Earthquake swarms in the Tjörnes Fracture Zone in N-Iceland, 2012 and 2013

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The Tjörnes Fracture Zone in N-Iceland is a complex right lateral transform offset connecting the offshore Kolbeinsey Ridge in the north-west to the on-shore volcanic fissure zone some 100 km to the south-east. Seismicity recorded in the area suggests it is composed of two major parallel lineaments separated by 30-40 km which are mainly offshore.

We investigate seismicity in the southern lineament, the Húsavík-Flatey fault (HFF) which lies across the island Flatey and the coastal town Húsavík. Historical records of major earthquakes in the HFF are scarce and the recurrence time of significant earthquakes is not well known. Records describe e.g. the threat of extensive rock fall in nearby islands and fjords south of the fault, caused by double M6.5 and M7 earthquakes in 1872 and 1755, respectively.

The regional seismic network SIL, run by the Icelandic Meteorological Office, has recorded earthquakes on the HFF since 1990's. Background seismicity is rather constant with time and is spread along the lineament. Earthquakes swarms, some quite intensive counting up to many thousand earthquakes, are seen in parts of the HFF and are usually separated by years.

Here we present analyses of intensive seismic swarm activity in the western most part of the fault and its intersection to the Eyjafjarðaráll graben. Over a period of a few weeks in late October and first half of November in 2012, roughly four thousand seismic events where recorded, first within the graben and later migrating to the east towards the HFF. The largest event, M5.6 occurred in the graben and its source mechanism indicates normal faulting, consistent with the extensional setting. The events on the HFF show however strike-slip, in accordance with shear movement, and have a maximum magnitude of 3.5. In total this activity extended over some 30km, leaving a part of the fault earthquake free.

In late September 2013 another swarm occurred counting roughly 1700 earthquakes, activating a 7 km part of the fault which was left out in the previous swarm in 2012 (see figure). Waveform correlation analysis of the 2013 swarm reveals very similar families of almost identical earthquakes and suggest same fault mechanism for all earthquakes within the swarm. Relative locations give us a very detailed picture and show that these events occurred in a very narrow depth range of 8.5-11 km. This seismic activity resembles more volcanic swarm activity in its temporal and magnitude distribution. Based on the high spatial resolution, the relative locations provide us with, we suggest that the HFF may be locked above the area where the swarm took place. Considering the volcano like behavior of the swarm we propose it might have been triggered by fluids penetrating from below.

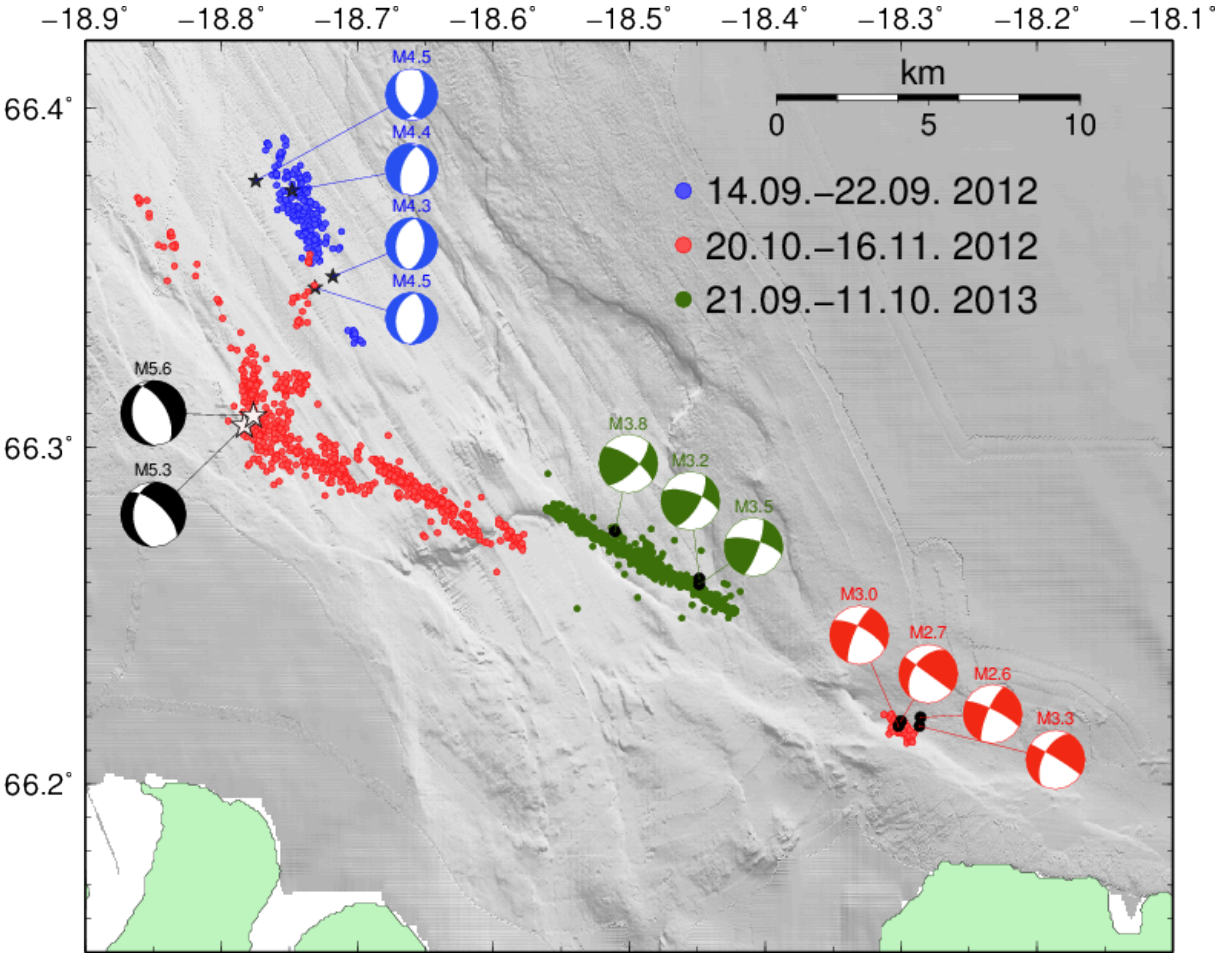

Figure. Map showing the epicenters of the seismic swarms that took place in 2012 and 2013 in the Eyjafjarðaráll graben and the western part of the HFF.