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Non-eruptive Uplift and Subsidence episodes beneath the Hengill Triple Junction, SW Iceland

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Non-eruptive uplift and subsidence episodes at volcanic systems have been observed on volcanic systems around the world and understanding the complex source processes of the deformation is key to mitigate the hazard assessment or geothermal potential of the area. The Hengill area, an approximately 100 km² area in SW Iceland, located at the triple junction of the Eurasian plate, North-American plate and Hreppar Microplate, is one such example of a complex deforming volcanic system. The triple junction accommodates a total spreading and shear of 1.8 cm/yr through a systems of spreading ridges and "bookshelf-faulting" processes. The two active volcanoes of the area (Hrómundartindur and Hengill), last erupted ~2000 years ago. Beneath these adjacent volcanic systems, deep sources (5-7 km depth) caused successive episodes of broad-scale uplift (1993 – 1999; 2017 – 2018) and subsidence (2006 – 2017; 2018 – ongoing at the time of writing) in the area. These deep sources may be closely related as they have been located only 2-3 km from each other within the brittle-ductile transition zone of the area. More superficial sources (depth < 3 km) of deformation are also observed in the Hengill area, related to the extraction and injection of fluids in the Nesjavellir and Hellisheiði geothermal power plants.

Through the combination of GNSS, InSAR, analytical models and geophysical data sets from the area we investigate the spatial and temporal relation between these deep sources. The observed ground motions associated with these deep sources may be magmatic in nature (e.g. magma accumulation, degassing of older intrusions), however previous seismic tomography work (Tryggvason et al. 2002) in the area does not suggest a large partially melted magmatic body at those depths, hinting that other processes (e.g. hydrothermal) may be at the origin of some of these episodes. The correlation of geodetic measurements with geophysical and geothermal datasets may bring clues to constrain the nature of uplift and subsidence episodes in volcanic and high temperature geothermal areas such as the Hengill area.