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TITLE: Comparing Long and Short Term Deformation in the Krafla Fissure System, NE Iceland, using LiDAR, InSAR and GPS

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ABSTRACT BODY: The Krafla volcanic system is situated on the divergent plate boundary separating Eurasia from North America, one of five fissure swarms (rift segments) in the Northern Volcanic Zone (NVZ) of Iceland. The Krafla segment is a 5-10 km wide and 100 km long region consisting of a central volcano and fissure swarm. Dyke intrusions and fissure eruptions characterise the activity in Krafla. A rifting episode in 1975-1984 activated an 80 km long segment of the Krafla fissure swarm.

The eruptive history suggests that the Krafla fissure swarm may not have been active for the whole of the last 10 ka, and that other rift segments may accommodate extension during periods of quiescence. Bjornsson (1977) estimated that the Northern Volcanic Zone has a major rifting event every ~ 100 years, each affecting only one of the five swarms. To better understand the deformation in this region we have attempted to determine whether faulting has been proceeding at a steady rate during this time period by examining both the long term (10 ka) and short term (10s of years) rates of vertical motion.

To study the short-term vertical deformation during the post-rifting period in the Krafla system we have combined a series of interferometric synthetic aperture radar (InSAR) images, acquired by ERS and Envisat, with GPS data. The GPS data constrain the horizontal deformation – we remove the contribution of horizontal motion from the InSAR data to isolate the current vertical surface deformation rates.

For the long term deformation, we have acquired high resolution LiDAR surveys over the Krafla fissure swarm in August 2007 and September 2008. We have interpolated these data to create a 1,300 km2 high resolution (~0.5 m) Digital Elevation Model (DEM) of the area. Using the DEM and ages of known lavas, we have estimated the average rate of vertical deformation during the post-glacial period for an area north of the main Krafla caldera, covered by a 10 ka old lava shield.

Vertical deformation measurements made during the 1970s rifting episode have been used to calculate a possible average for cumulative rifting episodes as suggested by Bjornsson and a comparison of the observed long term deformation has been made to understand how much of the long term deformation is accounted for by rifting episodes alone.

We will present a comparison of the long-term rates with the present-day deformation to determine whether the present-day deformation can be used as a reliable indicator of long-term rates of activity.

KEYWORDS: [1209] GEODESY AND GRAVITY / Tectonic deformation, [1240] GEODESY AND GRAVITY / Satellite geodesy: results, [1295] GEODESY AND GRAVITY / Integrations of techniques.

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Additional Details

Previously Presented Material: Preliminary work (approx 10%) was presented in a poster at the ESA FRINGE conference in September 2011.

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