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Ölfus seismicity in Iceland - II: seismic stress inversions and seismotectonic implications

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The South Iceland Seismic Zone (SISZ) is a part of the Hengill triple junction in southwest Iceland, along which the Mid-Atlantic Ridge (MAR) transitions from the Western Volcanic Zone (WVZ) to the Eastern Volcanic Zone (EVZ). The ∼80-km-long E-W feature displays a cumulative left-lateral motion while the numerous N-S faults that cut across the belt show right-lateral faulting. The most recent sequence of significant earthquakes in the region began in 1987 and culminated in 2008, with a total of six M > 5 events reported from the area. The region of interest in this study is Ölfus, the western part of the SISZ, which lies south of Hengill central volcano, the southern part of the WVZ. The Hengill-Ölfus system has a prolonged history of seismic swarms that show spatial and temporal ties to one another. One of the most recent and well-instrumented instances of this interaction was following the ∼M5 earthquake in Hengill in June 1998, when a ∼15-km-long N-S swarm of earthquakes extended south towards the E-W Ölfus zone. These events were recorded by the South Iceland Lowlands (SIL) seismic network, and the data was provided by the Icelandic Meteorological Office (IMO). The modern SIL data further affirms the long history of volcano-lowland interaction from 1991 to the present. The objective of this study is to examine stress changes in Ölfus between 1991-1999, and compare these changes to the stress state of Hengill within the same time-window. The Ölfus dataset is divided into multiple temporal windows based on the growth of swarm activity. The events within each time zone are relatively relocated following the Waldhauser and Ellsworth (2000) method. These spatially constrained earthquakes are then used to divide the area into grids depending on spatial trends in seismicity. The focal mechanisms of these events are further used to compute the principal stresses prevalent over each time window. A corresponding stress inversion is carried out for events (raw data) in Hengill from 1991-1999, within identical time-windows. The stress inversions are computed following the routines formulated by Martínez-Garzón et al. (2014) and references therein. The results indicate that Ölfus transformed from a partly normal/oblique faulting regime to a purely strike-slip faulting region leading up to the 1998 Hengill earthquake. This corresponds to visible changes in stress in the Hengill volcanic zone, while the area immediately east of Hengill continually exhibits strike-slip faulting.