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InSAR data detect ground deformation at the Rabaul volcano, Papua New Guinea: Root plumbing model for a shallow dyke intrusion

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The Rabaul caldera developed in New Britain Island, PNG, is an elliptical volcanic complex of 9×14 km^2 within the Bismarck Volcanic Arc. Central part of the Rabaul Volcano field is breached by sea-water, causing inundation between the eruptive centers. The arc is associated with the subduction zone located near a triple junction constituted by the Solomon Sea, south Bismarck and pacific lithospheric plates. The caldera was formed by a series of caldera collapse structures and a group of basalt-andesite volcanic centers that consists of two intra-caldera active eruptive centers, namely, Tavurvur and Vulcan. After a major twin eruption in 1994, Vulcan has ceased activity while Tavurvur has continued intermittent eruptive activity with last major eruption in 2014. Local seismicity is monitored by the Rabaul volcanologic observatory that is operational since 1937. Various studies have constrained point pressure source (Mogi) beneath the caldera. Others have suggested radial dyke intrusions along the caldera wall to explain complex caldera-deformation. The Rabaul seismicity zone defines an elliptical seismic zone oriented NNE/SSW, trending ~5×9 km ellipse extending from near surface to a depth of 4 km. This corresponds to the walls of subsequent caldera collapse, leading to outward-dipping ring-fault structure. This is also corroborated by 3D seismic tomography to indicate low velocity zones in the calderas area which has put more constraints on the possible magma source locations. In addition to conventional geodetic data, Interferometric Synthetic Aperture Radar (InSAR) technology has been used in the present study to detect ground deformation to further constrain possible pressure sources. Using ALOS PALSAR and GPS dataset, we modeled a shallow dyke intrusion at a depth of 1 km to explain localized deformation observed on the NE-edge of the Tavurvur cone and a 4 km deep Mogi source at the center of the caldera just south of Matupit. Finally, the shallow dike intrusion is interpreted to represent the root plumbing system beneath the Rabaul caldera at this specific locality.

Biography

Manoj Mukhopadhyay is a Professor of Geophysics at Department of Applied Physics, University of Technology, Lae, Papua New Guinea. He was also a Professor of Geophysics at the Department Geology and Geophysics, King Saud University, Riyadh, Saudi Arabia (2008-2015). He was the Visiting Professor in Kuwait University, Head of the Department Applied Geophysics, Indian School of Mines, Dhanbad, India. His research area includes gravity interpretation, seismotectonics, petrophysics in reservoir studies and volcano-geophysics.

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