

Analysis of the magmatic ? Hydrothermal volcanic field of Tacora Volcano, northern Chile using travel time tomography

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Tacora Volcano ($17^{\circ}43'S$? $69^{\circ}46'W$) lies at the southernmost end of a 10 km-long volcanic lineament that extends between Chile and Perú. Around Tacora volcano, thermal manifestations are two active fumarolic fields located at the western flank of the stratovolcano and at the volcano summit, indicating active magma degassing in a shallow hydrothermal system. Beneath Tacora volcano is located the NW Challaviento reverse fault that belongs to the Incapuquio - Challaviento fault system of Middle Eocene age. To complement previous exploration results and conceptual modeling developed by INFINERGEOS SPA, seventeen short period seismic stations were installed around Tacora Volcano, between August and December 2014. Using the P and S wave arrival times of locally recorded seismicity, a 3D velocity model was determined through a travel time tomography. We interpreted high V_p/V_s values as water-saturated areas, corresponding to the recharge zone of Tacora hydrothermal system. In addition, low values of $\Delta V_p/V_p$ (%) and V_p/V_s ratio represent the location of a gas-saturated magmatic reservoir and circulation networks of magmatic-hydrothermal fluids. Low V_p/V_s volumes (magma reservoirs/high temperature hydrothermal fluids), the presence of fumarolic fields and surface hydrothermal alteration have a spatial correlation. This suggests a structural control of the Challaviento fault in the hydrothermal flow. Finally, we present a cluster analysis using the $\Delta V_p/V_p$ (%) parameter. Through this analysis, we found a method for the identification of a key structure in depth composed by the magma reservoir (low V_p/V_s ratios, low $\Delta V_p/V_p$ (%)), clay level areas (intermediate values of $\Delta V_p/V_p$ (%)), and degassification zones (low values of $\Delta V_p/V_p$ (%)) directly related with the surface thermal manifestations.