Paper Number: 3772

Searching for the significant displacement zone of the 2014 Orkney earthquake fault with strain data and Map3Di for targeting scientific drilling.

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The largest event recorded in a South African gold mining region, a M5.5 earthquake, took place near Orkney on 5 August 2014. This was an exceptional event as the main- and after-shocks were recorded by 46 geophones (red dots in Fig.1) at 2-3 km depth, 3 Ishii borehole strainmeters at 2.9 km depth (a green triangle in Fig.1), and 17 surface strong motion meters at close distances. The strain meters were only several hundreds of meters above the upper edge of the planar distribution of aftershock activity dipping almost vertically. A scientific project is planned to drill into the 2014 Orkney earthquake fault from the localities near the strainmeter sites. This is a rare opportunity to recover fault material and fractures, to measure stress, and to monitor the M5.5 fault zone after drilling. The final purpose of our research is to understand how the main rupture stopped and why aftershocks have occurred in sequence as observed. For this purpose, we attempted to constrain the significant displacement zone of the 2014 Orkney earthquake fault that accounts for the observed co-seismic strain (into which we want to drill) with Map3Di.

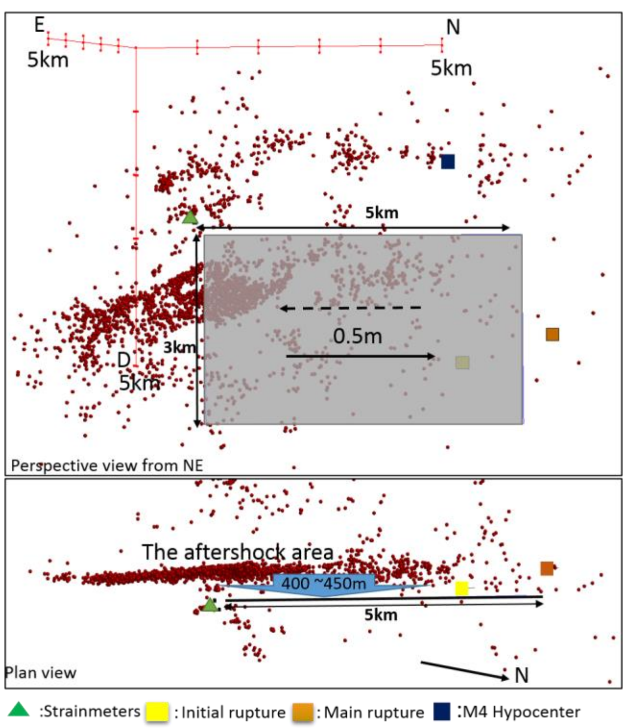

Figure 1: A fault plane of the 2014 Orkney M5.5 earthquake that can account for the observed strain step. Aftershocks: in-mine seismic network. Initial and main rupture origins: Ogasawara et al. IGC located using the CGS surface strong motion meter recordings.

We checked polarities of each component of the strainmeters by comparing the observed tidal change with theoretically calculated tide Gotic2 [Sato and Honda (1984)], and selected some components with proper tidal responses. The responses of the selected components were identical to a M4 earthquake (a blue square at 3 km depth in Fig.1) at a few km distance, whereas different and much larger (up to 1e-5) to the

M5.5 earthquake. By using the Boundary Element method, we calculated the strain change of each component of the three strain meters by assuming uniform fault slip over a rectangular area equivalent to the seismic moment of the M5.5 earthquake and with the same aspect ratio as the aftershock area. We found that a rectangular area with a uniform fault slip of 0.5 m on a 3 x 5 km^2 plane can explain the observed magnitudes of strain changes. Compared to the aftershock area, the extent of significant fault slip is closer to the area where the main- and initial- rupture originated, and shifted to the east (Figure 1). We haven't yet evaluated any local effects that might cause discrepancies in each component of the three strainmeters. At the 35^{th} International Geological Congress, we are going to make a follow-up report.