Peregrina anticlinoria the Consuelo Group and the Los San Pedros Alloformation gradually change upward to a formation (Cuarcítica Cualac) constituted mainly by metamorphic quartz and other metamorphic rocks fragments. Nevertheless, only in the Tlaxiaco Anticlinorium sedimentation was continued throughout the Middle Jurassic [29].

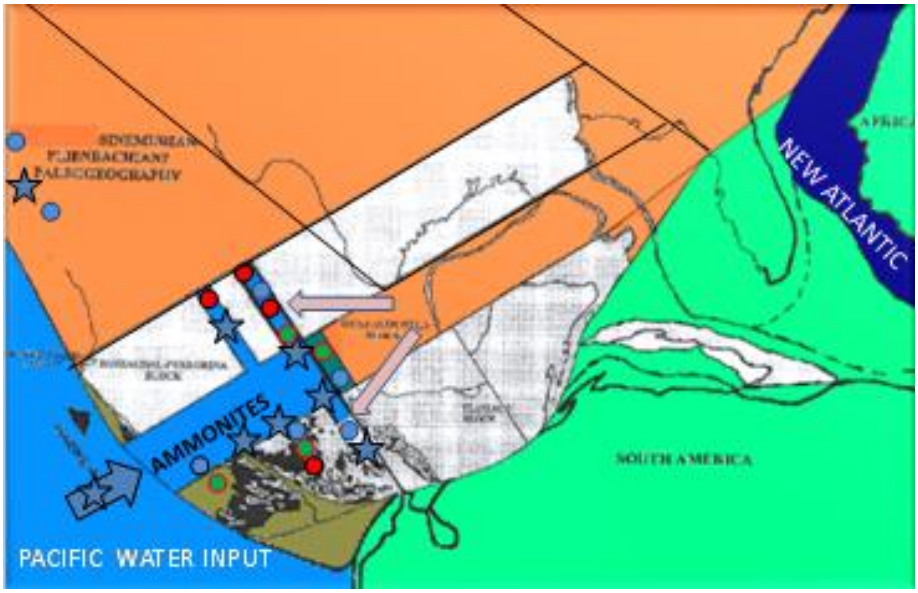

Fig 27. During the Sinemurian-Pliensbachian Time, the Huayacocotla block became deeper at SW, and an epicontinental sea connected the Pacific Ocean to the graben basins, depositing marine sediments among red beds. A hot spot and a doming stage began to lift the NE region, depositing metamorphic quartz fragments among red beds in Huizacha-Peregrina and Tlaxiaco graben basins [27].

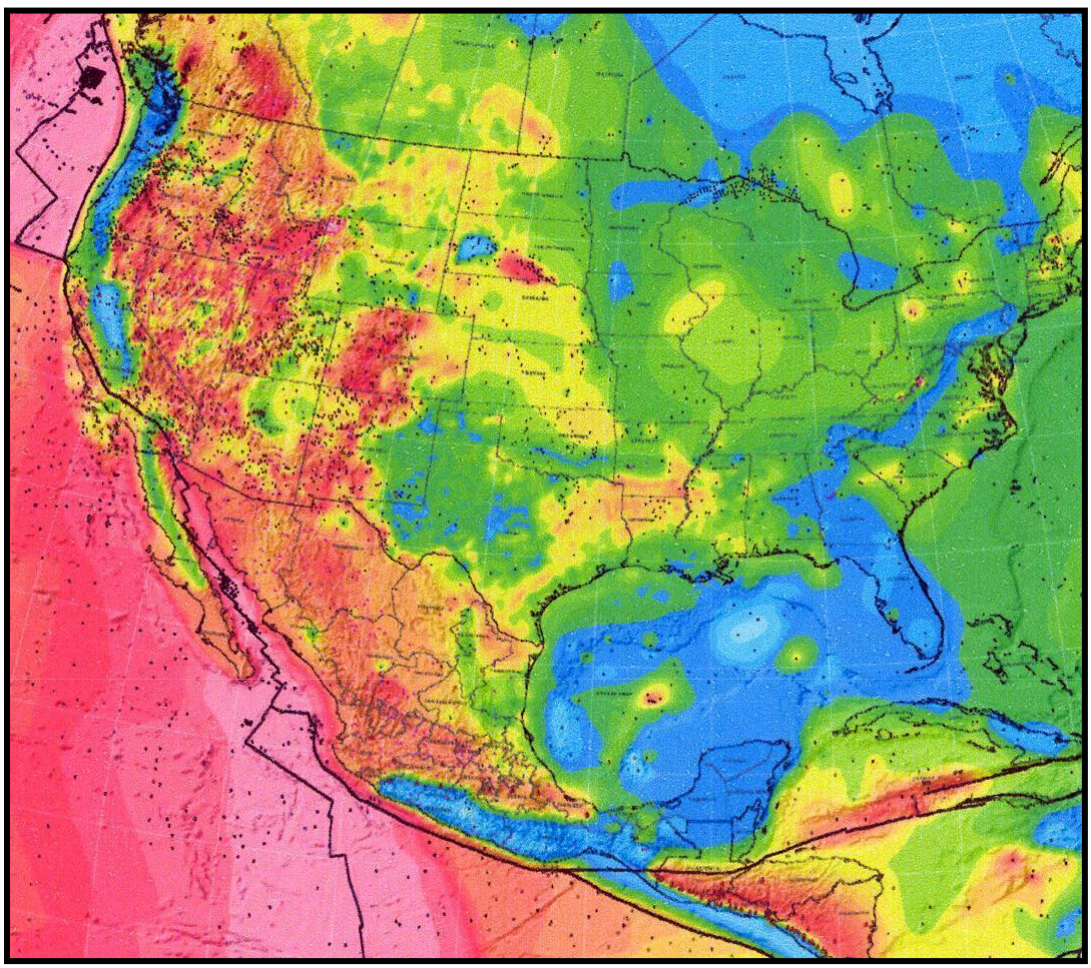

Fig 28. A vestige of this main Liassic Hot Spot can still be detected, at the central part of the Gulf of Mexico, (From GEOTHERMAL MAP OF NORTH AMERICA. AAPG, 2004).

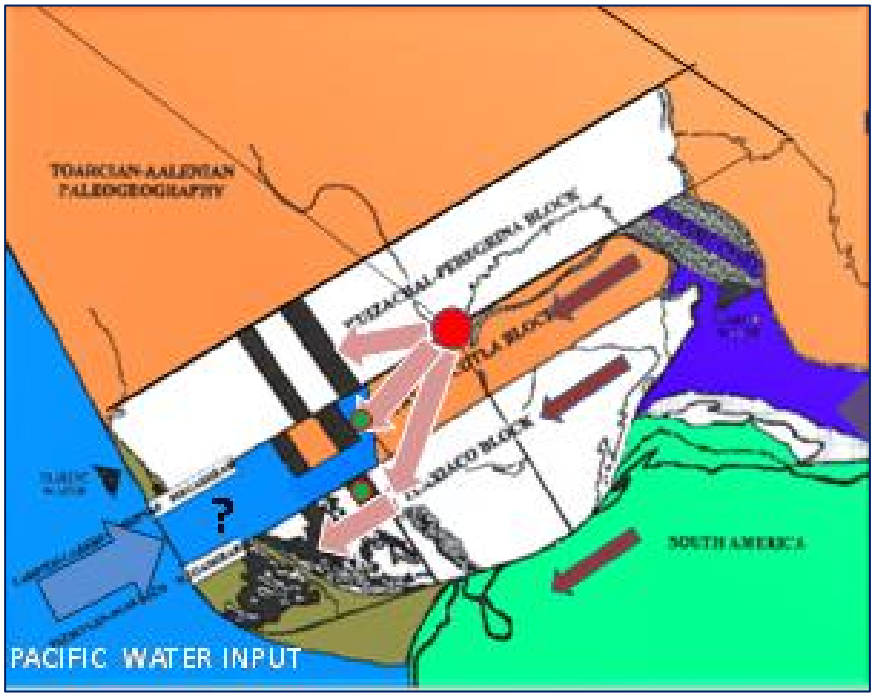

Fig. 29. During Toarcian-Aalenian, Atlantic waters went into the NE region of the present Gulf of Mexico. Abundant metamorphic quartz fragments were deposited above the red bed sequences because of the high erosion of metamorphic rocks exposed by the continued lifting during the doming tectonic stage [27]

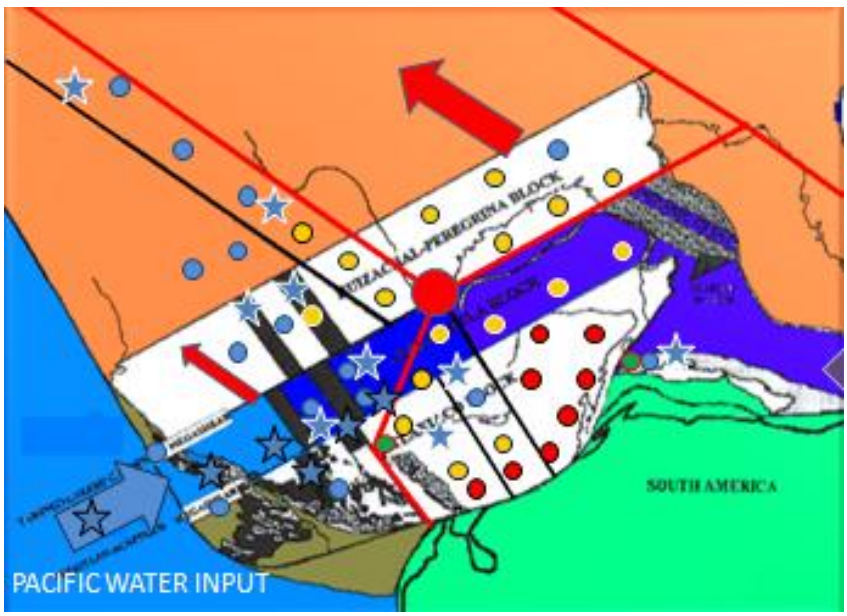

Fig. 30. During Bajocian-Oxfordian Time, the Hispanic Corridor was formed through the Gulf of Mexico, along the Huayacocotla block. Pacific and Atlantic waters permitted the mélange of ammonites from these two affinities; their fossils are found in the Taberna Formation at the Tlaxiaco Anticlinorium. This Time was represented by the end of rifting, sinking and the beginning of drifting tectonic stages [27]

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