Deformation processes before, during, and after the March 2011 Kamoamoa fissure eruption, Kilauea Volcano, Hawai'i

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We examine surface deformation of Kilauea Volcano surrounding the March 5, 2011, Kamoamoa fissure eruption along the volcano's east rift zone (ERZ). The Kamoamoa eruption followed several months of magma accumulation beneath Kilauea's summit. In addition to inflation of a shallow (1.5-2 km depth) source near Halema'uma'u Crater, precursory deformation at Kilauea's summit is attributable to sources distinct in space and time from previously identified zones of magma storage and faulting. Differential interferometric synthetic aperture radar (InSAR) data from the COSMO-SkyMed (CSK) and TerraSAR-X (TSX) satellites, combined with GPS data, show evidence for two additional sources active during the inflation prior to the Kamoamoa eruption: 1) progressive inflation of a triangular-shaped area extending from the southern edge of Kilauea Caldera and west of the ERZ, and 2) a nearly vertical, mostly extensional feature beneath the western edge of Kilauea Caldera. The shallow Halema'uma'u source appears to have gained in volume during the entire pre-eruption period, while the source of the triangular deformation in the south caldera became active in the final month prior to the Kamoamoa eruption. Following the eruption, GPS and satellite InSAR time series (from CSK and TSX data) over ten months, along with individual airborne interferograms from the NASA UAVSAR instrument over an eight-month interval, show inflation of the area surrounding the fissure eruption. To model the sources, we use a Markov chain Monte Carlo (MCMC) Bayesian approach. Preliminary pre-eruptive models show a set of shallow (upper 4 km) sources: mostly tensile opening along the west caldera margin shallower than 1 km, and pressurization of magma storage areas beneath the central part of the caldera and south of the caldera. Preliminary post-diking models suggest deeper opening of the ERZ beneath the Kamoamoa dike, similar to deformation patterns observed during previous ERZ intrusions and fissure eruptions (for example, in 1997). We will compare models for the pre- and post-diking surface deformation observations with the co-eruptive intrusion and to observations of Kilauea's magmatic and structural system. Finally, we will compare the 2011 observations with the present-day spatiotemporal deformation sequence to ascertain whether or not the pre-Kamoamoa summit deformation represents a recurring pattern that is characteristic of a magma system that is about to rupture.