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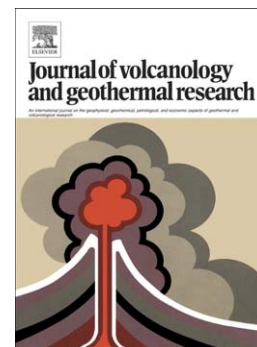
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Deformation at Krafla and Bjarnarflag geothermal areas, Northern Volcanic Zone of Iceland, 1993-2015

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Abstract

The Krafla volcanic system has geothermal areas within the Krafla caldera and at Bjarnarflag in the Krafla fissure swarm, 9-km south of the Krafla caldera. Arrays of boreholes extract geothermal fluids for power plants in both areas. We collected and analyzed InSAR, GPS, and leveling data spanning 1993-2015 in order to investigate crustal deformation in these areas. The volcanic zone hosting the geothermal areas is also subject to large scale regional deformation processes, including plate spreading and deflation of the Krafla volcanic system. These deformation processes have to be taken into account in order to isolate the geothermal deformation signal. Plate spreading produces the largest horizontal displacements, but the regional deformation pattern also suggests readjustment of the Krafla system at depth after the 1975-1984 Krafla rifting episode. Observed deformation can be fit by an inflation source at about 20 km depth north of Krafla and a deflation source at similar depth directly below the Krafla caldera. Deflation signal along the fissure swarm can be reproduced by a 1-km wide sill at 4 km depth closing by 2-4 cm per year. These sources are considered to approximate the combined effects of vertical deformation associated with plate spreading and post-rifting response. Local deformation at the geothermal areas is well resolved in addition to these signals. InSAR shows that deformation at Bjarnarflag is elongated along the direction of the Krafla fissure swarm (~4 km by ~2 km) while it is circular at Krafla (~5 km diameter). Rates of deflation at Krafla and Bjarnarflag geothermal areas have been relatively steady. Average volume decrease of about $6.6 \times 10^5 \text{ m}^3/\text{yr}$ for Krafla and $3.9 \times 10^5 \text{ m}^3/\text{yr}$ for Bjarnarflag are found at sources

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