Unraveling Innerworkings of Magmatic System Beneath the East Pacific Rise 9º50’N

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Authors:

Milena Marjanović[1], Suzanne M. Carbotte[2], Alexandre Stopin[3,4], Felix Waldhauser[2], Satish C. Singh[1], René-Édouard Plessix[3], Miloš Marjanović[5], Malden R. Nedimović[2,6], Juan Pablo Canales[7], Hélène D. Carton[1], Javier Escartin[8], John C. Mutter[2]

[1]Université de Paris, Institut de Physique du Globe de Paris; CNRS, Paris, France

[2]Department of Marine Geology and Geophysics, Lamont-Doherty Earth Observatory, Columbia University; Palisades, NY, USA

[3]Shell Global Solutions International B.V.; Amsterdam, The Netherlands

[4]Now at Bureau de Recherches Géologiques et Minières – BRGM; Orléans, France

[5]Faculty of Mining and Geology, University of Belgrade; Belgrade, Serbia

[6] Department of Earth Sciences, Dalhousie University; Halifax, Nova Scotia B3H 4R2, Canada

[7]Department of Geology and Geophysics, Woods Hole Oceanographic Institution; Woods Hole, MA, USA

[8]Laboratoire de Géologie, Ecole Normale Supérieure (CNRS UMR), PSL Research University; Paris, France

Text:

Volcanic activity is readily observed and monitored for subaerial volcanoes; however, due to inaccessibility, little is known about the dynamics and physical properties of magmatic systems that govern eruptions. Some of the most active magmatic systems operate beneath portions of mid-ocean ridges (MOR), which we can readily explore using sophisticated geophysical techniques. An opportunity to probe the subsurface and image magma bodies in high-resolution was offered by collecting 3D high-quality reflection seismic data at the East Pacific Rise (EPR) 9º50'N, a volcanically highly active portion of the MOR with two documented eruptions. The seismic volume has been reprocessed using pre-stack depth migration, from which the shallowest axial-magma lens was mapped at unprecedented resolution revealing fine-scale

complexities in the geometry of the magma body inherited from eruption and replenishment. Among these complexities is the presence of a depression (latitudinal extent 9º49.8-51'N). A line of evidence argues that this depression is directly related to the last documented eruption. The depression 1) is underlain by the gap in the deeper axial magma body that was suggested to feed the eruption; 2) its most prominent northern part underlies the deepest portion of the axial summit through mapped in bathymetry, resembling caldera collapse ubiquitously reported for subaerial volcanoes; 3) matches latitudinal extent of the recorded earthquakes, interpreted as diking events induced by tectonic forces leading to the eruption. In addition to the depression, based on the close correlation between the topography of the magma body and expression of the faults in the seafloor, we infer that the inward facing near-axis faults penetrate deep into the crust at steep angles, ~75º, shaping magma reservoirs and exerting control on the magma pathways that contribute to the erupted volume. Finally, by mapping seafloor in the seismic volume, we reveal a nascent caldera of Lamont' seamounts, upheld above reported off-axis magma bodies suggesting a hybrid plumbing system witnessed in the geometry of the imaged on- and off-axis magma accumulations and persistent geochemical signal. Collectively, the novel observations suggest that magmatic systems operating beneath the EPR and subaerial volcanoes may not be quite so different.