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The 2014-2015 Bárðarbunga-Holuhraun magmatic rifting event: A seismic study

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Over two weeks in August 2014 magma propagated 48 km laterally from Bárðarbunga volcano before erupting at Holuhraun for 6 months, accompanied by collapse of the caldera. A dense seismic network recorded over 47,000 earthquakes before, during and after the rifting event. More than 30,000 earthquakes delineate the segmented dike intrusion. Earthquake source mechanisms show exclusively strike-slip faulting, occurring near the base of the dike along pre-existing weaknesses aligned with the rift fabric, while the dike widened largely aseismically. The slip sense of faulting is controlled by the orientation of the dike relative to the local rift fabric. This is demonstrated by an abrupt change from right- to left-lateral faulting as the dike turns to propagate in a more northerly direction. Approximately 4,000 earthquakes associated with the caldera collapse delineate an inner caldera fault zone, in good correlation with geodetic data. Caldera subsidence was largely aseismic, with seismicity only accounting for 1% of the geodetic moment. 90% of the seismic moment release occurred on the northern rim, suggesting an asymmetric collapse. Well constrained focal mechanisms reveal sub-vertical arrays of inward dipping faults at $\sim 60^\circ \pm 9^\circ$, along both the north and south caldera margins. These steep normal faults strike sub-parallel to the caldera rims, with slip vectors pointing towards the center of subsidence. The maximum depth of seismicity defines the thickness of the seismogenic crust under Bárðarbunga as 8 km, suggesting that the primary shallow melt storage region lies $\sim$ 6 km b.s.l., in agreement with constraints from geodesy and geobarometry