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DYNAMICS AND EVOLUTION OF THE LITHOSPHERE - RESULTS AND PERSPECTIVES OF GEOPHYSICAL RESEARCH IN MEXICO

PART A

J. URRUTIA FUCUGAUCHI

GUEST EDITOR

Laboratorio de Paleomagnetismo y Geofísica Nuclear
Instituto de Geofísica, UNAM,
D. Coyoacán 04510, D. F., MEXICO

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J. Urrutia-Fucugauchi

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BIBLIOTECA
INSTITUTO DE GEOFISICA, UNAM
Apdo. Postal 99056
México 20, D. F. (MEXICO)

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SPECIAL VOLUME - PART A

J. URRUTIA-FUCUGAUCHI*
Guest Editor

PREFACE

The International Lithosphere Program (ILP) was established in September 1980 by the International Council of Scientific Unions (ICSU) on behalf of the International Union of Geodesy and Geophysics (IUGG) and the International Union of Geological Sciences (IUGS). This new international interdisciplinary research program for the decade 1980 - 1989 will focous mainly on the study of the nature, origin, dynamics and evolution of the lithosphere, seeking to provide an improved framework for understanding those aspects such as earth resources and hazards reduction on which human society depends for its well-being.

The ILP was initially organized in nine scientific Working Groups (ICL-WG) and eight Coordinating Committees (ICL-CC). Lists of the Working Groups and Coordinating Committees, and brief descriptions of main objectives and terms of reference may be found in ICL Report No. 1 (1981). Mid-term reports of activities of ICL-WG's and ICL-CC's are given in the ILP Newsletter (Inter-Union Commission on the Lithosphere, 1984). Details of the activities of the Mexican ILP Committee may be found in the ILP newsletters and ILP reports (GEOS Boletin, no. 2, 1984 & no. 2, 1985). The ILP has been recently re-organized from August 1985 into six working groups (WG), six coordinating committees (CC) and two subcommittees (SC).

* *Laboratorio de Paleomagnetismo y Geofísica Nuclear, Instituto de Geofísica, UNAM, D. Coyoacán 04510, D. F., MEXICO.*

Working Groups

WG-1: Recent plate movements and deformation
WG-2: The nature and evolution of the continental lithosphere
A: Variations in the nature and evolution of mobile belts
B: Plate motions and orogeny through time
C. Thermal, mechanical, chemical, and magmatic evolution of the continental lithosphere
WG-3: Intraplate phenomena
WG-4: The nature and evolution of the oceanic lithosphere
WG-5: Paleo-environmental evolution of the oceans and atmosphere
WG-6: Structure, physical properties, composition, and dynamics of the lithosphere-asthenosphere system

Coordinating Committees

CC-1: Environmental geology and geophysics
CC-2: Mineral and energy resources
CC-3: Geosciences within developing countries
CC-4: Continental drilling
CC-5: Data centres and data exchange
CC-6: National representatives

Subcommittees

SC-1: The Himalayan region
SC-2: The Arctic region

The Lithosphere Program has been primarily focussing on the study of the continental lithosphere. The study of the oceanic lithosphere has been very important in documenting the cinematics and dynamics of plate motions during the Mesozoic and Cenozoic, and in providing data for development of the theory of plate tectonics. However, since older oceanic lithosphere has been subducted and recycled within the mantle, the only record of the rest of the Earth's history, amounting to ~ 95%, is that preserved in the continents. The record is however complex and incomplete since the continental lithosphere has been affected by multiple discrete episodes of fracturing, deformation, magmatism and metamorphism, as a result of rifting, drifting, accretion, subduction, and collision.

Besides trying to provide a comprehensive perception of the origin and evolution of the Earth, the ILP also tries to provide an improved knowledge of the mineral and energy resources, natural hazards, and environmental relationships, so important for our human society and earth's life.

As part of the activities of the ILP Mexican National Committee, a special volume concerned with related studies of Mexico is being edited. This number of Geofísica Internacional includes eight papers written by fourteen different authors from several institutions, which constitutes the first part of the special volume.

In the first paper, Morán-Zenteno (UNAM, Mexico) presents a review and discussion of the tectonic evolution of Mexico. The geologic and tectonic structure of Mexico and nuclear Central America shows a very complex history of crustal integration and evolution. In this paper, the author presents a discussion on the major tectonic elements of basement and cover, and on their relations with global plate tectonic processes. A most comprehensive synthesis of available information has been recently reported by Morán-Zenteno (1984).

In the following paper, K. Cameron (U. California, USA), M. Cameron (U. Oklahoma, USA) and B. Barreiro (Darmouth College, USA) present a study of the ignimbrites from the Batopilas area, Chihuahua and a discussion about the formation of the crust beneath the Sierra Madre Occidental. These authors conclude that the extrusion of the voluminous rhyolitic ignimbrites and sparse interlayered andesitic and dacitic lava flows, and the emplacement of the underlying batholith mark a major crust forming event in northwestern Mexico.

In the third paper, Urrutia-Fucugauchi (UNAM, Mexico) presents a tectonic model for the evolution of the extensive magmatic province of northwestern Mexico. The model is mainly based on the spatial-temporal distribution of radiometric dates obtained from magmatic-arc-related rocks, which indicates a lateral W-E and E-W migration of magmatism across the province during the Late Mesozoic and Cenozoic. This magmatic province includes one of the largest rhyolitic provinces of the world (the Sierra Madre Occidental), and presents a complex evolution as a result of distinct tectonic phenomena of subduction, collision, accretion, transform faulting and rifting.

In the next paper, Nimz, K. Cameron (U. California, USA), M. Cameron & Morris (U. Oklahoma, USA) present results of a petrologic study of xenoliths from La Olivina mine, Chihuahua, and its implications for the lower crust and upper mantle beneath northern Mexico. These authors argue that the samples studied from La Olivina mine are identical in mineral assemblage and very similar in mineral chemistry to samples from Kilbourne Hole, New Mexico, and conclude that Precambrian craton, similar in age, metamorphism and protolith composition to that beneath Kilbourne Hole extends into northern Mexico.

In the fifth paper, Ferriz and Mahood (U. Stanford, USA) present a review and discussion of the rhyolitic volcanism of the Trans-Mexican volcanic belt (TMVB). Most of the discussion focuses on five major silicic volcanic centers - viz: La Primavera, Jalisco; Los Azufres, Michoacán; Amealco, México; Huichapan, Hidalgo and Los Humeros, Puebla - which occur behind the volcanic front of the TMVB formed by the active andesitic stratovolcanoes. These silicic volcanic centers are being studied because of their potential hazard to major population centers and their geothermal energy potential.

In the next paper, Padilla y Sánchez (UNAM, México) presents a synthesis and discussion of the post-Paleozoic tectonics and paleogeography of northeast Mexico. This model for the evolution of Mexico and the Gulf of Mexico includes lateral motion of parts of Mexico along major NW left-lateral fault systems and one right-lateral NNW fault system. The evolution of the area is depicted in a series of paleogeographic maps, which include the major geologic-tectonic elements of NE Mexico and the Gulf of Mexico.

In the next paper, Mota-Palomino (UNAM, Mexico), Andrieux (U. Paris, France) and B. Bonnin (IPG, Strasbourg, France) present a study of the seismotectonic characteristics of southern Mexico. In their study, they consider four distinct zones: Isthmus of Tehuantepec-Chiapas, Oaxaca, Guerrero-Michoacán and Jalisco-Colima. The first zone is considered transitional between a zone of high-subduction angle (Central America) and an 'anomalous' zone of low-subduction angle (Oaxaca). The Jalisco-Colima zone shows a marked reduction in the frequency of seismic activity.

In the last paper, Medina-Martínez (UNAM, Ensenada, Mexico) presents an analysis of the March-April 1982 eruption of El Chichón volcano. Based on volumes of erupted material and duration times, he estimates the heights and flow velocities

of the eruptive columns. With the velocity estimates, the internal pressure in the fragmentation level of the magma chamber was calculated The pressure data, treated as a function of water content and gassification temperature, gives the water percentage for the different eruption episodes. The high water percentage for the April 3 eruption and sudden growth of the crater are considered a probable cause for the resulting surges.

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J. Urrutia Fucugauchi, Chairman, National ILP Committee,
Member ICL-WG-2B and Correspondent Member ICL-WG-2

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