

EGU2020-10569

<https://doi.org/10.5194/egusphere-egu2020-10569>

EGU General Assembly 2020

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Seismic and geodetic response to crustal deformation in Krísuvík volcanic system, southwest Iceland

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The Reykjanes Peninsula (RP) is a transtensional plate boundary in southwest Iceland that marks the transition of the Mid-Atlantic Ridge (MAR) from the offshore divergent Reykjanes Ridge (RR) in the west to the South Iceland Seismic Zone (SISZ) in the east. The seismicity here trends ~N80°E in central RP and bends to ~N45°E at its western tip as it joins RR. Seismic surveys, geodetic studies, and recent GPS-based kinematic models indicate that the seismic zone is a collection of strike-slip and normal faults (e.g., Keiding et al., 2008). Meanwhile, the tectonic processes in the region also manifest as NE-SW trending volcanic fissures and normal faults, and N-S oriented dextral faults (e.g., Clifton and Kattenhorn, 2006). The largest of these fissure and normal-fault systems in RP is the Krísuvík-Trölladyngja volcanic system, which is a high-energy geothermal zone. The seismicity here predominantly manifests RP's transtensional tectonics; however, also hosts triggered events such as those following the 17 June 2000 Mw6.5 earthquake in the SISZ (Árnadóttir et al., 2004) ~80 km east of Krísuvík. Stress inversions of microearthquakes from 1997-2006 in the RP indicate that the current stress state is mostly strike-slip with increased normal component to the west, indicating that the seismicity is driven by plate diverging motion (Keiding et al., 2009). However, the geothermal system in Krísuvík is a potential secondary source for triggered seismicity and deformation. This study uses seismic and geodetic data to evaluate the activity in the Krísuvík-Trölladyngja volcanic system. The seismic data is used to identify specific areas of focused activity and evaluate variations in the stress field associated with plate motion and/or geothermal activity over space and time. The data used, within the time period 2007-2016, was collected by the the South Icelandic Lowland (SIL) seismic network operated and managed by the Iceland Meteorological Office (IMO). Furthermore, variations in seismicity are compared to crustal deformation observed with TerraSAR-X images from 2009-2019. Crustal changes in the Krísuvík area are quantified to develop a model for corresponding deformation sources. These changes are then correlated with the stress-field variations determined with seismic analysis.