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The Great Geysir and tectonic interactions in South Iceland

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The Great Geysir is within a tectonically active region bordering the eastern flank of the Western Volcanic Zone (WVZ), south of Langjökull glacier. The geothermal area has been active at least throughout the Holocene (Torfason, 1985). It is a high-temperature system, which is not common in Iceland for geothermal areas located outside the neovolcanic zones. Its longevity suggests continuously active tectonics in the region. Indeed, half a century of seismic monitoring shows relatively high activity of minor earthquakes (magnitude<4.0). The general pattern of seismicity is rather constant through time, but comes in bursts of activity. We attempt to elucidate the driving forces in this unusual and poorly tectonically understood area, by analyzing the most modern seismic data collected in the years 1995-2016 within a study area ~25x25 km^2 enclosing the Geysir area. It is, for instance, observed how the large (Mw~6.5) earthquakes in June 2000, located ~45 km south and southwest of Geysir in the South Iceland Seismic Zone (SISZ), induced seismicity kilometers away within hours after their occurrence. The heightened level of activity, an order of magnitude in terms of number of earthquakes, lasted half a year after the 2000 events in large parts of the study area and finally tapered down in 2001. Within the first two weeks of the 2000 events, the main activated faults are within 5 km of the Great Geysir. The activation is mostly at shallow depth (< 4 km). However, none pass directly through the Geysir geothermal area. That may explain the only minor change observed in the dormant state of the Great Geysir, which has now lasted approximately a century. There are historic accounts on how several large South Iceland earthquakes in the SISZ activated the Great Geysir, lasting for years or decades. The last such activation was in 1896. In its full might, it erupts up to a height of 70-80 m (Torfason, 1985). Its currently active neighbor, Strokkur geysir, usually erupts to heights of 15-20 m. Cross-sections of the seismicity near Geysir suggest several near vertical right-lateral ~NNE trending faults. Focal mechanisms indicate strike-slip movements, but also oblique-normal and thrust events in between. This may suggest fault jogs and high horizontal stresses. Approximately 6 km north of Geysir, in the Sandfell and Sandvatn area, there is a persistent ~ENE trending ~5 km long seismic pattern with main activity between 4-8 km depth. This seismicity has occurred, on and off, through the history of seismic observations. Here the faulting is also complicated (strike-slip and thrust), but focal mechanisms suggest the main component to be normal to oblique normal. Cross-sections, although unclear, suggest possible dip to the ~SSE. We intend to calculate stress inversions in the study area prior to the conference.