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ABSTRACT Session K2.2

The unrest on the Reykjanes Peninsula and eruption in Fagradalsfjall 2021 & 2022

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The Reykjanes Peninsula is an oblique transform zone marked with adjacent volcanic systems intersected by strike-slip earthquake faults. For the first time since modern instrumentation was installed (last 30 years) a clear, rapid uplift signal was observed on the peninsula in January 2020, interpreted as a magmatic intrusion. This event was followed by several events of further unrest. Between January to July 2020 three intrusions were detected in the vicinity of Mt. Þorbjörn and from July to August 2020 another near Krýsuvík, all accompanied by increased seismic activity.

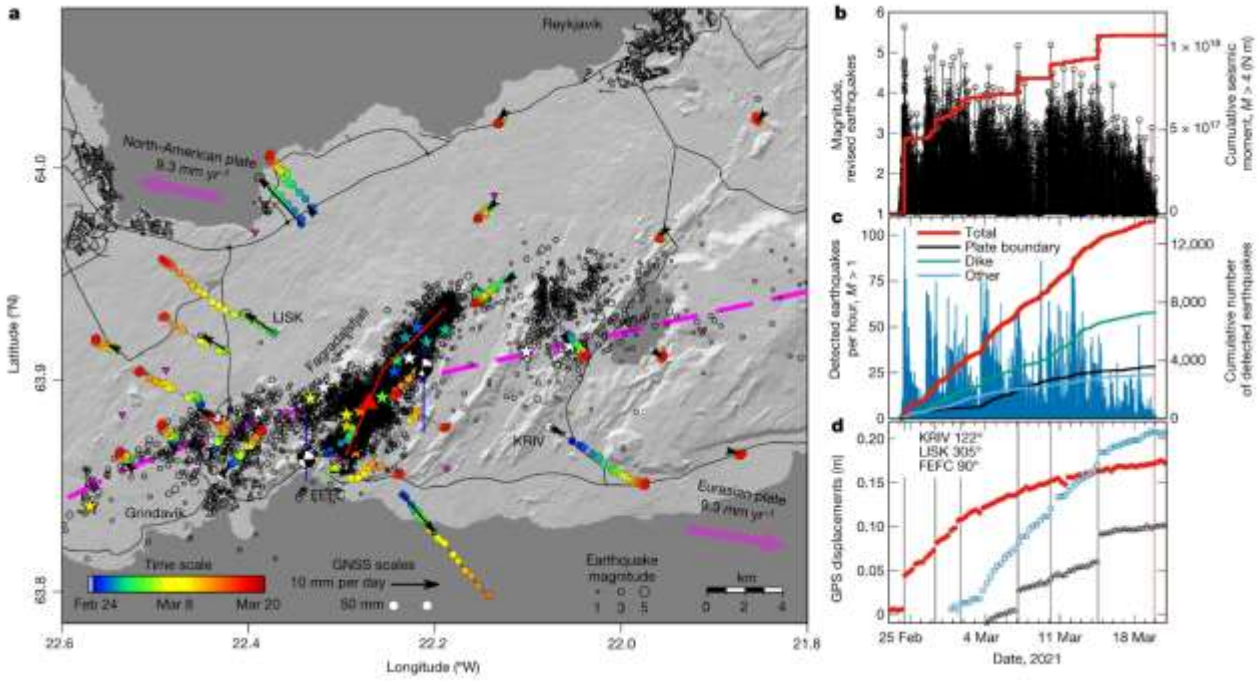

Fig. 1 Map of the Reykjanes Peninsula. Manually reviewed earthquake locations M > 1, covering the period from 24 February to 19 March 2021.

On the 24th of February 2021, a M5.7 earthquake was recorded NE of Fagradalsfjall and a dyke intrusion was detected beneath Fagradalsfjall a few days later. The intrusion continued until mid-March by which time the estimated length of the dyke was 9 km and the associated volume change 34 million cubic meters. This intrusive event triggered an unprecedented, roughly three-weeks long earthquake sequence, which extended over an area of some 350 km2 and counted over 50.000 earthquakes, of which 600 were above M3. It culminated in an effusive lava forming eruption which commenced on the 19th of March 2021 at 20.35 UTC. Lava was initially erupted from a ~100 m long fissure which opened in Geldingadalur valley in Fagradalsfjall. In the final days before the onset of the eruption, the seismicity as well as all deformation signals had dramatically decreased, at that time unexpected observables shortly before eruption onset.

This was the first eruption on the Reykjanes Peninsula in 800 years, and the first one in Fagradals-fjall in over 6000 years. The eruption was characterized by lava fountaining and the extrusion of basaltic lava flows, with an initial effusion rate of ~5 m3/s. The effusive eruption was accompanied by the release of magmatic gases. Activity remained stable until the 5th of April when two new fissures opened approximately 500 m north of the initial erupting craters. In total six fissures opened between the 5th and 13th of April. After the 27th of April, lava was erupted from one main vent (the fifth opening in temporal order) which in turn formed a crater that reaches ~120 m over the pre-eruption landscape. Lava was last seen spewing from the vent on September 18th.

Fig. 2 Icelandic Meteorological Office seismologist Kristín Jónsdóttir stands besides erupting craters spewing glowing lava from the Fagradalsfjall's eruption.

In total the eruption which started in the valley of Geldingadalir inside the Fagradalsfjall mountain massive produced a lava field covering about 4.9 km2 and created a total SO2 output of 0.9 Mt. The eruption progressed through different phases characterized by different emission sources, eruptive style, intensities, and associated hazards. However, in terms of intensity the eruption was small and arelatively easily accessible eruption, where the main hazards were in the near field to the thousands of visitors which had to be mindful of volcanic gasses, lava outbreaks and occasional minor lava bombs. By joining forces in monitoring and utilizing the available expertise in different institutions, the Civil Protection, Icelandic Institute of Natural History, Institute of Earth Sciences of the University of Iceland, Iceland Geosurvey, the Environmental Agency, and the Icelandic Meteorological Office, which runs the 24/7 monitoring services, a good overview was established of the evolution of the eruption and its hazards.

Reference:

Fig. 1: Overview of seismicity and deformation.
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