Field and lab characterization of fault zone in geothermal areas in central Mexico

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Introduction

There are more than 500 geothermal areas in the Trans-Mexican Volcanic Belt of central Mexico. Of these, two are presently object of a transnational project between EU and Mexico (GEMex): Acoculco (Canet et al., 2015), where there is already a commercial exploitation, and Los Humeros (Portugal et al., 2002), not developed yet.

The GEMex project aims to improve the resource assessment and the reservoir characterization using novel geophysical (Griffith at al., 2015; Guglielmetti et al, 2013) and geological (Cilona et al., 2012; Liotta et al., 2015) methods and interpretations.

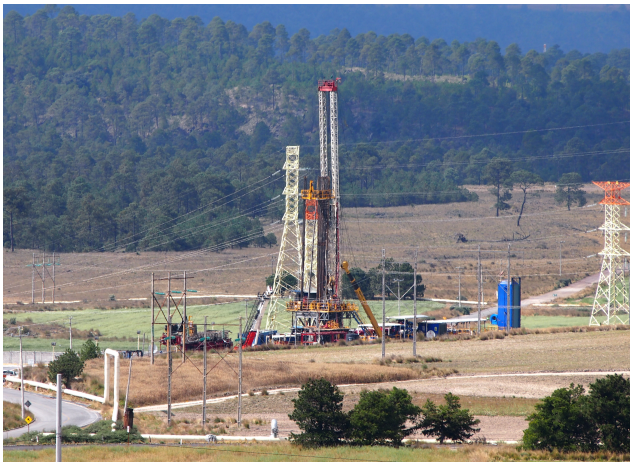

Figure 1: A drilling rig operating at Los Humeros.

Methodology and expected results

One of the main issues controlling the geothermal system is the presence of pervasive fracture systems affecting the carbonatic basements underlying the volcanic complex (basalts and andesites). We propose the characterization of rock masses (rock and fractures) using a multiscale analysis, from the field to the outcrop down to the microscale integrating a wide variety of techniques.

In detail, the research unit from the University of Torino is supposed to perform:

1) technical field studies and geomechanical surveys aimed to the characterization of the mechanical transitions throughout brittle deformation zones, from the intact rock, to the damage zone to the shear/slip zone;

3) measurements of key geophysical parameters (seismic and electrical properties) both on site (seismic surveys and electrical resistivity tomographies) and on collected representative rock samples, in order to assess the mean physical and mechanical properties of the rock mass and provide calibration and scaling for further laboratory analyses;

4) Petrophysical detailed characterization both at room temperature and on representative samples previously heated up to the temperatures of the reservoir (> 400°C);

5) Standard mono and tri-axial deformation tests, with coupled active and passive Acoustic Emission (AE) methods, to analyze the micro-cracking processes at different temperatures and stress conditions. Petrographic analysis on the deformed samples will be compared with undisturbed specimens, to verify the alteration and weakening of the rock mass under heating processes.

7) Numerical modeling to estimate the petrophysical, geophysical and geomechanical properties of the rock mass under the P and T conditions of the reservoir (i.e., using Comsol, VGeST, UDEC, 3DEC, ...).

Detailed geological field studies and photogrammetry/laser scanner imaging of studied outcrops are supposed to be available soon: multiscale analysis will benefits from these new data.

Finally, microseismicity monitoring and passive seismic methods on the field could potentially help not only for fracture and reservoir characterization but also as a powerful future tool for the control of the geothermal exploitation.

Conclusions

Two post doc fellowship will be spent to characterize rock masses of the reservoir int the field and laboratory. Results will be shared between EU and Mexican partners to improve the general model of these two geothermal field.

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