*International Journal of Research in Engineering and Science (IJRES)*
*ISSN (Online): 2320-9364, ISSN (Print): 2320-9356*
*www.ijres.org Volume 10 Issue 3 ǁ 2022 ǁ PP. 45-48*

# Conceptual Model of Geothermal Manifestation in Pajacuaran, Mich.

José Martínez Reyes *[1],Ignacio Moreno Nava[1], Iván Vera Romero [1], Osbaldo OrdazMurillo [1], Agustina Ortiz Soriano [1].
[1]*University of the Ciénega of Michoacán de Ocampo State*
*Av. Universidad 3000, Sahuayo, Michoacán, Mex.*

***ABSTRACT***
*The area of the Ciénega de Chapala is to the east of the rift Cítala that houses a geological system that gives rise to the regional hydrothermal activity, mainly the Ixtlan and Pajacuaran fault lines. The regional geothermal activity is composed of a superficial hydrothermalism consisting of springs and hot water wells with temperatures between 48 and 94 C in Ixtlan de losHervores and San Juan Cósala as well as mud volcanoes in Los Negritos. The waters and gases of these hydrothermal manifestations have physical and chemical characteristics that indicate the presence of geothermal fluids.*
*In the present work a theoretical-conceptual model of the locally studied geothermal manifestation (Pajacuaran fault) is proposed in the town of Pajacuaran, Michoacán, at the coordinate point 20 ° 7 '38.8 "N and -102 ° 32' 57 , 0 "O. Based on the study with a GPR GSSI SIR2000 georadar with a 200 MHz antenna, dielectric variable 4 and measurement of gas emanation temperatures through the fault ($CO_2$ at 200 C) with a BACHARACH PCA 3 gas analyzer and a Fluke Ti 32 IF FUSION thermograph.*
*Which allows to propose as a conceptual theoretical model, the rise of geothermal fluids ($CO_2$) through the fracture of the Pajacuaran fault from a magmatic chamber at a determined depth, manifesting as a local geothermal manifestation.*
***KEY WORDS:*** *GEOTHERMAL STUDY, PERIBAN, MICHOACAN*

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Date of Submission: 01-03-2022 Date of acceptance: 12-03-2022

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## I. INTRODUCTION

The Michoacán zone of the Ciénega de Chapala is located to the east of the Citala rift that gives rise to the graben and Chapala lake. The graben is delimited by a couple of faults that allow the geothermal activity of the region: the Pajacuaran and Ixtlán faults (Gómez Tuena et al, 2005).

STUDY AREA

Regional geology

The Ixtlan fault forms part of the north flank of the Chapala graben with a length of 30 km in NW-SE alignment along the course of the Duero river, the fault is visible by a series of superficial hydrothermal manifestations (Rosas et al, 1989; Viggiano and Gutiérrez, 2007), while the Pajacuaran fault is part of the south edge of the graben with a length of 20 km in EW orientation (Rosas and Olguín, 1981, Viggiano and Gutiérrez, 2007). The stratigraphy of the area is mainly composed of andesites and basalts from the Late Tertiary (Late Miocene) to the Quaternary (Late Pleistocene) periods that emerge in the southern part of the region interspersed with lake sediments, mainly limonites and Pliocene dolomites, which emerge in the center west and north of the area (Rosas et al, 1989, Viggiano and Gutiérrez, 2007).

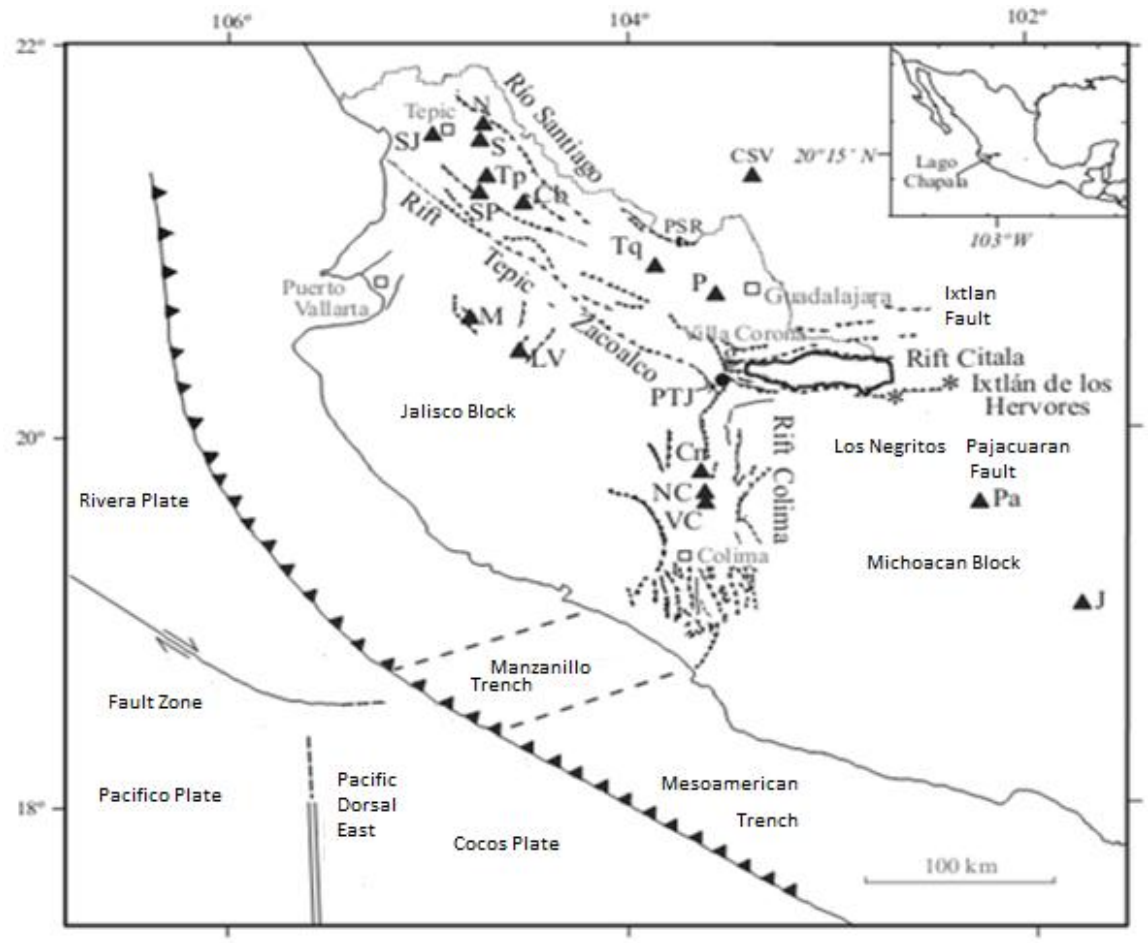
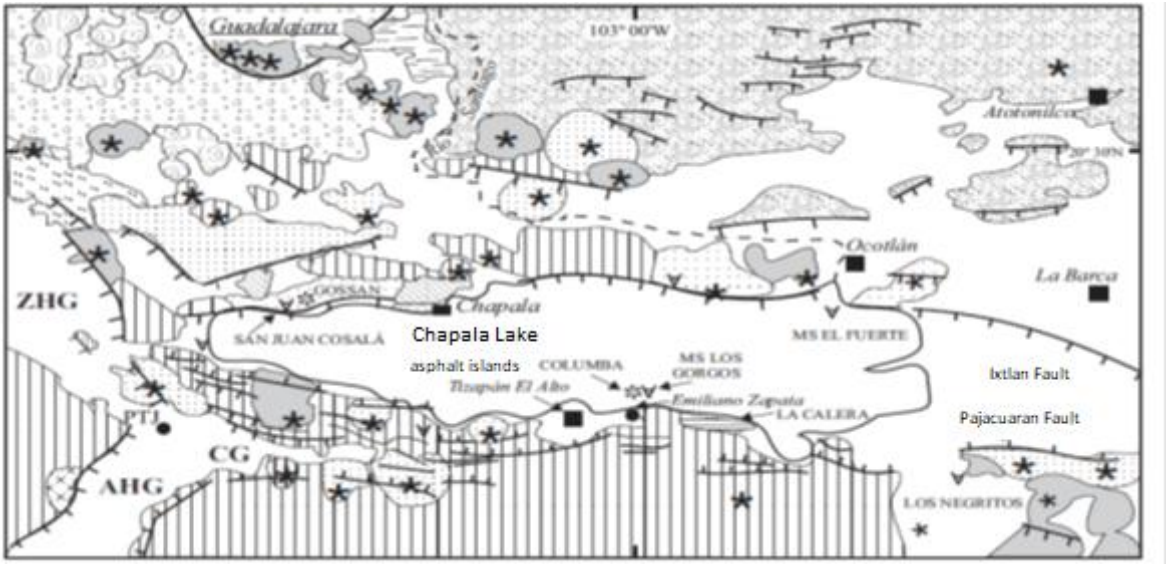



**Figure 1**: Regional Geology (Modified from Zarate and Simoneit, 2005)

Geothermal of the Zone

The regional geothermal system consists of a surface hydrothermal activity of springs and hot water wells with temperatures between 48 and 94 C in Ixtlán de losHervores (Quijano and Chacón, 1982, Tello, 1986a, Viggiano and Gutiérrez, 2007) as well as Mud volcanoes in the Negritos (Villamar, Zarate and Simoneit, 2005). The waters of these hydrothermal manifestations are mainly of the sodium chloride type with a boron content that indicates the presence of geothermal fluids, in turn the gases of the same manifestations show a characteristic composition of geothermal gases. The geothermometers of both fluids result in geothermal reservoirs of medium temperature (125 to 225 C) for the area (D'Amore and Panichi, 1980, Tello, 1986b, Viggiano and Gutiérrez, 2007). On the other hand, the isotopy of the waters shows an 18 ($^{18}O$) oxygen enrichment typical of geothermal environments (Tello, 1986b, Viggiano and Gutiérrez, 2007). All the above characteristics together result in a possible geothermal reservoir of wide fracture (amplitude of fault greater than 100 m) of low relief with a phreatic level of maximum 3 m depth.




*Monogenetic volcanoes. V Geothermal manifestations
Figure 2: Geothermal Manifestations of the Ciénega de Chapala
(Modified from Zarate and Simoneit, 2005)

CONCEPTUAL MODEL OF GEOTHERMAL MANIFESTATION IN PAJACUARAN

In the present work a theoretical-conceptual model of the locally studied geothermal manifestation (Pajacuaran fault) is proposed in the town of Pajacuaran, Michoacán, at the coordinate point 20 ° 7 '38.8 "N and -102 ° 32' 57 , 0 "O. Based on the study with a GPR GSSI SIR2000 georadar with a 200 MHz antenna, dielectric variable 4 and measurement of gas emanation temperatures through the fault ($CO_2$ at 200 C) with a BACHARACH PCA 3 gas analyzer and a Fluke Ti 32 IF FUSION thermograph.

Which allows to propose as a conceptual theoretical model, the rise of geothermal fluids ($CO_2$) through the fracture of the Pajacuaran fault from a magmatic chamber at a determined depth, manifesting as a local geothermal manifestation, as described in next figure:

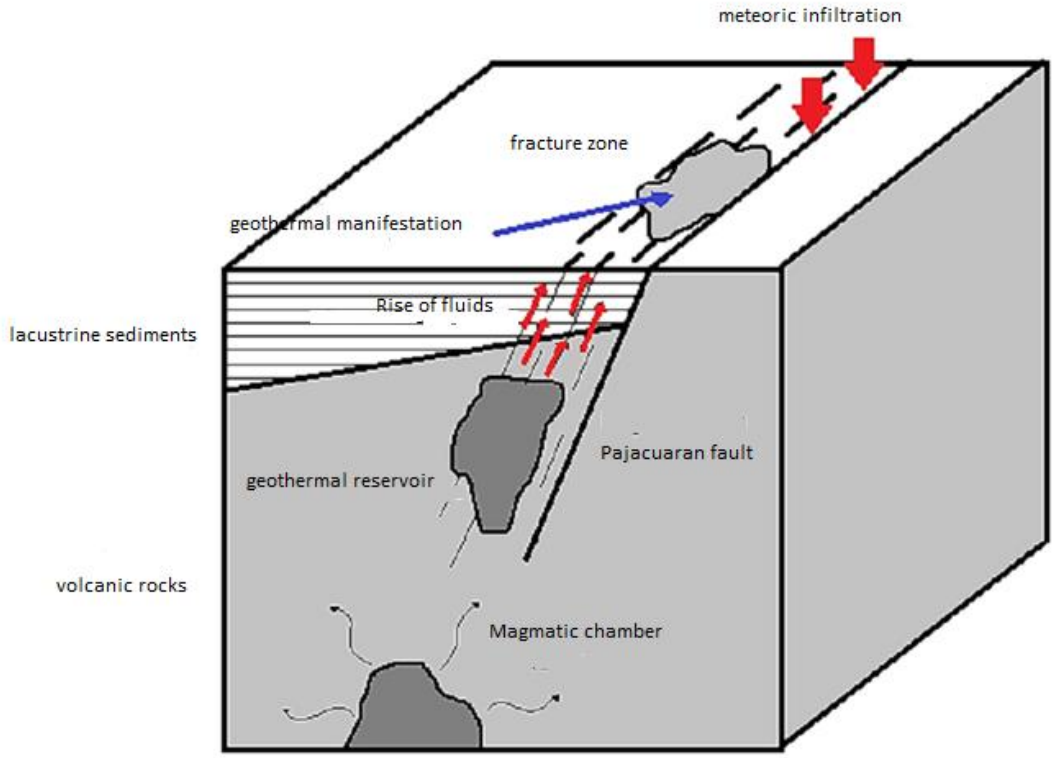



Figure 3: conceptual model of the geothermal manifestation in Pajacuaran, Mich.

## II. CONCLUSIONS

In the present work, based on the described study is proposed as a conceptual theoretical model, the rise of geothermal fluids ($CO_2$) through the fracture of the Pajacuaran fault from a magmatic chamber at a determined depth, manifesting as a local geothermal manifestation.

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