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Crustal movements at a divergent plate boundary: interplay between volcano deformation, geothermal processes, and plate spreading in the Northern Volcanic Zone, Iceland since 2008.

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Iceland is a subaerial part of the Mid-Atlantic Ridge, where the divergent plate boundary between the North-American and Eurasian Plates can be studied. The Northern Volcanic Zone (NVZ) of Iceland, comprised of several volcanic systems, is particularly well suited to study interplay between volcanoes, geothermal areas and plate spreading, as the zone is relatively simple and accommodates the full spreading of the plates (18.6 mm/yr in a direction of 105 degrees according to NUVEL-1A predictions). The most recent volcanic activity in the area was the Krafla rifting episode (1975-1984). In 2007-2008 two intrusive events were detected: one in Upptypingar and the other in Þeistareykir.

Extensive crustal deformation studies have been carried out in the NVZ; we report the results of recent GPS and Interferometric Synthetic Aperture Radar (InSAR) studies focusing on Krafla, Þeistareykir and Askja volcanic systems in the NVZ. An extensive GPS survey was undertaken in 2013, with over 135 stations occupied. This data was evaluated in conjunction with data acquired since 2008, to generate a velocity field spanning this entire time period. In addition to an existing continuous GPS (cGPS) station, three cGPS stations were installed in the area in 2011-2012. The 2008-2013 GPS velocities were compared to earlier GPS results, and complementary analysis of InSAR images was undertaken.

Earlier studies have shown that the Krafla caldera underwent uplift during 1984-1989, followed by subsidence. Since 1995, the maximum subsidence in Krafla has shifted from directly above the shallow magma chamber towards an array of boreholes (geothermal exploitation) in Leirbotnar. Similar subsidence has been observed around another array of boreholes in Bjarnaflag, 7 km further south.

The most significant signal on the velocities calculated from campaign GPS data over the 5 year period, is plate spreading with an E-W velocity of about 12 mm/yr over a 30 km wide area. However it also shows an ongoing pressure decrease inside and south of Krafla caldera, meaning the subsidence caused by geothermal exploitation is still continuing.

TerraSAR-X images have been acquired every year since 2009 and preliminary interferograms and time-series analysis show similar results as those observed by GPS but with a much better resolution. We can cleary see local subsidence toward the center of Askja, around the boreholes in Leirbotnar and Bjarnaflag ($\sim$3-4 mm/yr) but also on the 1975-1984 Krafla lava field ($\sim$3-4 mm/yr). By combining InSAR and GPS data, an enhanced spatial and temporal resolution of the deformation history within in the area is achieved.

The planned expansion of geothermal utilization and new power plants in the area may produce additional deformation signals. Continuous monitoring for the upcoming years may deliver information on further magmatic activity as well as the effects of geothermal exploitation on the volcanic systems. The recent Supersite award to the FUTUREVOLC project will ensure that a considerable amount of past and future SAR data will be available over Iceland and thus greatly improve our InSAR results over the NVZ.