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PALAEOMAGNETISM AND TECTONICS OF MIDDLE AMERICA AND ADJACENT REGIONS

PART 2

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PREFACE

This issue presents the second part of a special collection of papers concerned with recent palaeomagnetic and tectonic investigations of Mexico. It contains a total of four papers, written by four authors from four different institutions. Three papers present palaeomagnetic results of relevance to the tectonic evolution of Mexico during the Cretaceous and Tertiary, whereas the other paper discusses the tectonic evolution and setting of Mexico, following a regional geologic approach.

In the first paper, Carfantan offers a model for the tectonic evolution of Mexico since the Jurassic, and presents a discussion of major geologic-tectonic units of southern Mexico. In this model, large-scale left-lateral transform motion along regional NW-SE fault systems was a dominant tectonic process. Major movements affected northern Mexico during the Late Jurassic along a ridge-trench transform fault. Reorganization of spreading system from the Gulf of Mexico to the Caribbean Sea was accompanied by lengthening of the subduction zone of northwestern Mexico. Major left-lateral transform motion was restricted to a similar ridge-trench system located in southern Mexico. This transform boundary evolved into a diver-

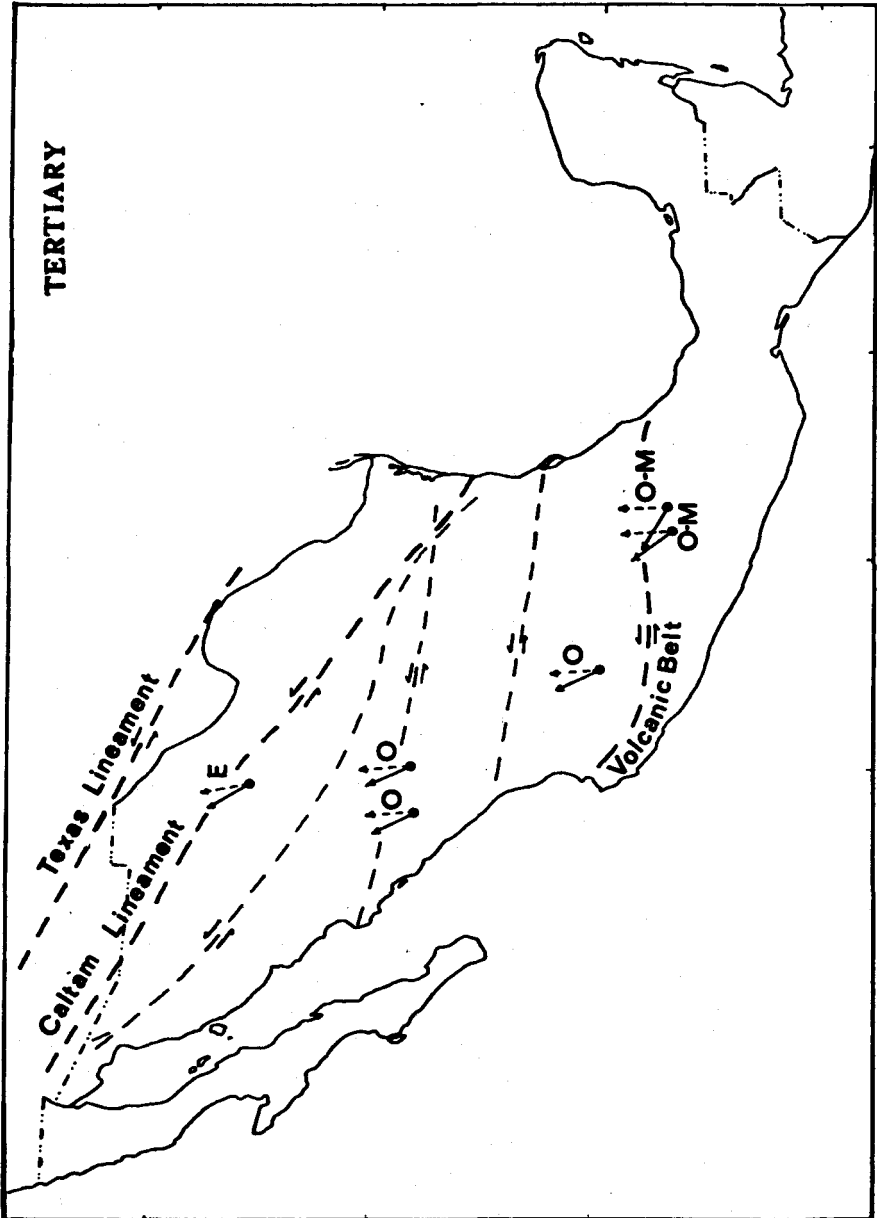


Fig. 1. Comparison of observed mean palaeomagnetic directions (continuous arrows) and expected directions (discontinuous arrows) for localities studied in central and northern Mexico. Expected directions are computed from corresponding mean pole positions from the apparent polar wander path for 'stable' North America (see Fig. 4). Letters indicate age assignments: E, Eocene, O, Oligocene, and M, Miocene. There are 8 studies used in the figure (details and references in Urrutia Fucugauchi, 1982). Dashed lines represent major lateral faults crossing Mexico. Note the consistent divergence to the left of observed directions.

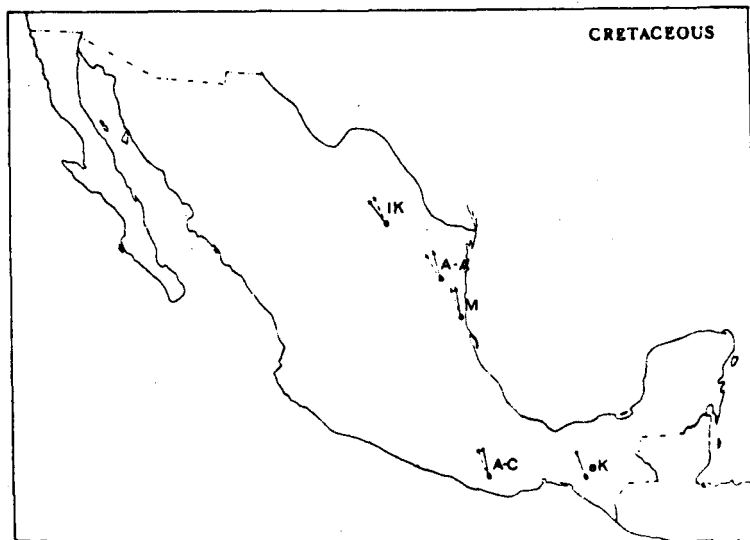


Fig. 2. Comparison of observed and expected mean palaeomagnetic directions for Cretaceous localities in Mexico (see Fig. 1 for explanation). Letters indicate age assignments: Ik, Late Cretaceous, ek Early Cretaceous, A-A, Aptian-Albian, M, Maestrichtian, and A-C, Albian-Cenomanian. Additional details and references are given in Urrutia Fucugauchi (1982). Note that observed directions are displaced to the left, right or not displaced from the expected directions. See Fig. 5 for details.

gent boundary (perhaps similar to that of the Gulf of California?) during the latest Jurassic-Cretaceous (Portlandian-Turonian). Cessation of active spreading was later followed by the closure of the basin. Major left-lateral motion continued during the Early Tertiary, which resulted in the separation of northern Central America from southern Mexico. Palaeomagnetic results available for the Mesozoic and Cenozoic indeed seem more consistent with regional left-lateral motion of parts of Mexico, in particular for the Jurassic (Fig. 3) and Early Tertiary (Fig. 1). Results for the Cretaceous (Fig. 2), however, suggest that tectonic evolution of the area was more complex, involving perhaps both right-lateral and left-lateral tectonic motion of different parts of Mexico.

In the next paper, Urrutia Fucugauchi presents preliminary palaeomagnetic results for two intrusive bodies located in southern Mexico, close to the presently active subduction zone system of the Middle America trench. If the intrusives are subduction related, then, they are located anomalously close to the trench. Based on this and other observations (de Cserna, 1965), it has long been proposed that part of the continental margin of southern Mexico was removed, possibly, in the form of left-lateral motion (e.g. Malfait and Dinkelman, 1972; Kesler, 1973; Carfantan, this issue), or right-lateral motion (e.g. Karig *et al.*, 1978; Beck *et al.*, 1982).

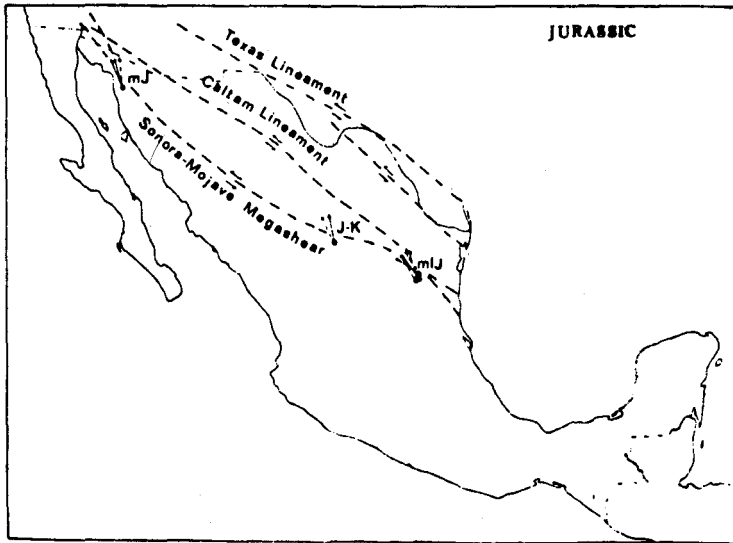


Fig. 3. Comparison of observed and expected mean palaeomagnetic directions for Jurassic localities in Mexico (See Fig. 1 for explanation). Letters indicate age assignments : mJ, Middle Jurassic, J-k, Jurassic-Cretaceous, and mlJ, Middle-Late Jurassic. Additional details and references are given in Urrutia Fucugauchi (1982). Dashed lines represent major lateral faults crossing Mexico. Note the displacement to the left of most observed mean directions with respect to expected directions. See Fig. 5 for details.

In particular, Beck *et al.* (1982) based on palaeomagnetic data argued for a regional model in terms of northward translation of Mesozoic batholiths along the western margin of North America. Results obtained for the southern Mexico intrusives studied indicate a complex palaeomagnetic record, and although further measurements are required before a tectonic interpretation can be put forth, it seems that northward translation of this area with respect to surrounding areas in Mexico is not supported by the results.

Bobier and Robin, in the next paper, present palaeomagnetic results derived from igneous rocks sampled in the States of Durango and Sinaloa, northern Mexico. Results from andesitic lava and granodiorites (100 to 45 m.y.) from the Lower Volcanic complex define a mean pole which deviates from corresponding mean poles for the 'stable' part of North America (Fig. 5). This pole deviates to the right of the corresponding segment of the reference apparent polar wander path (APWP) for North America (Irving, 1979), and is in agreement with other palaeomagnetic results reported for the Cretaceous of Mexico (Fig. 2). The angular divergence observed is explained in terms of a tectonic model involving slight northward displacement and clockwise rotation of the area during the Early Tertiary (Palaeocene). Re-

sults from rhyolitic ignimbrites (32 to 22 m.y.) from the Upper Volcanic supergroup yield a mean pole which also deviates from the corresponding segment of the North American APWP (Fig. 4). This pole is however deviated to the left, which agrees well with other palaeomagnetic results reported for the Early Tertiary of north-

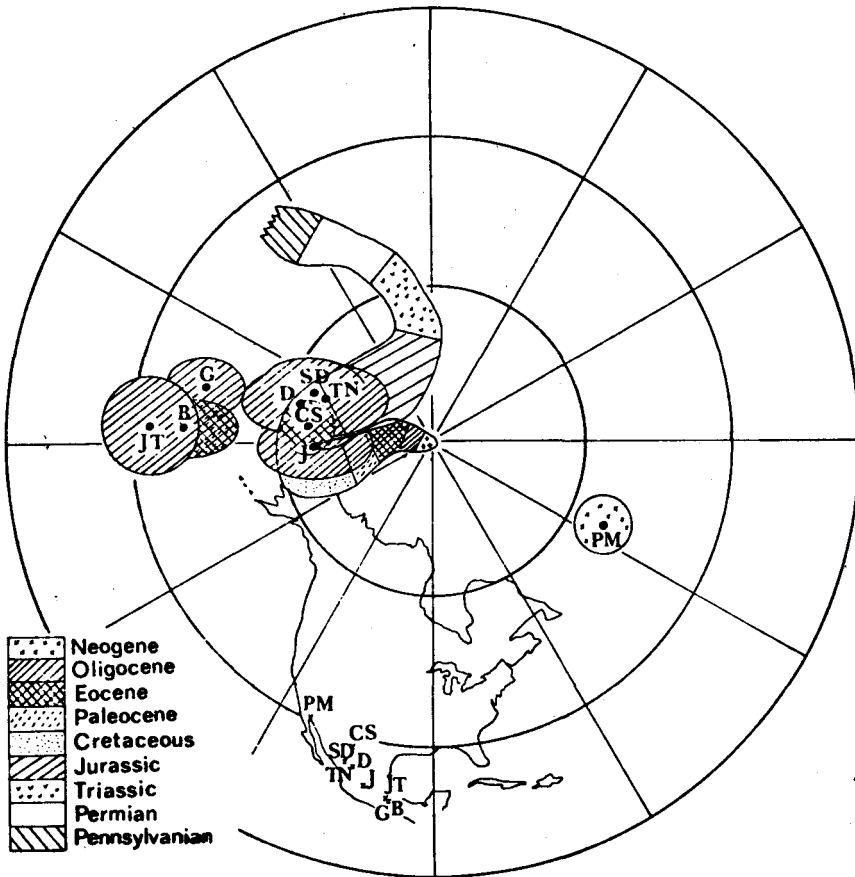


Fig. 4. Summary of mean pole positions for the Cenozoic of Mexico, which apparently deviate from corresponding segments of the apparent polar wander path for 'stable' North America (continuous curve). Letters refer to units studied: PM, Pliocene Muds; CS, capping series, Chihuahua; SD, Sinaloa-Durango volcanics; D, Durango volcanics; TN, Tepalcates-Navios, Durango; J, Jalisco volcanics; JT, Jantetelco granodiorites and volcanics; G, Guerrero volcanics, and B, Balsas red sediments. See Bobier and Robin (this issue) and Urrutia Fucugauchi (this issue, final paper) for details of some of the entries, and for interpretation and discussion. Age assignments are indicated by symbols, and sampling localities are given by the crosses in the sketch of Mexico. Note that all poles older than Neogene are displaced to the left of the reference path. (See Fig. 1 for additional details).

western Mexico (Fig. 1). Bobier and Robin's discussion centers on two possible explanations: (a) low-frequency large spatial variations of the geomagnetic field during the Oligocene and Early Miocene, and (b) anticlockwise tectonic rotation of the sampling area during the Tertiary, following the emplacement of the ignimbritic sequence.

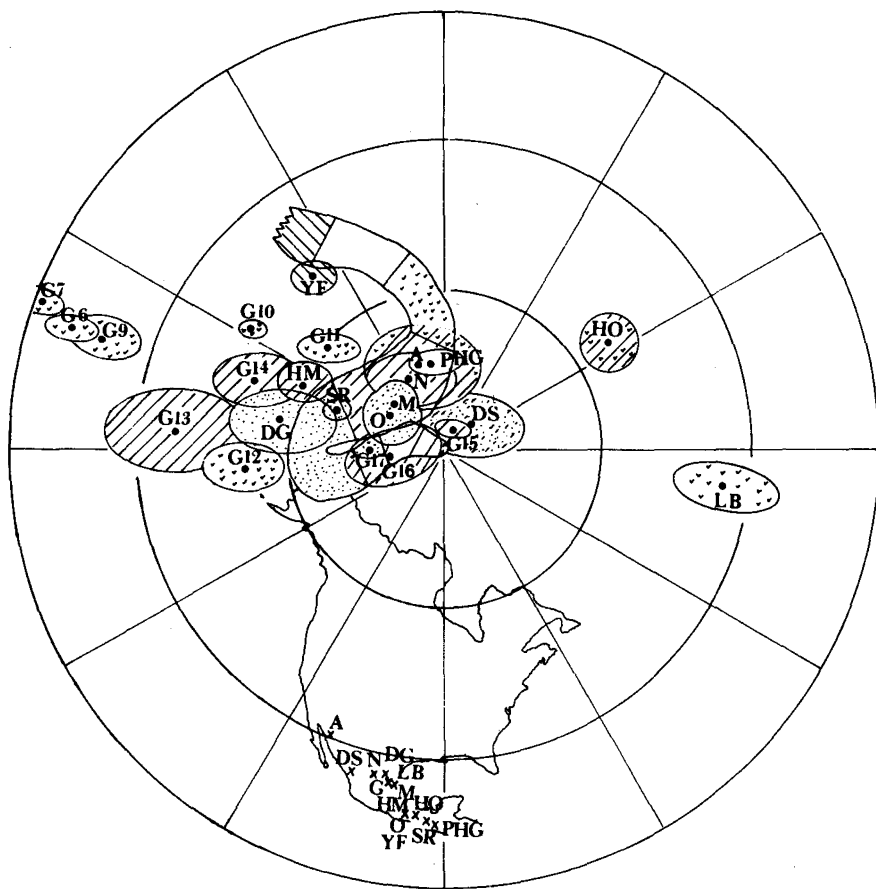


Fig. 5. Summary of mean pole positions for the Mesozoic and Palaeozoic of Mexico. Letters refer to sampling localities and units which are indicated in the map of Mexico: A, Jurassic units, Sonora; D-S, Durango-Sinaloa volcanics; N, Nazas Fm.; DG, Difunta Group; LB, La Boca Fm.; G, Triassic-Jurassic sediments; M, Mendez shale; HM, Huizachal red beds of northern Mexico; HO, Huizachal red beds of Oaxaca; O, Oaxaca limestones; SR, San Ricardo red beds; PHG, Paso Hondo and Gruperá Fm.; and YF, Yododeñe Fm. Details and references are given in Urrutia Fucugauchi (1982). Age assignments are indicated by the symbols which are explained in Fig. 4. See Figs. 2 and 3 for additional details of results for the Cretaceous and Jurassic.

Last paper by Urrutia Fucugauchi reports preliminary palaeomagnetic results from seven Lower Tertiary volcanic units from Morelos and Guerrero States, central-southern Mexico. Mean palaeomagnetic directions and pole positions diverge from corresponding results reported for other localities in northern Mexico and the United States (Figs. 1 and 4). Discussion in this paper is restricted to possible tectonic deformation of these areas in central-southern Mexico. Alternative explanations such as local geomagnetic field variations, magnetic anisotropy effects (e.g. see Bobier and Robin, this issue), secular variation effects, and local tectonics, cannot be definitely rejected. The possible tectonic model examined involves relative counterclockwise tectonic rotation of the sampling sites, possibly associated with regional compression and shear acting on blocks cut by large lateral strike-slip faults beneath the Mexican volcanic belt. Several studies in the past have proposed that this area of the volcanic belt represents a major crustal discontinuity, which may have acted as an efficient control for the magmatic activity (e.g. Molnar and Sykes, 1969). An oblique regional fault system has been mapped in the field (Mooser, 1972, 1975), and some studies have shown evidence for both right-lateral (e.g. Gastil and Jenschky, 1973) and left-lateral (e.g. Walper, 1980) strike-slip motion. Further investigations will help in establishing the presence and characteristics of such fault system.

Mexico is possibly one of the most intriguing and complex geologic tectonic areas in the world. Detailed geologic and palaeomagnetic investigations such as those reported in the papers of the two special issues of *Geofísica Internacional* have just begun. It is my hope that research reported in these two special issues will stimulate collaboration among research groups and individuals, which will certainly contribute to our understanding of the geologic history of this part of Earth.

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