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Post-Eruptive Deformation of the 2006 Rabaul Volcano (PNG) Eruption Detected by ALOS-SAR Data

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Rabaul volcano is located at 4.271oS and 152.203oE on the eastern flank of the Bismarck Volcanic Arc on the northeastern end of the Island of New Britain in Papua New Guinea (PNG). It is a 9 x 14 km caldera complex. The volcanic arc is associated with the current subduction of the Solomon Sea Plate beneath the Bismarck Plate along the New Britain Trench. The most recent twin eruptions of VEI 6 occurred in September 1994 from two vents, Vulcan and Tavurvur, located roughly on the western and eastern margins of the caldera respectively, preceded by a deformational crisis ten years earlier. Leading up to and after the deformational crisis, intense monitoring was carried out anticipating an eruption in the near future.

After the 1994 eruption, Vulcan eruption ceased shortly thereafter while Tavurvur continued intermittently to end of 2010. An eruption of VEI 4 occurred on August 11, 2006 with vent and explosive eruptions. Lava flow and lava dome extrusion also occurred. Before the eruption, uplift was observed since February 2005 and amounted to 4 cm uplift at the time of eruption. At the eruption, ~25 cm of subsidence was detected by continuous GPS measurements. Habitants of Rabaul town were evacuated to safe locations.

Generally, it is agreed that the central up-doming of the caldera is being caused by one or two point sources at shallow levels within the caldera block, at depths ranging from 1 to 2.5 km. In contrast, the complexity of the observed deformation has also led to suggestion that more complex source may be involved other than a single (or two) point source. Moreover, the observed deformation may be the response of the caldera structure to the stresses from a 4- to 5- km deep magma source. Also, pressurization along ring faults, as delimited by seismic annulus, has been proposed to account for the observed deformation.

We processed ALOS PALSAR Data using InSAR technique for images obtained on February 27, July 15 and October 15 of 2007, October 17 of 2008, and September 4 and December 6 of 2009. This period corresponds to post-eruption deformation. Few centimeter subsidence are detected in the northeastern part of the caldera around Tavurvur volcano in the periods February ? July and July ? October in 2007 and September ? December in 2009. InSAR detected deformation estimates are consistent with vertical deformations of GPS processing by Rabaul Volcano Observatory for the corresponding periods. Subsidence of ~30 cm was observed in the caldera by continuous GPS measurements for 2 years until 2009. Small deformations are also detected around Vulcan.

A spherical deflation source at a depth of 2 km in the Greet Harbor provides a reasonable fit to the data using Mogi (1958) solution. We attributed the subsidence to decrease in the source volume as part of it recedes back into the magma chamber further beneath.

Keywords: Post-eruptive deformation, Rabaul volcano, ALOS PALSAR image, InSAR, subsidence, spherical source