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Spatial stress variations in the aftershock sequence following the 2008 M6 earthquake doublet in the South Iceland Seismic Zone

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The South Iceland Seismic Zone (SISZ) is an approximately 80 km wide E-W transform zone, bridging the offset between the Eastern Volcanic Zone and the Hengill triple junction to the west. The plate motion is accommodated in the brittle crust by faulting on many N-S trending right-lateral strike-slip faults of 2-5 km separation. Major sequences of large earthquakes (M>6) has occurred repeatedly in the SISZ since the settlement in Iceland more than thousand years ago.

On 29th May 2008, two M6 earthquakes hit the western part of the SISZ on two adjacent N-S faults within a few seconds. The intense aftershock sequence was recorded by the permanent Icelandic SIL network and a promptly installed temporary network of 11 portable seismometers in the source region. The network located thousands of aftershocks during the following days, illuminating a 12-17 km long region along both major fault ruptures as well as several smaller parallel faults along a diffuse E-W trending region west of the mainshock area without any preceding main rupture. This episode is suggested to be the continuation of an earthquake sequence which started with two M6.5 and several M5-6 events in June 2000. The time delay between the 2000 and 2008 events could be due to an inflation episode in Hengill during 1993-1998, that potentially locked N-S strike slip faults in the western part of the SISZ.

Around 300 focal solutions for aftershocks have been derived by analyzing P-wave polarities, showing predominantly strike-slip movements with occasional normal faulting components (unstable P-axis direction), which suggests an extensional stress regime as their driving force. A subsequent stress inversion of four different aftershock clusters reveals slight variations of the directions of the average σ_3 axes. While for both southern clusters, including the E-W cluster, the σ_3 axes are rather elongated perpendicular to the overall plate spreading axis, they are more northerly trending for shallower clusters located further north. In this study we will try to shed light into whether the azimuth variations of σ_3 is caused by stress changes due to the inflation-deflation episode in Hengill (NW of the activated fault zone) or solely depending to the depth of the aftershock clusters.