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Numerous large and long-duration seismic events during the Bárðarbunga volcanic eruption in 2014: What do they tell us about the caldera subsidence?

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The volcanic unrest in and around the Bárðarbunga volcano was followed by a sequence of large events occurring on the caldera rim. Between Aug 16th and Dec 31st 2014, more than 70 events occurring close to the caldera rim, with Mw >= 5 had been reported by Iceland Meterological Office (IMO). The events are in many aspects unusual:

1) Moment tensors for the events have a large negative vertical CLVD component (see Hensch et al, and Cesca et al., this conference). Similar events, but with a large positive vertical CLVD component, occurred in Bárðarbunga during the 1990s, and were interpreted to result from near simultaneous motion on a significant part of the caldera ringfault, as a piston of material above the magma chamber was rising (Nettles and Ekström 1998, Tcalcic et al 2009). The large negative CLVD component observed in events during this eruption, could then indicate subsidence on the ring fault, consistent with the observed subsidence of the caldera floor.

2) Many of the largest events are accompanied by a sudden subsidence at the center of the caldera (see Roberts et al, this conference). A GPS station was installed in the caldera in early september and has been nearly continuously operating since. The steps are seen to be decreasing with time, even for events of the same magnitude.

3) The events have a very long duration for their size. This is evidenced by a large difference between centroid and hypocentral time and a difference between magnitudes estimated from short period P-waves (NEIC) and those estimated from long-period body- and surface waves over time. This difference seems to be increasing with time. As part of this work, we plan to present independent estimates of the durations of the events, based on P-wave modeling in process.

4) Event hypocenters are very shallow. An accelerometer was installed on the ice cap (possibly the first time in history?) in the 7x11 km wide subglacial caldera next to the cGPS instrument in early November, and shows very small ts-tp times for all caldera events, indicating depths of 3 km or less.

5) Relatively relocated M$\sim$2 events (see Vogfjord et al, this conference) show a near vertical southern caldera rim with a fault plane reaching down to several km, although the exact depth extent may be influenced by the velocity model used. The seismicity along the northern caldera rim seems more diffuse and appears to be dipping towards the north, outward from the caldera.

6) We present a preliminary results from a waveform correlation analysis by correlating. waveforms of over 1000 caldera events with each other and group them into families of highly similar events. Looking at the occurrence of these families we find that individual families are usually clustered in time and they represent events of similar magnitudes. Using families including many events we analyse individual events within a family using coda wave interferometry in order to track temporal stress changes in the medium between the source and the receiver.

In this presentation we describe the earthquakes and discuss the their connection to the ongoing subsidence.