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Interseismic Deformation in the Tjörnes Fracture Zone, Iceland, from continuous GPS and InSAR Time-Series Analysis

S. Metzger (1), S. Jónsson (1), G. Anderson (1), and H. Geirsson (2)

(1) ETH Zürich, Institute of Geophysics, Seismotectonics and Geodynamics, Zürich, Switzerland (smetzger@erdw.ethz.ch),
(2) Icelandic Meteorological Office, Reykjavík, Iceland

The Tjörnes Fracture Zone on Iceland's north shore is one of the two most active seismic regions in Iceland. A 120 km offset of the mid-Atlantic ridge at this location results in a right-lateral transform zone that appears to accommodate the transform motion on two or three parallel structures. These structures have been called the Grímsey lineament, the Húsavík-Flatey fault, and the Dalvík lineament. The relative importance of the three lineations in accommodating the 18.2 mm/year (NUVEL-1A) transform motion is not yet fully understood. It has been proposed that the transform motion is primarily split up between the centrally located, mainly offshore Húsavík-Flatey fault (40%) and the offshore Grímsey lineament to the northeast (60%), while the onshore Dalvík lineament is believed to be of little importance. The Húsavík-Flatey fault, in particular, poses significant seismic risk to the town of Húsavík, which is the largest town in northeast Iceland and located right next to the fault.

In this project we have installed a network of 10 continuously operating GPS stations in the Tjörnes Fracture Zone to augment the limited pre-existing network of only 4 stations. This enhanced network is designed to constrain the slip partitioning between the three different lineaments in the fracture zone in order to better understand in particular the hazard represented by the Húsavík-Flatey fault. Data have been recorded at the GPS sites since late summer 2006 or for almost 2 ½ years. Comparisons of station baseline strain rates already provide important information about the interseismic deformation in the area and our preliminary results show somewhat high strain-rates across the Húsavík-Flatey fault, suggesting a relatively shallow fault-locking depth.

In addition, we analyze multiple satellite radar interferometric (InSAR) images of the area to retrieve further information about the interseismic deformation. The radar data are from the ERS-1 and ERS-2 satellites and were primarily acquired between 1992 and 2000. The individual multi-year interferograms exhibit fairly good interferometric coherence in most areas, although low-altitude vegetation, snow, and a poor digital elevation model all limit the quality of the data. However, we hope that time-series analysis of the radar interferograms will help reduce noise and provide additional constraints on the interseismic deformation rate across the 25 km-long portion of the Húsavík-Flatey fault that is not offshore.