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Afar unrest: the 2008 Alu eruption in the Erta ‘Ale volcanic system (Ethiopia)

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The Alu volcano is located within the Erta ‘Ale volcanic system in northern Afar (Ethiopia), about 30 km to the north of the Erta ‘Ale volcano whose summit caldera hosts a lava lake. Aster, Hotspot and S02 emissions images formed on 3rd November, 2008 showed that a fissural eruption was occurring east of the Alu volcano. Here we present an InSAR study of the area, using data from four tracks of the Envisat satellite both in descending ad ascending orbits, also including data in Wide Swath acquisition mode. The interferograms span different time periods allowing us to separate pre-, co- and post-eruptive deformation. In particular, an acquisition made on 3rd November at 19:20 (the day of the eruption) is used to observe deformation over two different co-eruptive periods. The co-eruptive interferograms show two closely-spaced but distinct concentric deformation patterns, both consistent with deflation, on the Alu volcano and on another unnamed volcano 3 km south of Alu. Most deformation in both volcanoes occurred during the first part of 3rd November (until 19:20) but significant deflation, up to $\sim$ 45 cm, is also observed in the following interferogram from 3rd November at 19:20 to 8th December. Interestingly, no significant pre-eruptive deformation was observed in the area, nor any deformation was observed at the Erta ‘Ale lava lake prior to, during or after the Alu eruption. Preliminary modelling results, using two deflating Mogi sources, suggest that the two shallow magma chambers at $\sim$1-1.5 km depth deflated during the eruption, with a volume change of the sources of $\sim$-0.01 km3. Lack of pre-eruptive deformation suggests that the erupted magma was sitting at shallow depth under the Alu volcanoes. The lava lake in the nearby Erta ’Ale volcano also indicates that shallow magma reservoirs are a common feature in the area. We plan to model the observed deformations using different models, i.e. sill, penny shaped crack and ellipsoidal source and to compare our data with field and seismic records.