DYNAMICS AND EVOLUTION OF THE LITHOSPHERE – RESULTS AND PERSPECTIVES OF EARTH SCIENCES RESEARCH IN MEXICO

SPECIAL VOLUME – PART I

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INTRODUCTION

This number of Geofísica International includes the first part of a special volume being published as part of the activities of the National Committee for the International Lithosphere Program (ILP). The ILP was established in September 1980 by the International Council of Scientific Unions (ICSU), with the objectives of constituting the major international interdisciplinary research program of the decade 1981-1990. The Program is coordinated by the Inter-Union Commission of the Lithosphere (ICL), established at the request of the International Union of Geodesy and Geophysics (IUGG) and the International Union of Geological Sciences (IUGS). The establishment of ICL followed a long tradition of succesful international programs between the two unions organized in the previous decades. This time however after the five years evaluation, the two unions took an unprecedented step for Earth Sciences research. In a joint letter by the presidents of IUGG and IUGS, the request was made to extend the mandate of ICL and assure the continuation of the Lithosphere program. At the 21st General Assembly of IUGS (Berne, Switzerland) the resolution was approved and ICL continuation (with five years reviews and adequate membership rotation) was assured.

This step follows the recognition that new understanding of past, present and future working of our planet can best come from an effective joint approach in Earth Sciences. Traditionally, the background and membership of the two unions have been different, it will be the task of ICL to establish a solid link and provide the basis for joint interdisciplinary international ventures in Earth Sciences.

The present special volume of Geofísica Internacional has tried to include papers with geophysical and geological emphasis. Interdisciplinary studies are yet to appear

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and we hope it can be estimulated. Earth Sciences are in the midst of a major scientific 'revolution' (or rather in the developing of a new paradigm or research program), which is affecting virtually every field and forcing ever increasing interdisciplinary approaches. It is both a pleasure and an honor introducing this special volume on Earth Sciences research in Mexico. This first part includes seven papers on diverse aspects of Geophysics, Geology, Geochemistry, etc.

The central theme of the Lithosphere Program is the origin, evolution, dynamics, and past and current characteristics of the lithosphere (with special attention to the continents and their margins). The studies seek to provide, and also include, research on earth resources and hazard reduction, aspects for which human society depends for its well-being. Then, an ultimate quest of ILP is a consistent comprehensive understanding of our Earth. As current yet temporary passengers of planet Earth, it is our responsibility not only to search for an improved knowledge of the mineral and energy resources and natural hazards, important as they are for our survival, but to endeavour for a global perception of the planet and its life.

In the first paper, B. P. Hausback (California State University, USA) reports paleomagnetic results for Miocene volcanic rocks from southern Baja California peninsula and presents two evolutionary models for the tectonics of northwestern Mexico during the Cenozoic. The mean paleomagnetic pole position for Baja California Sur is not statistically different from the Middle Tertiary North American pole, supporting that latitudinal tectonic movement of the peninsula has been restricted to the 2° northward movement estimated from the marine magnetic anomaly studies in the Gulf. On the other hand, the peninsula and mainland Mexico may have experienced a counterclockwise tectonic rotation prior to the rifting of the Gulf of California. The Gulf development then resulted in a clockwise tectonic rotation of the peninsula. Therefore, as may be expected, the tectonic evolution of the peninsula and Gulf of California are linked to the evolution of northern Mexico and the continental margin and that prior to the drifting event the peninsula shared a common (perhaps quite complex) tectonic history.

In the next paper, D. J. Morán-Zenteno, J. Urrutia-Fucugauchi, H. Böhnel and and E. González-Torres (Institute of Geophysics, UNAM, Mexico) report results of a paleomagnetic study of sedimentary Jurassic units from Oaxaca State, southern Mexico. The tectonic and paleogeographic evolution of southern Mexico have been subjects of considerable interest and also of debate. Units studied include the Callo-

vian Yucuñuti Formation and the Oxfordian Caliza con Cidaris. The units are part of the Mixteco terrane, which during most of the Mid-Late Jurassic experienced subsidence in a tensional regime. The fluvial to marine sedimentary sequence may have been related to the paleo-Pacific ocean. Following the paleomagnetic results, the authors interprete a northward latitudinal displacement and a counterclockwise 18-to-30 rotation of the Mixteco terrane relative to 'stable' North America. The tectonic movement may have occurred some time between the Oxfordian and the Albian.

In the third paper, H. Köhler, P. Schaaf and D. Müller-Sohnius (University of Munich, FRG), R. Emmermann (University of Giessen, FRG), J. F. W. Negendank (University of Trier, FRG) and H. J. Tobschall (University of Hannover, FRG) present a geochronological and geochemical study of the intrusive complex of Puerto Vallarta, Jalisco State, Mexico. The Puerto Vallarta complex is located at a presently complex plate tectonic setting in the southern Mexico continental margin. To the east, the limit is with the Rivera plate and immediately to the south there is the western limit of the Middle America trench where the Cocos plate is being subducted beneath the continent. In the past, the tectonic relationships, and the tectonic evolution, may have also been complex. The margin apparently experienced a process of tectonic truncation (possible related to the Gulf of California rifting process). The complex has been grouped within the Guerrero terrane, a composite tectonostratigraphic entity characterized by magmatic arc rock assemblages whose origin and tectonic relationship with the margin are then of particular interest. The isotopic and geochemical results reported by Köhler and coworkers indicate low initial Sr ratios compatible with a mantle origin of magma. The intrusion age of the granitoid is between 97 and 88 Ma (biotite cooling ages are 83 Ma for Rb-Sr system and 86Ma for the K-Ar system). The corresponding cooling rate estimated is 35°C per 1 Ma. The complex was then intruded during Late Cretaceous times. Adequate isotopic studies of granitoids exposed along the continental margin such as the one reported here may permit to document the magmatic and tectonic history during Late Mesozoic-Early Cenozoic time.

In the fourth paper, E. González-Partida (IIE, Cuernavaca, Mexico) and V. Torres-Rodríguez (DEP, Faculty of Engineering, UNAM, Mexico) present a regional geologic synthesis of the continental margin and central portions of Mexico and of their associated mineral deposits. These authors present a paleogeographic interpretation at various times in the Mesozoic and Cenozoic. Major metallogenic provinces appear

roughly parallel to the present coastline and are interpreted as a result of Upper Cretaceous to Middle Tertiary magmatic arc processes. The mineral deposits characteristics and geographic distribution are related to lateral migration of the magmatic activity across the continental margin.

In the next paper, Z. Jurado-Chichay, J. Urrutia-Fucugauchi and D. J. Morán-Zenteno (Institute of Geophysics, UNAM, Mexico) report paleomagnetic results for a Middle Cretaceous carbonate sequence and discuss the effects of folding and internal deformation on the corresponding paleomagnetic record. Initially, most paleomagnetic studies with tectonic objectives were conducted in sequences not affected by tectonic deformation. They are important in many respects and successfully permited to unravel the paleogeographic and tectonic evolution of the major continental land masses (leading to the development of the theories of Continental Drift, Sea-floor Spreading and Plate Tectonics). More recently however, it has become apparent that to understand the orogenic processes, the evolution of continental margins, accretion zones, the tectonostratigraphic 'tectonics' etc., units deformed and metamorphosed must now be studied. For successful use of paleomagnetic data in tectonic problems, the effects of strain in the paleomagnetic record then should be first understood and if possible properly be taken into account. The study reported by Jurado-Chichay and co-workers documents that strain is capable of effectively modify the geometric relationships of the remanent magnetization. Nevertheless, the pre-folding and internal deformation paleomagnetic record can still be recovered. Results are interpreted in terms of the passive markers rotation model, where the strongly consistent assymetric strain effects are due to flexural folding and internal deformation.

The next paper, by E. Mosheim and E. Althaus (Karlsruhe University, FRG), report on a chemical and optical study of geologic and archaeological obsidians from Mexico. Obsidian was an important material in ancient Mexico, readily available in the extensive volcanic province of central Mexico. The detailed characterization of archaeologic obsidians and of naturally occurring obsidians from potential source areas is clearly of great importance. In their paper, they present a procedure to characterize the volcanic glass using microscope photometry. The absorption behaviour depends on the chemical composition, which if widely variable can then permit characterization and provenance investigations. Based on their results, Mosheim and Althaus distinguish several obsidian-supply areas in central Mexico (within the Trans-Mexican volcanic province) and speculate on the archaeologic context for provenance relationships.

In the last paper, T. Besch (University of Mainz, FRG), H. J. Tobschall (University of Hannover, FRG), J. F. W. Negendank (University of Trier, FRG) and R. Emmermann (University of Giessen, FRG) report on a geochemical study of volcanic rocks from the eastern Trans-Mexican volcanic belt. Besch and co-workers present data of major, trace and REE (rare earth elements) for calcalkaline and alkaline volcanic rocks and discuss them in terms of magma generation and geotectonic setting. The Trans-Mexican volcanic province has long attracted interest of workers for the apparently complex characteristics and the peculiar geometric arrangement for a subduction zone-magmatic arc system.

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