

Long lived effusive activity on Arenal Volcano: Insight from a volcano-tectonic study

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Interactions between tectonic and volcanic systems are not well understood. Here we present the initial results of a joint study combining several dozen UNAVCOs permanent GPS stations, a gravimetric campaign and geological field results at Arenal volcano which showed more than four decades of relatively low-level continuous effusive activity since its reawakening in 1968. Our results indicate that the magmatic system of Arenal volcano is being built in an active extensional area, which may have promoted the low-level yet persistent activity.

Costa Rica is located in the western part of Caribbean Plate; the Cocos Plate subducts along the Middle America Trench (MAT). Oblic subduction has generated a trench-parallel motion up to 10 mm yr⁻¹ toward the North-West, which creates shear stresses between the MAT and the volcanic arc. Located in the volcanic arc, Arenal volcano, a basaltic-andesitic stratovolcano, grew within a comparable short timescale of a 7ka. The tectonic setting is complex and active seismogenic faults surround the Arenal volcanic edifice. After 440 years of dormancy, Arenal erupted in July 1968. The eruptive period lasted until 2010, during which approximately 0.55 km³ (2 m³ s⁻¹ in 1968 to 0.086 m³ s⁻¹ between 2000 and 2004) of lava and pyroclasts have been erupted.

Gravimetric measurements detect an E-W negative anomaly with 10 mgal amplitude while the GPS velocities shows a centimetric shear strain located within the volcanic arc. These geophysical techniques plus geological field observations suggest the settlement of the volcanic complex on a pull-apart basin. We propose a hypothesis in which the reported long-lived low effusion rate volcanic activity would be a consequence of local extensional tectonics and relatively high heat fluxes typical of active volcanic arcs.