Geof. Int. Vol. 24-1, 1985, pp. 193-202

THE TECPAN REGIONAL FAULT: EVIDENCE FOR MAJOR NE LINEAMENTS

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RESUMEN

Con base en una revisión de algunos trabajos publicados acerca de estudios sobre la margen continental en el sur de México, se encontró una posible asociación de rasgos morfotectónicos tanto del subfondo marino como del continente.

Son doce los rasgos geológicos locales aparentemente independientes que cuando se correlacionan en un panorama regional sugieren la existencia de la Falla Regional de Tecpan que aquí se propone. Esta falla sería un miembro representativo de un sistema de fallas conjugadas del sistema de fallas o rift asociado a la Faja Volcánica Mexicana y del cual muchos otros han sospechado. La falla interpretativa va desde el talud interior de la Trinchera Mesoamericana hasta la Faja Volcánica Mexicana con un rumbo general N 17° E.

ABSTRACT

Several published works about the continental margin structure in southern Mexico were reviewed in order to find a possible connection of on- and offshore morphotectonic features.

From a regional view, twelve local geological features are combined to suggest the presence of major structural lineament, the Tecpan Regional Fault. This fault is an element of the Mexican Volcanic Belt fault or rift system which has been suspected by others. This structure runs from the inner slope of the Middle American Trench to the Mexican Volcanic Belt system with a N 17° E strike.

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INTRODUCTION

Several studies related to the Guerrero-Oaxaca Massif and adjacent regions are reviewed, including both on- and offshore locations. Analysis of the recent studies, from a regional perspective, suggests the presence of a major fault that could be a component of a macrosystem of faults related to the fault or rift system along the Mexican Volcanic Belt. These macrosystems have been suspected by several authors (Stoiber and Carr, 1973; Carr *et al.*, 1974; Gasca y Reyes, 1977; Flores, 1978; Scheidegger, 1979; Mooser, 1972, and others).

Twelve local geological features combined from marine and terrestrial studies, were analyzed and have led to the identification of a regional fault bearing N 17° E. This fault, here called the Tecpan Regional Fault, is the first identified element of the NNE-SSW fault system transverse to the southern Sierra Madre Occidental (i.e. the Sierra Madre del Sur) which runs from Bahía de Banderas to the Tehuantepec Isthmus. We believe this fault extends from the inner slope of the Middle America Trench to the Mexican Volcanic Belt (a distance of 300 km). The twelve local geological features, have led to this regional interpretation.

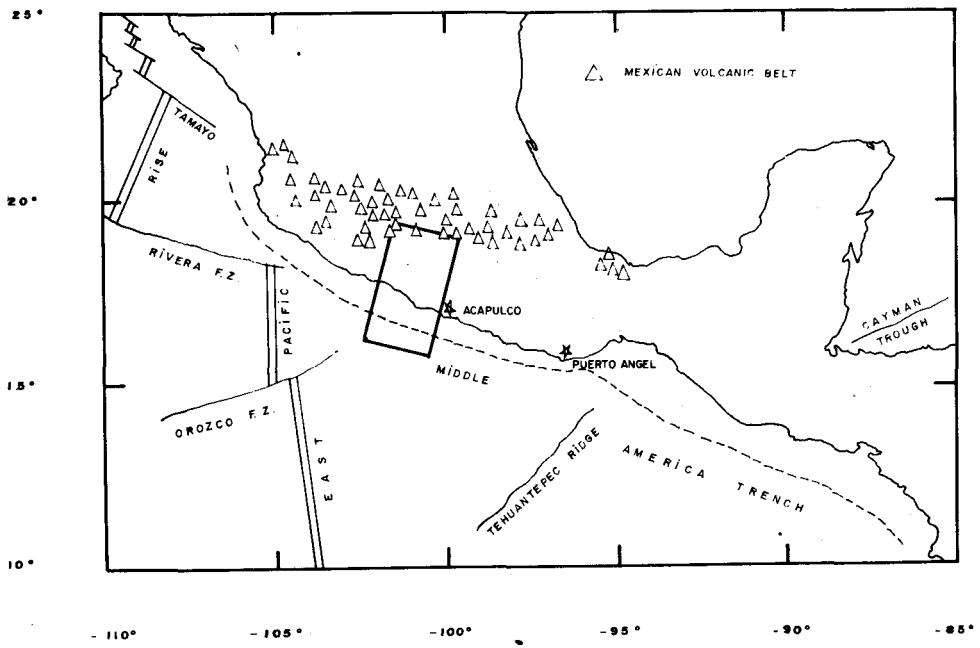
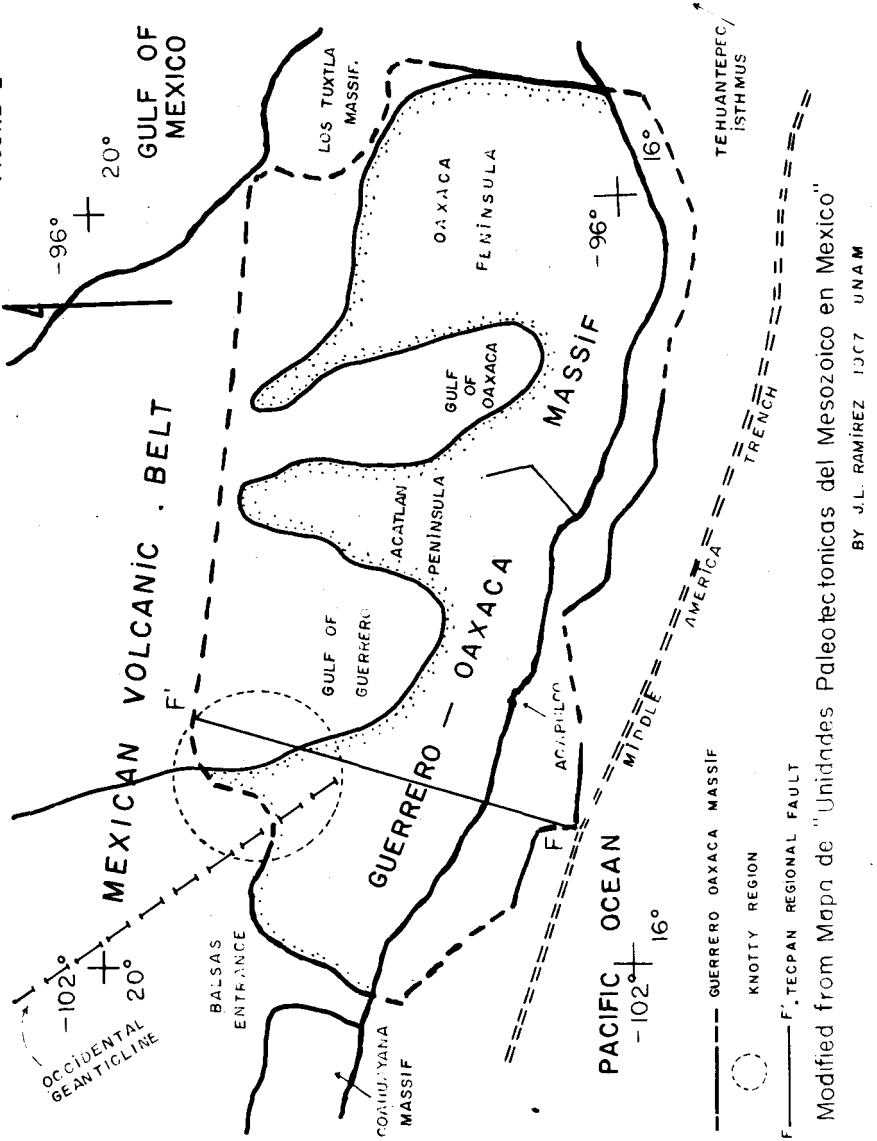


FIGURE 1 LOCATION MAP STUDIED AREA

The analysis began by trying to find an onshore morphotectonic connection to the offshore continental margin structure identified by Karig *et al.* (1978). The area of interest is underscored in Figure 1 showing the location of previously studied areas as well as the location of the Middle America Trench. The lineament seems to be evident in the offshore region, its inland prolongation runs along some linear features observed in satellite (Landsat-1) images.

Figure 2 shows the apparent boundaries of Guerrero-Oaxaca Massif that can be considered as an independent crustal block. These bound-



aries are as follows: the eastern edge is the fault contact with the metamorphic rocks along the Tehuantepec Isthmus, the southern boundary with oceanic crust is contained somewhere seaward and beneath the continental upper slope (Shipley *et al.*, 1980), the northern portion is not completely well defined yet but is probably associated with the WNW-ESE fault system of the Mexican Volcanic Belt. Finally the western edge is a lowland region active since the Mesozoic coinciding with the Balsas river mouth. Thus, the Massif can be considered as a single block containing two old and persistent intracratonic basins of post-Triassic geologic development. These old basins according to Ramírez (1967), are the Paleogulf of Guerrero and the Paleogulf of Oaxaca, both divided by the Paleopeninsula of Acatlán (see Figure 2).

The Guerrero-Oaxaca Massif is not exempt from faulting. It is also characterized by the lack of a well developed continental shelf because of recent geodynamics and morphotectonism (i. e. Miocene shear of the margin). Analyzing three seismic reflection sections across the inner trench slope presented by Karig *et al.* (1978), and the structural tectonic pattern product of Mesozoic-Cenozoic events in the entire area (Shipley *et al.*, 1980; and Shipley, 1981), I have distinguished several local morphotectonic features. Although some of them are highly speculative, when put together they tend to corroborate the presence of a regional fault across the western portion of the Guerrero-Oaxaca Massif.

SYNTHESIS

The following morphotectonic features are shown in Figure 4.

- From a regional view the 1 600 m bathymetric contour shows a horizontal offset, with the western portion shifted northward along the vertical plane.

- In the eastern portion beneath de 1 200 m contour is an E-W buried ridge or structural high, shown by seismic profiles reported by Karig *et al.* (1978). This ridge divides the upper and lower slope. At the western end, the structural high seems to be truncated against the proposed lineament F-F'.

- The fault F-F' which represents the zone of discontinuity also differentiates distinct minor slope basins on both sides. The slope basins

have no connections just like the outer ridge (i.e. the buried ridges or structural highs).

- The Tecpan river old bed (Vs. the one it occupies now inshore) and its submarine extension in the form of a canyon coincide with the trace of the fault.

- The northeastward dipping strata contained in a minor slope basin at 3 000 m on the western side of the fault show two possible events: it either suggests a northeastward tilting of the west side or that the buried structural high on the left is being uplifted. It also suggests a differential vertical movement from the eastern side, since no tilting is observed in the eastern block (Figure 3).

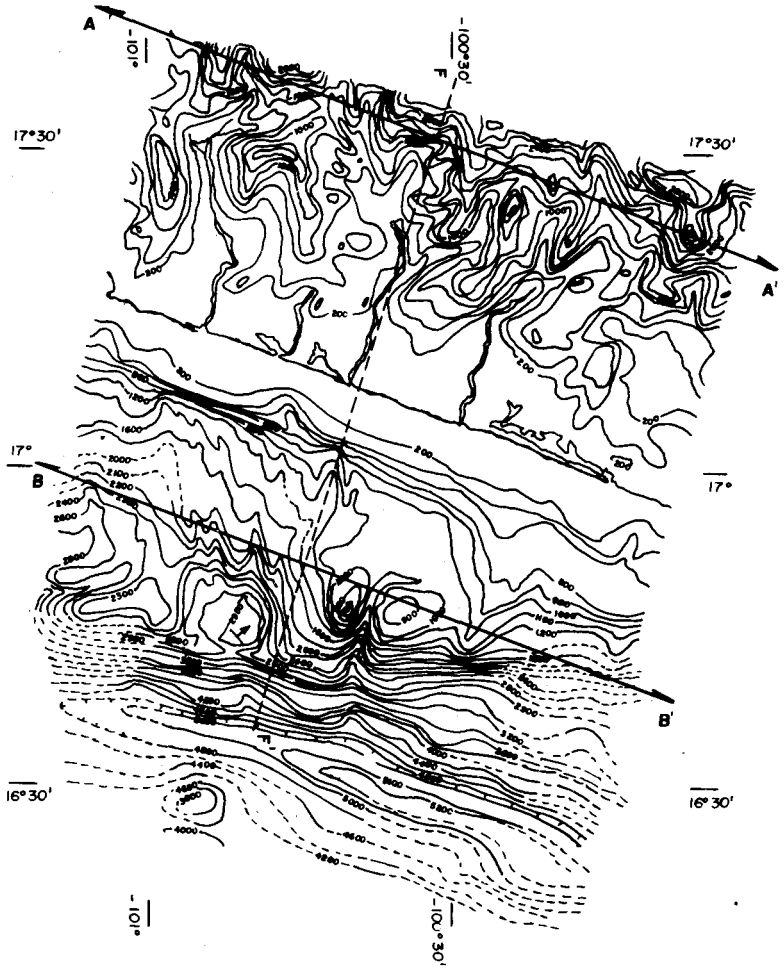


FIGURE 3.- TOPOGRAPHIC AND BATHYMETRIC CONTOURS IN METERS.
NOTE: LOCATION OF PROFILES AA' AND BB'

- The trough in the eastern block of the Middle America Trench is deeper than the trough in the western block. This is not due to varying sedimentary fill. Furthermore, the trench axis shows a 10 degree shift in trend in spite of the straight coast line.

- Two major magnetic anomaly trends, reported by Karig *et al.* (1978) can be explained by the behavior of the buried structural high whose apparent discontinuity also follows the bathymetric contour at −1 200 m and around the fault (Figures 3 and 4).

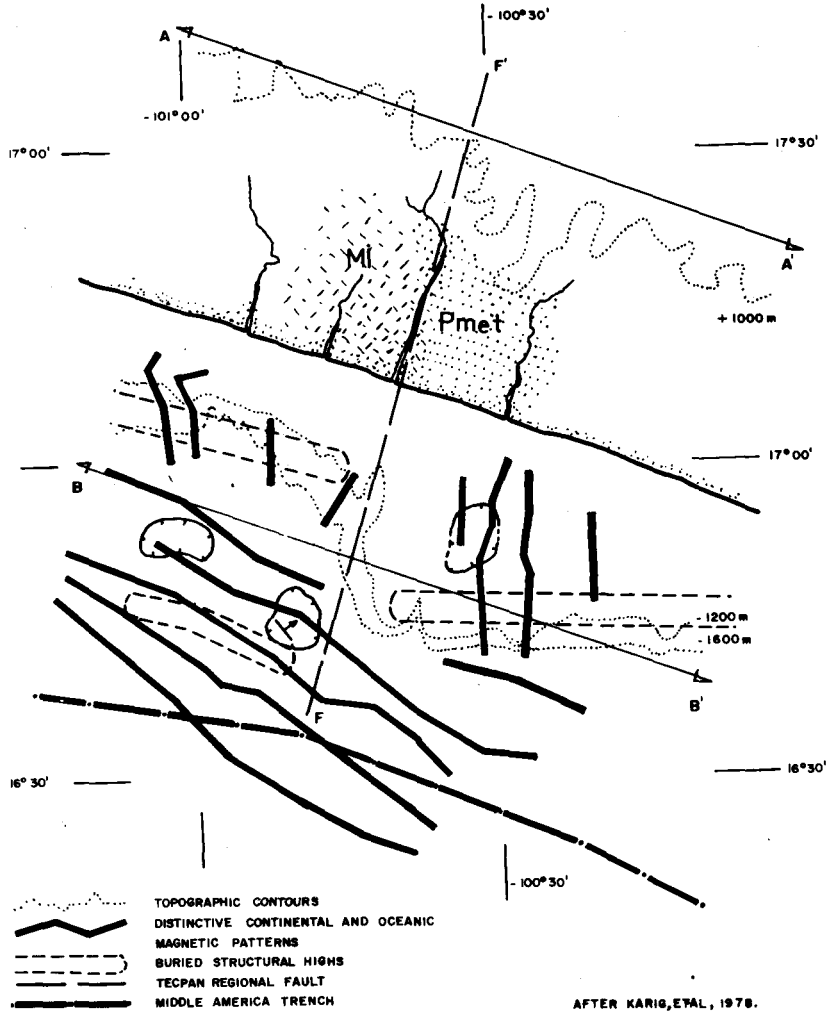


FIGURE 4

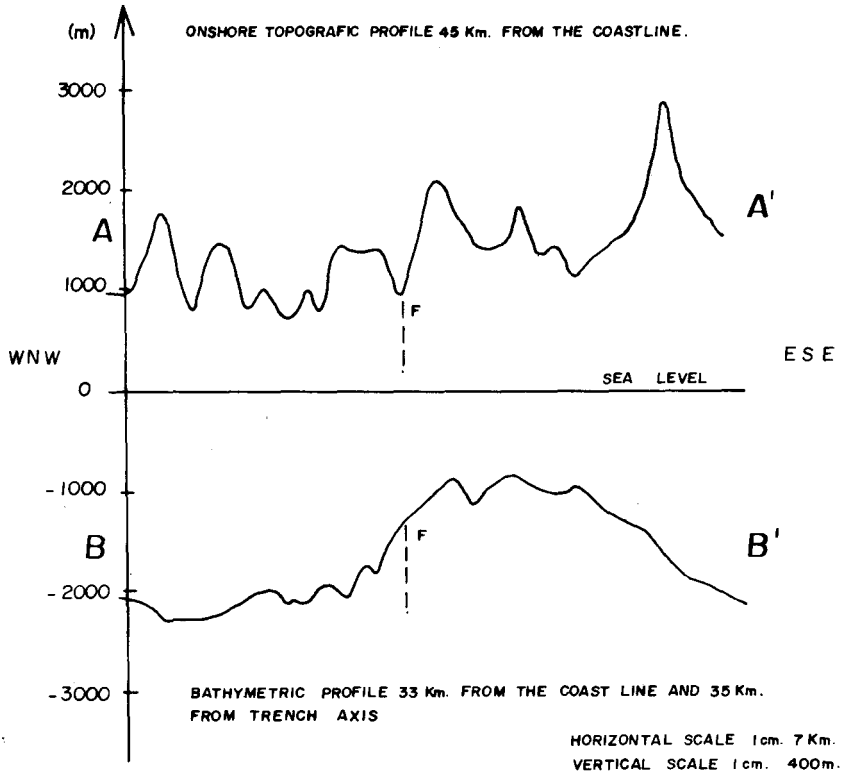


FIGURE 5.- PROFILES AA' AND BB' PARALLEL TO THE COAST LINE, THE TRENCH AXIS AND SUBNORMAL TO THE TECPAN REGIONAL FAULT. VERTICAL EXAGERATION 17.5 X

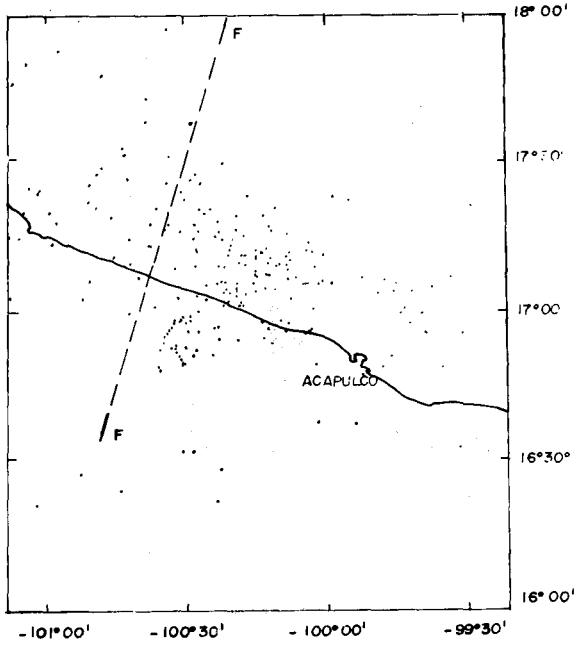
- Besides the parallelism shown between the - 1 200 m bathymetric contour and the + 1 000 m topographic contour (or other contours for that matter) there is a shift right where the fault is placed. In regard to topography-bathymetry of Figure 4, a smoothing of the contour lines on both sides of the plane is necessary to account for depositional and erosional activity. A frontal view of two profiles derived from the bathymetry chart (Figure 5) show the apparent vertical (> 600 m) and horizontal (> 10 km) shifts (Figure 4).

- Inland surface geology indicates the existence of a geologic contact of about 30 km in length, between Mesozoic Intrusive rocks and Paleozoic Metamorphic rocks in the vicinity of the Tecpan River. This contact follows the orientation of the fault (Figure 4).

- De Cserna (1965) performed an exhaustive study of the central meridional portion of the State of Guerrero. In his work several observed and inferred faults are reported, most of them showing a general N 23° E trend; Scheidegger (1979) reported a preferred strike direction about N 17° E of a set of joints around the Bay of Acapulco, and Ortega (1979) reported some structural elements (F_1, F_2, M_1 and M_2) with a northeastward trend.

- The proposed fault can be traced inland up to the north portion of Guerrero-Oaxaca Massif, the west portion of Paleogulf of Guerrero, southern end of the Occidental Geanticline and the Mexican Volcanic Belt as shown in Figure 2 (see the knotty area inside the circle).

- Presently the tectonic stress is particularly active in the eastern block defined by the proposed fault. This is shown by the multiplicity of shallow seismic hypocenters (0-30 km), the distribution is seen by Morales (1980) in two kind of scales for the Tecpan-Acapulco region: 1963-1978 earthquakes and in microearthquakes from June-July 1977 (Figure 6).



MAP SHOWING COMPUTED EPICENTERS FROM JUNE-JULY 1977 MICROEARTHQUAKES PERIOD. A SHALLOW EARTHQUAKES MAP FOR 1963-1978 PERIOD ALSO SHOWS HIGHER SEISMICS ACTIVITY IN THE EASTERN BLOCK OF THE TECPAN REGIONAL FAULT. (MORALES 1980)

FIGURE 6.-

AFTER MORALES M. 1980

INTERPRETATION AND CONCLUSIONS

Considering all of the discussed geologic features, the presence of the "Tecpan Regional Fault" with a strike of N 17° E, is proposed. This fault extends from the Mexican Volcanic Belt fault system, the knotty area shown in Figure 2 to the inner slope of the Middle America Trench (Figure 4). This fault separates two blocks: the eastern block contains an array of morphotectonic elements that resemble the trench slope model presented by Seely *et al.* (1974). The western block is probably a block displaced northward. Along this continental margin different degrees of tectonic erosion as well as sequential accretion of rock wedges are observed in the two blocks (*cf.* Shipley *et al.*, 1980). The outer ridge of the western block presently is being uplifted by a newer accretionary prism with a minor basin being tilted backwards to face the Fault.

In both, on and offshore regions, topographic and bathymetric profiles: Figures 3 and 5 show the differentiation of the blocks on the basis of elevation, which is at least 600 m lower on the western block.

Thus, it is suggested a fault or lineament, here called the Tecpan Regional Fault, as part of a NNE-SSW fault system "orthogonal" to the Mexican Volcanic Belt WNW-ESE trends.

In summary, the combined evidence from on and offshore features indicates the presence of the "Tecpan Regional Fault" which may be an element of a NNE-SSW fault system conjugated to the Mexican Volcanic Belt faulting.

Given the information reviewed in this work, it is concluded that a likely process and structural model (i.e. sequential accumulation of accretionary prism) seem to be the more plausible in this offshore region where the Tecpan Regional Fault plays an important role. If the inland Miocene Intrusive terrane (MI, in Figure 4) has moved northward, relative to the eastern block, the fault must be considered in the long-term history of the ocean-continent transition zone.

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(Received: June 6, 1984)
(Accepted: October 20, 1984)

It is recommended that reference to this paper be made as follows:

J. H. Sandoval-Ochoa, 1985. The Tecpan regional fault: Evidence for major NE lineaments. *Geofís. Int.*, Special Volume on Mexican Volcanic Belt - Part 1 (Ed. S. P. Verma), *Vol. 24-1,* pp.