Acoculco: Resistivity Survey; Data Acquisition, Processing and Inversion

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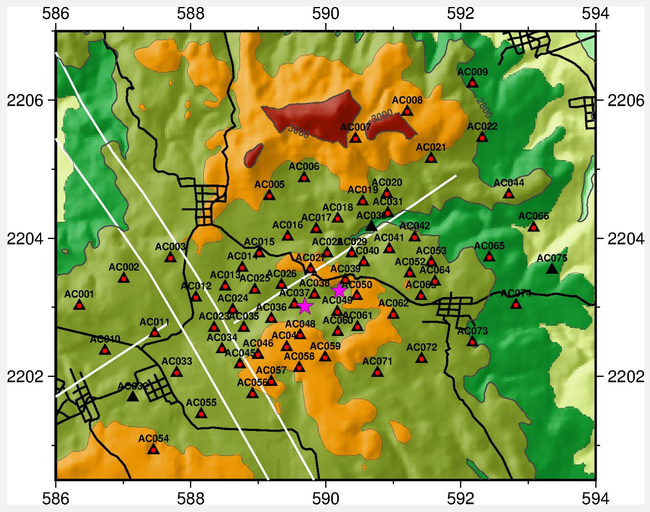
1 Introduction

The Acoculco high-temperature geothermal area in the easternmost region of the Trans-Mexican Volcanic Belt was proposed to develop an Enhanced Geothermal System (EGS) within GEMex. Therefore, extensive geological, geochemical and geophysical studies were carried out in the area. These included 68 co-located MT and TEM soundings which were measured in 2017-2019 through a joint effort by the European and Mexican partners. The TEM was measured using a TerraTEM equipment and the MT data were collected using instruments from the Metronix manufacturer. The Bounded Influence Remote Reference Processing method (BIRRP) was used for processing the MT time-series.



The Acoculco survey area. Black triangles and red circles denote the location of MT and TEM soundings, respectively. White lines are major faults in the area and black lines are roads. Coordinate system is UTM zone 14 WGS84.

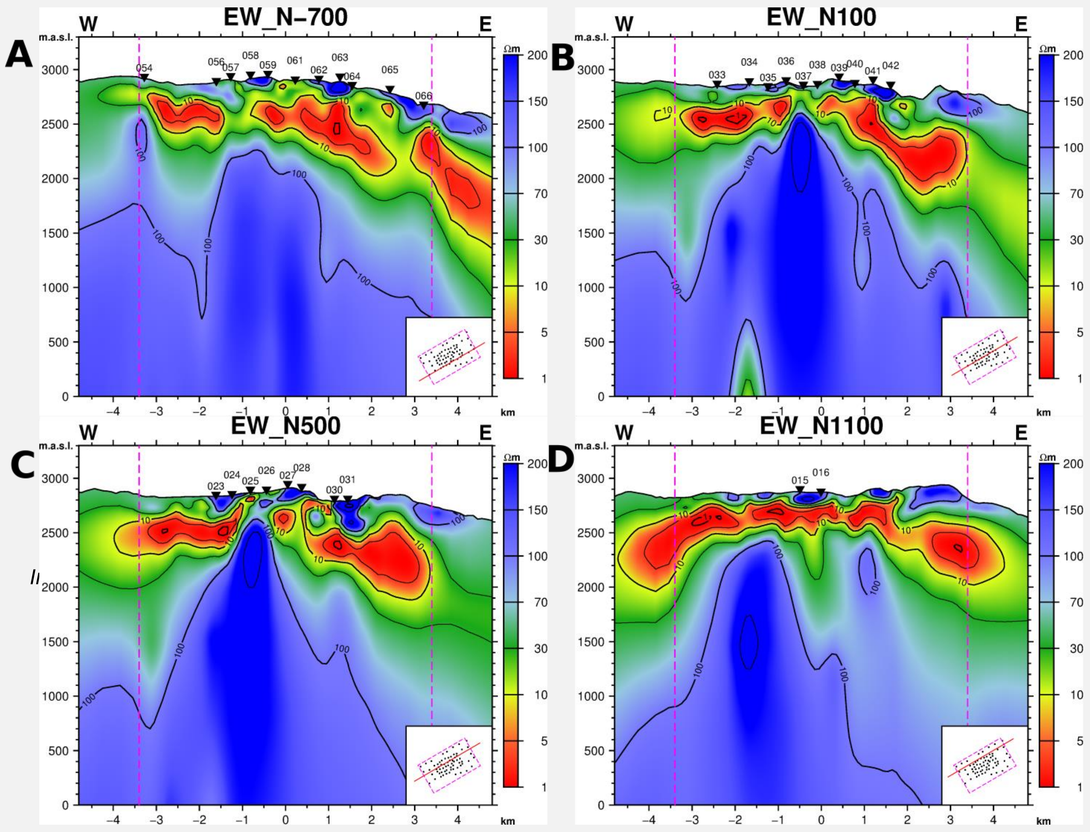
2 Methods

A resistivity model of the Acoculco survey area has been compiled from the results of 1D joint inversion of the TEM and MT data. It is based on inversion of the TEM data and the apparent resistivity and phase calculated from the determinant value of the MT impedance tensor. During the inversion process the MT data were static shift corrected using the TEM data.

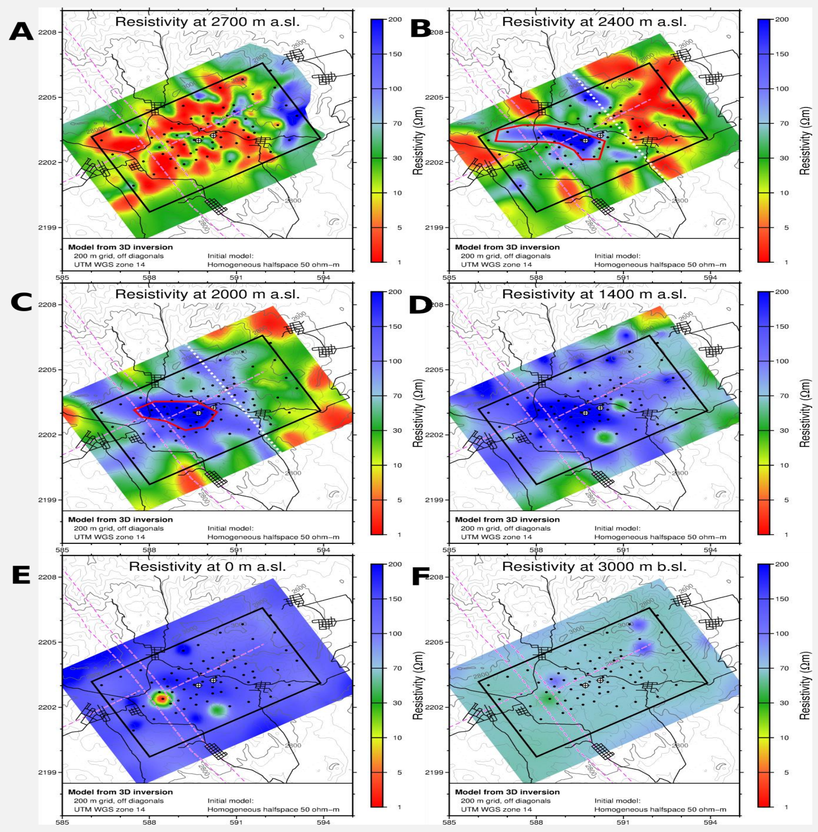
Electrical strike analysis of the MT data was carried out through a study of the Tipper and induction arrows for different frequencies as well as the phase tensor which suggest a one-dimensional resistivity structure of the Acoculco area. The analyses indicate that the survey area in Acoculco can be divided into two parts. In the eastern part the area of the phase tensor ellipses is larger, as compared to the western ellipses, suggesting a more vertical contrast in resistivity structure to the east.

A 3D inversion was performed for the full impedance tensor of the static shift corrected MT data using different initial models. Two codes were applied for comparison, the WSINV3DMT code was run in Europe and ModEM in Mexico.

3 Results and Discussion



West-east lying vertical cross-sections through the final resistivity model plotted down to sea level. Pink dashed vertical lines are the boundaries of the densely gridded area. Black triangles at the surface are the station locations along with their names. Small inlet in the bottom right corner: Location of the cross-section is shown as a red line. The black dots are sounding locations and pink dashed lines are the outlines of the densely gridded area



Horizontal cross-sections through the final resistivity model at 2700 meters above sea level (A), 2400 meters above sea level (B), 2000 meters above sea level (C), 1400 meters above sea level (D), sea level (E), and at 3000 meters below sea level (F). The black dots are the MT sites. Black box outlines the densely gridded area black circles are sounding locations, pink lines are main fault lines in the area, gray lines are elevation contours, and dark gray lines are roads. Black crosses on a white circle are the locations of the two EAC wells.

The vertical and horizonal cross-sections above through the resistivity model are based on 3D inversion of the static shift correct MT data applying the WSINV3DMT code and an initial model of a homogeneous half space of 50 Ωm. The Acoculco area can be divided into two sub-areas that are distinguished from one another; the boundary could well be a buried fault. The low resistivity cap (presumably reflecting smectite hydrothermal alteration) becomes thinner close to the western well. It is in this area where the resistive core (presumably reflecting chlorite/epidote hydrothermal alteration) is the shallowest in a very confined area, suggesting the existence of a zone of geothermal interest. This is a typical resistivity structure of a high temperature area in a volcanic environment. A low-resistivity body, located 500 m above sea level down to 4000 m below sea level, was observed. The body was confined, and it is unknown whether this is an artefact or a real feature as the longest MT data periods acquired in the Acoculco area where relatively short (1-10 s in most cases),

This project has received funding from the European Union's Horizon 2020 research and innovation programme under grant agreement No. 727550 and the Mexican Energy Sustainability Fund CONACYT-SENER, project 2015-04-68074

Partners

We acknowledge the Comision Federal de Electricidad (CFE) for kindly providing support and advice and for granting access to their geothermal fields. Data has been kindly provided by CFE.We also acknowledge our Mexican colleagues for their help an collaboration.

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