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# Geological, geophysical and hydrological constraints on the deep-seated processes acting in the Long Valley Caldera (California)

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The Long Valley Caldera (LVC), located in the eastern California, developed inside a transfer zone between NNW-SSE trending normal faults separating the western Sierra Nevada block and the eastern Basin & Range Province. Nowadays, the LVC hosts an active hydrothermal system circulating within the post-caldera rhyolites and the Bishop Tuff sediments with several superficial geothermal manifestations. A resurgent dome characterized by a recent unrest locates in its central section. Although industrial exploration and scientific research programs provided an extensive multidisciplinary dataset, some aspects regarding the location and size of the heat source, the reason of the recent unrest, the origin of the geothermal fluid and its mixing with meteoric water as well as the geometrical features of the main permeable structures controlling the flow path are still debated.

In this paper we present a novel thermo-rheological model of LVC obtained by integrating the available geological, geophysical, hydro-geochemical and remote sensing information. The main steps of this multiphysics approach are (i) the reconstruction of the 3D geological model accounting for the main lithothermal units and the permeable fault-related structures by merging the available geological and geophysical information, (ii) the optimization of the 3D conductive-convective thermal model minimizing the misfit between the measured and simulated temperature profiles at borehole locations, (iii) the definition from the crustal thermal structure of the 3D Brittle/Ductile transition according to the earthquake distribution and (iv) the optimization of the ground deformation model taking into account the rheological stratification and the InSAR measurements acquired during the 1992–2000 time period. Furthermore, latest results regarding high-resolution imaging of the b-value spatial variation and the P- and S-wave velocity structure highlighted at depths greater than 5 km until 20 km anomalous volumes possibly correlated with the occurrence of magmatic fluids and/or partially melted rocks.

The achieved results allow investigating the physical processes responsible for the observed thermal anomaly as well as the seismicity and ground deformation patterns. An upper crustal magmatic body at 5 – 6 km depth and 600 – 700°C localized in the central-western sector of the caldera may explain the above-mentioned geophysical anomalies. Accounting for the deepest anomalous volumes (15 – 20 km depth), we propose a magma emplacement conceptual model in which the variable partial melting of the mantle is responsible for injections of mafic magmas into the continental crust, which in turn induced an increase of isotherms, crustal anatexis and a variable degree of mafic-acid magma mingling. The produced hybrid melt emplaced at middle-crustal levels and fed the shallow magmatic system.