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The Zitácuaro Volcanic Complex, Michoacán, Mexico: magmatic and eruptive history of a resurgent caldera

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RESUMEN

El Complejo Volcánico de Zitácuaro descansa sobre un basamento mesozoico constituido por rocas metamórficas (Jurásico Tardío-Cretácico Temprano), rocas volcánicas, calizas y capas rojas del Cretácico. La actividad volcánica propia del Cinturón Volcánico Mexicano comenzó en esta zona durante el Mioceno Temprano con la formación de un estratovolcán (30x15 km) constituido por rocas andesíticas calcialcalinas. Para el Mioceno Medio (12 Ma), un cambio importante en la actividad volcánica del edificio provocó la formación de una caldera denominada "Las Tres Chicas", la cual tiene un diámetro de 30 km aproximadamente. La actividad post-caldérica consistió de tres eventos eruptivos de resurgencia dómica que ocurrieron hace 12 Ma, 5 Ma y 0.5 Ma respectivamente. Cada evento estuvo caracterizado por la intrusión de domos dacíticos y la generación de flujos piroclásticos que se emplazaron en el interior del recinto caldérico, y por la emisión de flujos de lavas pericaldéricas. La periodicidad de la actividad volcánica, la presencia de domos relativamente jóvenes (e.g. Cacique) y la actividad sísmica registrada en la zona, son evidencias que sugieren que el Complejo Volcánico de Zitácuaro debe ser considerado como un área potencialmente activa.

PALABRAS CLAVE: Cinturón volcánico mexicano, caldera, resurgencia dómica.

ABSTRACT

The Zitácuaro Volcanic Complex (ZVC) rises on a basement of metamorphic rocks of Late Jurassic to Early Cretaceous age, and volcanic rocks, limestones, and red beds of Cretaceous age. Volcanic activity related to the Trans-Mexican Volcanic Belt started during Early Miocene with the eruption of calc-alkaline andesites that formed a primitive stratovolcano covering an area about 30 km x 15 km. A major change in eruptive style occurred during Middle Miocene, when a caldera structure formed, "Las Tres Chicas Caldera", approximately 30 km in diameter and dated about 12 Ma. Post-caldera activity consisted of three eruptive episodes of intra-caldera dome resurgence around 12 Ma, 5 Ma, and 0.5 Ma. Each episode featured the intrusion of dacitic central domes, the generation of pyroclastic flows and peri-caldera andesitic lava flows. The activity at the ZVC features recurrent volcanic episodes, the most recent one with emplacement of young resurgent domes such as Cacique. Local seismic activity in the area felt at Zitácuaro, is persistent. The ZVC should be considered as a potentially active volcanic zone.

KEY WORDS: Trans-Mexican volcanic belt, caldera, resurgent domes.

INTRODUCTION

The Zitácuaro Volcanic Complex (ZVC), located in the Trans-Mexican Volcanic Belt (TMVB), covers about 700 km² from Heroica de Zitácuaro, Michoacán, to Donato Guerra in the State of Mexico (Figure 1). The ZVC has not been systematically studied during this century, but a few geological studies were carried out during the last two decades. Previous studies (Demant, 1978; Silva-Mora, 1979) mention the Zitácuaro region as the type locality for the metamorphic Jurassic basement, but no reference to the volcanic rocks is made. Recently, the ZVC was mapped and identified for the first time as a dacitic dome complex (Pasquaré et al., 1991); but the volcanic stratigraphy was not described. Demant (1978) described a fallout deposit in the Palizada region, NW of Zitácuaro, but identified it erroneously as a product of Nevado de Toluca Volcano (Lower Toluca Pumice).

Detailed geological reconnaissance of the ZVC was carried out by Garduño et al. (1993b), Capra et al. (1994), Capra (1994), Lafranconi (1994), and Lastella (1994). They produced a composite geological map (scale 1:25,000) based on the enlarged INEGI 1:50,000 topographic sheets. These studies recognize that the distribution of the volcanic products and collapse features are related to a caldera-like structure.

In this paper we present new geological data and we reevaluate previous results on the volcanological evolution of this complex. We describe the tectonic setting of the ZVC in the geological context of the TMVB and its eruptive history based upon detailed stratigraphic data, chemical and petrographic analyses of selected rocks, and radiocarbon data.

REGIONAL TECTONIC SETTING

The ZVC is located in the central sector of the TMVB (Pasquaré et al., 1987). It features three tectonic structures (Figure 2a) marked by lineaments of volcanic edifices and explosion craters. (1) The eastern area is dominated by a NNW-SSE fracture system corresponding to the San Miguel de Allende-Taxco normal fault system (Demant, 1978), or to the Querétaro fracture zone (Nixon et al., 1987; Garduño and Gutiérrez, 1992). This system shows evidence of a Miocene transcurrent component and a reactivation during the Pliocene. (2) The southwestern area includes the Tertiary Tzizio antiform system (Mauvois 1977; Bonassi, 1994; Mennella, 1994; Ferrari et al., 1990); (3) The northern area accommodates an E-W fault system related to the Acambay graben of Pleistocene age (Suter et al., 1992).

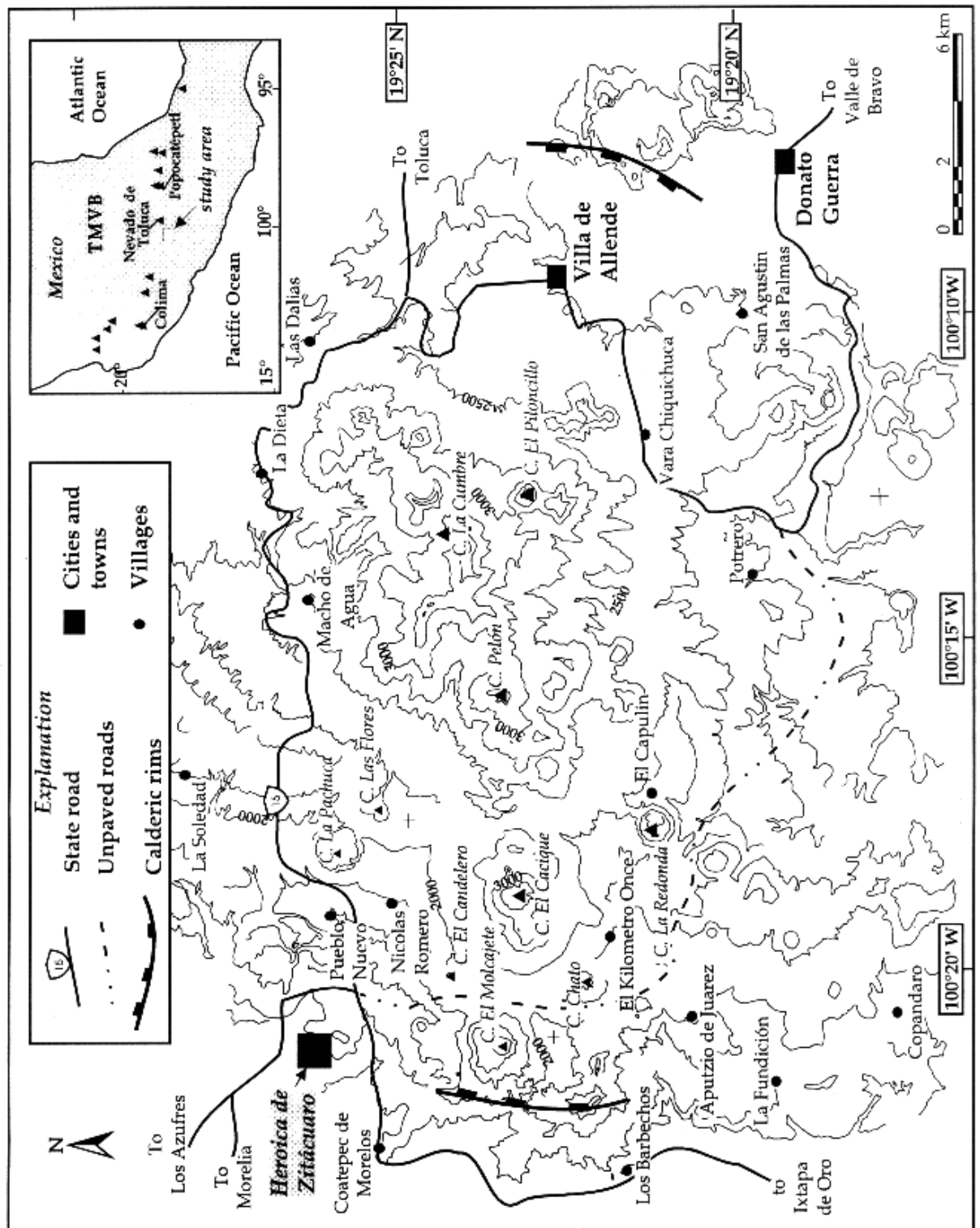


Fig. 1. Localization map of the Zitácuaro Volcanic Complex (ZVC). Small inset shows the location of the study area within the TMVB. The two identified lines show the locations calderas remnants.