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The large (M>5) co-eruptive earthquakes in Bárðarbunga caldera as observed by an accelerometer and cGPS in the caldera center

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The 2014-2015 eruptive episode in Holuhraun, northern Iceland, was accompanied by almost 70 meters of caldera subsidence in the ice-covered Bárðarbunga volcano. During the subsidence, over seventy 5.7>M>5 earthquakes occurred on the caldera rim, many of them with an unusual moment tensor (large non-double-couple component), indicating that they do not involve slip on a planar fault. Non- double-couple moment tensors are principally found in volcanoes in eruption (Shuler et al 2013), and several mechanisms for generating them have been proposed, such as: slip on a ring-fault (Nettles & Ekström, 1998); closing crack or sill (Kanamori et al 1993, Riel et al 2014); or a combination of both (Heimann et al, submitted). Thus, by what processes the seismic signal is related to the caldera subsidence is still under debate.

During the caldera subsidence, a high-rate (20 Hz) GPS station and an accelerometer were installed on top of the ice, near the center of the 7x11 km caldera. The GPS station started recording about three weeks into the caldera collapse and recorded over 35 m of subsidence, and several co-seismic steps of up to 40 cm in the vertical component. The size of the co-seismic steps diminished with time during the eruption. In addition to the steps, seismic waves are clearly seen in the high-rate GPS data at the caldera station. The accelerometer was installed more than two months after the start of the eruption and recorded intermittently due to unfavorable conditions on top of the ice sheet. However, more than 80 events were observed on the accelerometer, of magnitude M 1-4.3, providing important observations of s-p times.

Furthermore, the deformation of the glacier surface induced by some of the largest earthquakes, was captured by 1-day COSMO-SkyMed interferograms, providing further constraints on the earthquake process.

In this presentation we analyze the signals from the two instruments, together with InSAR interferograms as well as other available data, and use forward and inverse modeling of the seismic waveforms and the surface deformation to put constraints on the generating mechanism of the large earthquakes.