Geophysical Research Abstracts
Vol. 16, EGU2014-3231, 2014
EGU General Assembly 2014
© Author(s) 2014. CC Attribution 3.0 License.

The structural architecture of the Los Humeros volcanic complex and geothermal field, Trans-Mexican Volcanic Belt, Central Mexico

Gianluca Norini (1), Gianluca Groppelli (2), Roberto Sulpizio (3), Gerardo Carrasco Núñez (4), and Pablo Davila Harris (5)

(1) Consiglio Nazionale delle Ricerche, Istituto per la Dinamica dei Processi Ambientali, Milano, Italy (gianluca.norini@cnr.it), (2) Consiglio Nazionale delle Ricerche, Istituto per la Dinamica dei Processi Ambientali, c/o Università degli Studi di Milano, Milano, Italy, (3) Dipartimento di Scienze della Terra e Geoambientali, Università degli Studi di Bari, Bari, Italy, (4) Centro de Geociencias, Universidad Nacional Autonoma de México, Queretaro, Mexico, (5) Division de Geociencias Aplicadas, Instituto Potosino de Investigacion Científica y Tecnologica, San Luis Potosi, Mexico

The development of geothermal energy in Mexico is a very important goal, given the presence of a large heat anomaly, associated with the Trans-Mexican Volcanic Belt, the renewability of the resource and the low environmental impact.
The Quaternary Los Humeros volcanic complex is an important geothermal target, whose evolution involved at least two caldera events, that alternated with other explosive and effusive activity. The first caldera forming event was the 460 ka eruption that produced the Xaltipan ignimbrite and formed a 15-20 km wide caldera. The second collapse event occurred 100 ka with the formation of the Zaragoza ignimbrite and a nested 8-10 km wide caldera. The whole volcano structure, the style of the collapses and the exact location of the calderas scarps and ring faults are still a matter of debate. The Los Humeros volcano hosts the productive Los Humeros Geothermal Field, with an installed capacity of 40 MW and additional 75 MW power plants under construction. Recent models of the geothermal reservoir predict the existence of at least two reservoirs in the geothermal system, separated by impermeable rock units. Hydraulic connectivity and hydrothermal fluids circulation occurs through faults and fractures, allowing deep steam to ascend while condensate flows descend. As a consequence, the plans for the exploration and exploitation of the geothermal reservoir have been based on the identification of the main channels for the circulation of hydrothermal fluids, constituted by faults, so that the full comprehension of the structural architecture of the caldera is crucial to improve the efficiency and minimize the costs of the geothermal field operation.
In this study, we present an analysis of the Los Humeros volcanic complex focused on the Quaternary tectonic and volcanotectonics features, like fault scarps and aligned/elongated monogenetic volcanic centres. Morphostructural analysis and field mapping reveal the geometry, kinematics and dynamics of the structural features of the studied area. The integration of these structural data with available stratigraphy, geological maps and well logs is used to propose a new model of the caldera and geothermal field.
As a result of our study, we interpret the Xaltipan and Zaragoza calderas mainly as trap-door structures. These calderas affected a cone-shaped volcanic sequence, formed mainly by effusive products emitted in the pre-caldera forming phase and now hosting the geothermal reservoir (11-1.5 Ma). The main ring faults of the two calderas are buried and sealed by widespread post-calderas volcanic products, and for this reason probably do not have enough secondary permeability to be main channels for hydrothermal fluid circulation. Active, fast-moving subvertical faults have been identified inside the Zaragoza caldera depression. These structures affect recent post-caldera pyroclastic deposits and probably are related both to active resurgence inside the caldera and to regional faults NW-SE striking. The presence of active faults generating high secondary permeability is the most important structural element shaping the geothermal reservoir. Future plans of expansion of the geothermal field should focus on these active faults, considering their geometry at depth and the whole structural architecture of the Los Humeros volcanic complex.