

Different styles of magma replenishment at Sierra Negra Volcano, Galapagos

Dennis Geist¹, William Chadwick, Jr.²

¹University of Idaho, USA, ²Oregon State University/NOAA, USA

E-mail: dgeist@uidaho.edu

Volcan Sierra Negra, in the western Galapagos, is one of the most actively deforming volcanoes on Earth and is monitored by a 10-station continuous GPS network. Its most recent eruption was in October 2005, which was accompanied by > 5 m of deflation at the center of the caldera floor. The volcano began re-inflating the day after the eruption at a rate that decreased exponentially over the next 6 years. For the first 6 months after the eruption, inflation proceeded at 2.6 m/y, and by the beginning of 2011 the rate of inflation had decreased to 4.4 cm/y. We attribute this to a steadily decreasing pressure gradient between the shallow subcaldera sill and the deeper source of the magma. In August 2011, the caldera began to deflate gradually, which was not related to eruption of Sierra Negra or any neighboring volcano. By June 2012, deflation had amounted to a total of 8 cm. On June 18, 2012, the gradual deflation ended abruptly and the volcano suddenly inflated 2.2 cm over just 4 days. No seismicity was detected by the global seismic network at the time of this change in behavior. The rest of 2012 and early 2013 are characterized by rather erratic behavior, including another rapid inflation event (3.5 cm in 25 days in July) punctuated by moderate inflation and deflation events amounting to < 2 cm of deformation.

Deformation at Sierra Negra is modulated by a sensitive feedback between a deep pressurized magma source and the shallow (2 km) subcaldera sill. The years it took for the two chambers to equilibrate indicates that they are connected by a narrow conduit, which controls the flux of viscous magma, or by a porous network that provides viscous resistance. The ending of one episode of magma influx (2005-2011) and the apparent beginning of another (2012-?), suggests that the magma supply from depth to Sierra Negra is episodic rather than constant.