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GEOTHERMIC EXPLORATION IN THE HUMEROS-DERRUMBADAS AREA

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ABSTRACT

According to the geological, geochemical, mercury tracers and thermometry surveys, the area of Los Humeros Derrumbadas is a good prospect to look for a commercial geothermal field.

The heat source is probably provided by intrusive igneous rocks which underlie a thick layer of limestone. This limestone constitutes the possible reservoir due to the fractures caused by folding and faulting.

The cap rock is made of lacustrine sediments, ignimbrite and pyroclastic rocks, and the shaly sandy soils as well, which cover most of the area.

INTRODUCTION

The survey area is located to the east of Mexico City and includes a regional area of probably 7000 km^2 within the states of Puebla and Veracruz. The limits of the area are: to the east, the Pico de Orizaba volcano, which is the highest in Mexico (5700 M.A.S.L.) and the Cofre de Perote volcano (4282 M.A.S.L.), both being part of one range with trending north-south; to the west, the Tlaxco Range and the Malinche volcano (4461 M.A.S.L.); to the north, Chignautla and Tezompan Ranges, and to the south there is a series of northwest-southeast ranges in the neighborhood of the town of Tecamachalco (Fig. 1).

According to the geothermal exploration methods proposed by OLADE (Organización Latinoamericana de Energía), a first stage consisted of the collection of all the geological, geophysical, geochemical information, including topographic maps, aerial photos, etc., of the area. At the second stage, a fotogeological survey was made and then a regional geological reconnaissance.

The geological study made in semi-detail (1:50,000 scale) permitted the recognition of the genetical relationship between the thermal anomalies on the surface in regard to the subsurface. This led to a proposal of a first geothermical model of the area in order to plan additional work.

On the basis of the first geological results, a water and gas geochemical survey of the area was programmed in order to have knowledge of the area and also with the purpose of locating the most attractive zones from the geochemical point of view. At the moment, this survey is in the analysis and interpretation stages.
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A mercury tracer survey is now going on in the field, and will cover a complete regional area using a 5 km grid. Upon the completion of this grid, a 1 km one will be carried on over the anomalous area. The last survey of this regional geothermal exploration includes the thermometry of the lakes from volcanic origin.

The purpose of this survey is to evaluate a possible heat-flow anomaly. The caldera's lakes are 60 m deep on the average. Where found, the deeper limestone aquifers do not have a relationship to the shallow lacustrine aquifers located between 0-400 m below the surface.

GEOLOGY

A semi-detailed geological survey revealed that igneous and metamorphic rocks from Paleozoic age make up the regional basement, from which outcrops in the north side of the area can be observed as a dome locally, named "Macizo de Teziutlan." The batholith rocks consist of pink granite, a series of andesite and rhyolite porphyries, and green schist metamorphic rocks.

Overlying the basement rocks are thick beds of limestone of Jurassic and Cretaceous ages, which outcrop mainly in the middle and in the south parts of the area; and seldom in the north side. Such limestone formations were subjected to southwest stresses, producing northwest southeast folding (Sierra Madre Oriental). When this happened, a series of intrusive igneous rocks of acidic composition were emplaced in the middle part of the area, as can be shown by sienite, aplite and granodiorite towards the north side. The intrusion produced metamorphism in the affected limestone, reconstituting it, partially to marble and hornfels (Fig. 2).

During the Miocene, an episode of very intense igneous activity produced the outpouring of lava

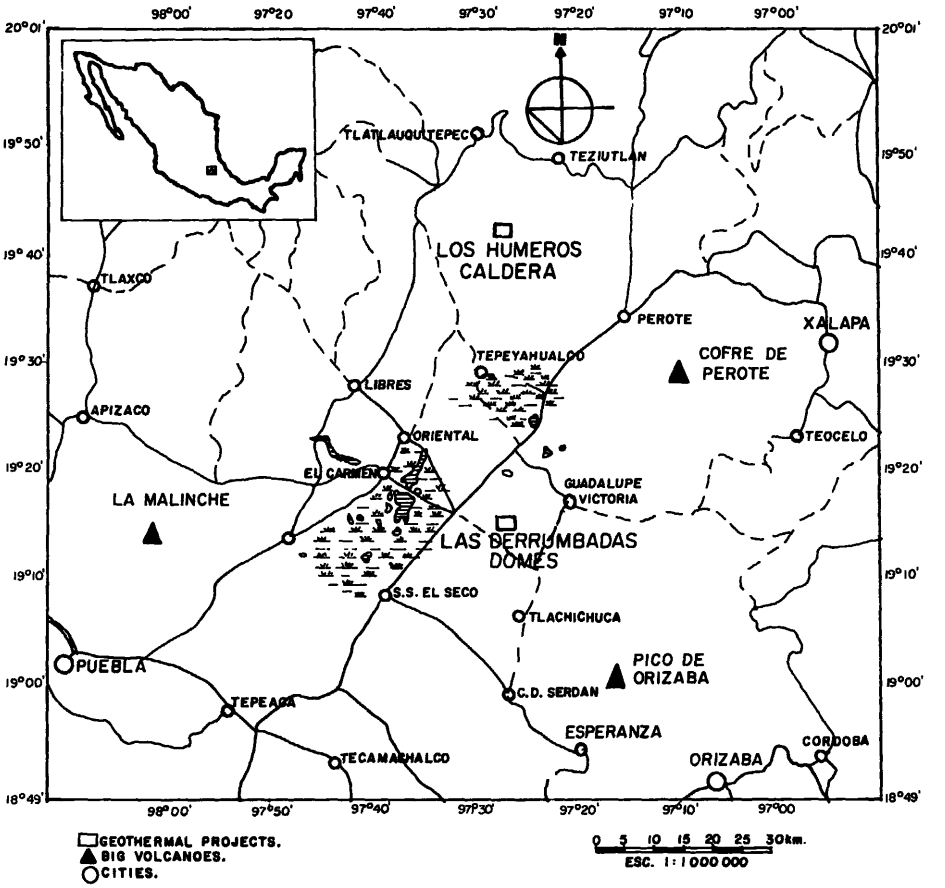

FIG. 1:- LOCATION MAP.

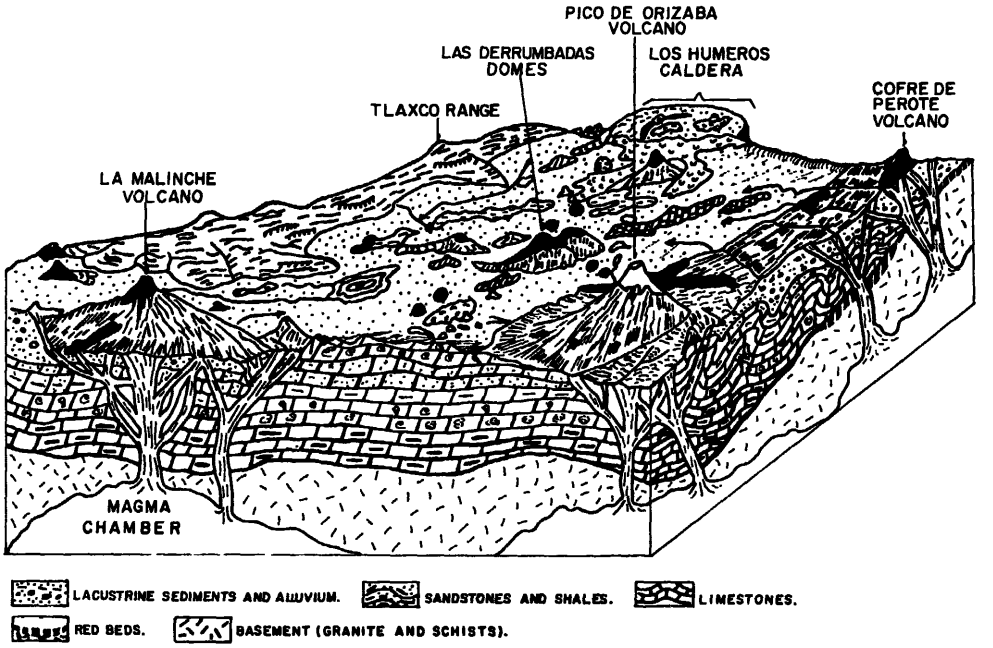

FIG. 2.-
ISOMETRIC DIAGRAM OF THE HUMEROS–DERRUMBADAS GEOTHERMAL PROJECTS.

and the formation of a number of good sized volcanoes, such as the Cofre de Perote, then La Malinche, and finally the Pico de Orizaba, which is Plio-Quaternary in age.

These volcanoes have rocks of intermediate composition, such as augite and hiperstene andesites; only the Malinche rocks are hornblende andesites.

Simultaneously the valley and depressions were filled with pyroclastic rocks (tuffs, volcanic sand, and volcanic ashes) as well as the materials from erosion of limestone. The result was a large lacustrian basin at the middle area, named Cuenca Libres-Oriental; the thickness of the sediments are 400 m in some places, as can be seen at the northeast northwest, southwest, where the topography consists of deep canyons on limestone rocks. During the Quaternary, the igneous activity has continued vigorously in the whole area, volcanoes, domes, cinder cones and collapse and explosive calderas. The volcanic structures such as Humeros caldera and Las Derrumbadas domes were formed during this time. Those structures bear surface thermal manifestations.

The unusual amount of materials derived from crater explosions and the presence of such craters in the middle and southern parts of the area under study do suggest a near-surface magma. Accordingly, the explosion craters can partake of a different nature: they can be phreatic, phreatic-magmatic and magmatic.

CONCLUSIONS

The general characteristics of the area, so far studied, suggest the possibility of a good geothermal prospect: there is good evidence for a source of heat deep and large enough. Such an indication is confirmed by the presence of young volcanoes, cinder cones and collapse and explosive calderas.

The reservoir may be conceived as being formed within the limestone body. In spite of low porosity and permeability at the surface, it could, however, noticeably improve at depth because solution cavities might have a tendency to increase with depth, a fact supported by folding, faulting, plus the physical-chemical action of hot water.

The impermeable cap of the reservoir can be considered to be made of a diversity of geological formations, mostly made up of well consolidated sediments including pyroclastic rocks (tuffs, volcanic ashes and volcanic sand); also clays, conglomerates and soils.

At the present, the status of the exploration work covers geological, geochemical and hydrogeological studies. A geothermic model of the area is being devised, and it will help to program geophysical investigations; the immediate main objective is to delineate the zone, or the zones interesting enough to justify drilling of test wells.

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