

Crustal Deformation During the 2011 Volcanic Crisis of El Hierro, Canary Islands, Revealed by Continuous GPS Observation

SAGIYA, Takeshi^{1*}, MARTINEZ, Jose Barrancos², CALVO, David², PADRON, Eleazar², HERNANDEZ, German, P.², HERNANDEZ, Pedro, A.², PEREZ, Nemesio Rodriguez², SUAREZ, Juan Manuel Poveda³

¹Disaster Mitigation Research Center, Nagoya University, ²Institute Volcanologico de Canarias (INVOLCAN), ³Cartografica de Canarias (GRAFCAN)

Seismo-volcnic activity of El Hierro started in the middle of July of 2011 and resulted in the active submarine eruption after October 12 south off La Restinga, the southern tip of the island. We have been operating one continuous GPS site on the island since 2004. Responding to the activity, we quickly installed 5 more GPS sites. Including another site operated by the Canary Islands Cartographical Service (GRAFCAN) for a cartographic purpose, we have been monitoring 7 GPS sites equipped with dual-frequency receivers. We present the result of our crustal deformation monitoring and the magmatic activity inferred from the deformation data. In accordance with the deformation pattern, we divide the volcanic activity in 2011 into 4 stages. The first stage is from the middle of July to middle of September, during which steady magmatic inflation is estimated at the center of the island. The inflated volume of the first stage is estimated to be about $1.3 \times 10^7 \text{ m}^3$ at the depth of about 5km. The second stage, which continued until the first submarine eruption on October 12, is characterized by the accelerated deformation due to the upward as well as southward migration of magma. Additional inflation of about $2.1 \times 10^7 \text{ m}^3$ occurred in the depth range of 1-2km. The third stage continued for about 3 weeks after the first submarine eruption. During this stage, submarine eruption continues while no significant surface deformation is observed. It is considered magma supply from a deeper magma chamber continued during this 3 weeks period. Therefore, the total inflation volume during the first two stages gives the minimum estimate for the total magma volume. Since the beginning of November 2011, many GPS sites started subsiding. However, this deflation pattern is quite different from those in the shallow inflation stages. Horizontal deformation during this 4th stage is not significant, implying that deflation is occurring below the moho.

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