

New insight of the hydrothermal system beneath Tolhuaca volcano (South Chile) revealed by magnetotelluric observations.

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SUMMARY

On the NW flank of the Tolhuaca volcano an active geothermal system has developed with reservoir temperatures estimated of 220° - 300°C, characterized by several surface thermal manifestations with fumaroles, solfataras and hot springs. The interplay between heat-fluid-rock interaction processes is fundamental in the development of geothermal systems. However, the heat source of the geothermal system are poorly constrained. The work presented here address this issue by studying the electrical properties of the active Tolhuaca geothermal system in the Andes of southern Chile. Using newly recorded magnetotelluric data in the surrounding of Tolhuaca, we present a 3-D model of electrical resistivity of the crust. We used temperature measurements in deep wells and geochemical analyses of borehole fluid samples and new water samples to constrain present-day fluid conditions. The magnetotelluric model reveals different electrical structures below the western flank of Tolhuaca. The derived model endorses a previous study that drew the conclusion that there was highly conductive region associated with a low permeability clay-cap directly under the NW flank of the Tolhuaca volcano. Additionally, the electrical resistivity model shows a shallow conductive anomaly, ~3km below the Tolhuaca volcano, connected with a sub-vertical anomaly of intermediate resistivity. As we found no indications of a deep conductor, such as those observed in other high enthalpy geothermal systems, we conclude that the shallow magmatic deposit that is cooling but still hot enough to provide the heat source of the geothermal system. This magmatic compartment would have been fed from deep crustal zones by a sub-vertical dipping basaltic-andesitic mush column, which would act as a preferential pathway for the ascent of hydrothermal fluids.

Keywords: magnetotellurics, electrical structures, hydrothermal system, geothermal reservoir
