Rift propagation vs inherited crustal fabrics in the Trans-Mexican Volcanic Belt (Mexico): insights into geothermal investigations from analogue models

Maestrelli D.*[1], Bonini M.[1], Corti G.[1], Montanari D.[1] and Moratti G.[1]

[1]CNR-IGG, Consiglio Nazionale delle Ricerche, Istituto di Geoscienze e Georisorse

The Trans-Mexican Volcanic Belt (TMVB) is a large-scale, NW to SE trending volcano-tectonic feature extending through central Mexico for a length of more than 1000 km. In some models, its genesis is related to the interaction between the subducting Rivera and Cocos plates and the North America plate, with the eastward propagation of volcanism being associated with slab detachment and consequent asthenospheric upwelling (e.g., Ferrari, 2004). Progressive SE-directed slab tearing has been causing crustal extension and the emplacement of large-scale volcano and caldera edifices. In the frame of the GEMex Europe-Mexico cooperation project (Horizon 2020 Programme, grant agreement No. 727550), we aim to investigate the interplay between continental extension and inherited crustal fabrics. Particularly, in the easternmost part of the TMVB, where the GEMex Project is focusing geothermal investigation on two calderas (Los Humeros and Acoculco), the inherited fabric is represented by ca. NE-SW and NW-SE regional faults (Campos-Enriquez & Garduño-Monroy, 1987). This fabric may have localized volcanic centres, thereby bearing significant implications for geothermal investigation. We aim to evaluate if and how the inherited structures may have interacted with continental-scale rift propagation through analogue modelling. In the models, the upper continental crust was simulated by a Qz- and K-feldspar sand mixture (80%-20% proportion in weight), while a PDMS-corundum mixture reproduced the lower crust. Continental rift propagation was simulated using a deformation apparatus represented by two basal moving plates hinged at their topmost side, allowing rotational opening. Extensional deformation was distributed using a basal rubber sheet. Artificial dilation zones (simulating the inherited fabrics) have been introduced within the analogue brittle crust at various angles to the rift axis. Our modelling highlights that a propagating rift may reactivate the inherited fabrics as extensional structures or transfer zones (depending on their orientation) for angles $\leq 45°$ to the rift axis. Numerical analysis of slip and dilation tendency evaluated for the reactivated fabrics corroborate the modelling results, and suggest that they may represent favourable sites for magma emplacement, and ultimately for geothermal exploration.

Campos-Enriquez, J., & Garduño-Monroy, V. H. (1987). The shallow structure of Los Humeros and Las Derrumbadas geothermal fields, Mexico. Geothermics, 16(5-6), 539-554.

Ferrari, L. (2004). Slab detachment control on mafic volcanic pulse and mantle heterogeneity in central Mexico. Geology, 32(1), 77-80.