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Magma intrusion model on the 2006 Mayon Volcano eruption based on GPS measurements

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Mayon Volcano

Mayon volcano is located in the southern Luzon Island in Philippine. The volcano is an eruption history since 1616, and ranging from strombolian to basaltic plinian including lava flows. After the 2001 eruptions of central vent eruption, pyroclastic eruptions and lava flows, the volcanic activities was quiet until July 13, 2006. The 2006 eruption is characterized by lava flow of 3.8×10^7 m³ and no explosion. We discuss the magma intrusion process of the 2006 eruption based on ground deformation by GPS measurements and seismic records.

Ground deformation detected by continuous GPS measurements

PHIVOLCS (Philippine Institute of Volcanology and Seismology) established eight continuous GPS network consisting 8 stations in 20 x 40 km radius around the Mayon volcano in 2004. The measurements are maintained by hand pick until now. The baseline lengths between the 8 GPS stations show the contraction of 1 cm in 2004 and the extension of 1 cm in middle of 2005. In 2006, the rapid contractions of 1-3 cm of the line lengths are detected until end of the year.

Estimated pressure sources beneath the summit

We discuss the spherical pressure source model by Mogi solution and divide three periods of Jan.2004 - Dec.2004 (period 1), June 2005 ? Dec.2005 (period 2) and Jan.2006 ? Dec.2006 (period 3).

In the period 1, because of shortening line lengths, one deflation sources is estimated at the depth of 6.5 km beneath a little bit to the north from the summit, and another inflation source is calculated at the depth of 5.0 km. It means the migration of magma from the 6.5 km depth to 5.0 km depth. In the period 2, line length shortenings are turn to extension, an inflation pressure source is estimated at the depth of 7.5 km. In the period of 3, line length changing are come back to contractions and they are very rapid in few months since July 13. One deep deflation source of -1.8×10^7 m³ is estimated at the 11.5 km depth.

2006 eruption

Since the 1999-2001 eruption, Mayon volcano was very silent and there are few small phreatomagmatic eruptions only. On July 13, the 2006 Mayon volcano eruption was started as the lava dome forming and lava flow at the summit.

It is estimated the magma migration at the depth from 6.5 km to 5.0 km. Moreover long-term volcanic tremors over few ten minutes are observed since June 2004 to February 2005. Long-term volcanic tremors are coursed by magma migration to the shallow depth.

In the period 2, magma are intruded to the magma chamber at the 7.5 km depth, and there is no volcanic activity on the ground surface.

In the period 3, line lengths changing on the most baselines are to the contraction in 2006, and long-term volcanic tremors are observed again in March. On July 13, lava doom is observed at the summit creator and lava flows are recognized as the shaking by lava falling. Lava flows arrives 5 km from the summit in the southeast flank and continued until September 2006. The volume of lava flows is estimated 3.8×10^7 m³ (PHIVOLCS) and it just half volume of the estimated deflation source in the 11.5 km depth.

The research is depend on the collaboration between Philippines and Japan under the JIST=JICA projects. We have a plan to extend the monitoring system at the Mayon volcano in 2011.

Keywords: Mayon Volcano, Maguma intrusion model, GPS measurements, volcanic activity, 2006 Mayon volcano eruption