Strain change with M2 events within 100m and an attempt for better location with double-difference method to discuss it

Naoyuki Shimoda[1]; Jun'ichi Takeuchi[2]; Hiroshi Ogasawara[1]; Hiroshi Ishii[3]; Shigeru Nakao[4]; Masataka Ando[5]; Sumitomo Norihiko International Research Group for Semi-controlled Earthquake Generation Experiment at South African Gold Mine[6]

[1] RitsumeiUniv.; [2] RitsumeiUniv.

; [3] TRIES; [4] ERI, Univ of Tokyo; [5] RCSV, Science, Nagoya Univ.; [6] -

Strain monitoring at the closest proximity of hypocenters is most straightforward to learn inelastic behavior on or proximity of fault, which is crucial to consider physics of earthquake generation. So, the Research Group for Semi-controlled Earthquake-generation Experiment in South African Deep Gold mines has monitored strain change closest to a fault 2.4km deep at the Bambanani mine with Ishii borehole 4-component strainmeter with 24 bit 25 Hz sampling. We have been reporting interesting strain recordings associated with some M0-2 events within 100 m (Ishii et al. 2000 JSS Fall; Ogasawara et al. 2002 Joint Meeting; Moriyama 2002 JSS Fall; Takeuchi et al. 2002 JSS Fall). On 14 February 2003, an M1.4 took place, kicking of foreshock activity within 100m from our strainmeter. 34.5 seconds later, another M1.4 occurred, immediately followed by an M2.5 mainshock. On 12 April 2003, an M2.6 event occurred without foreshocks. Takeuchi et al. (2003 IUGG; 2003 AGU Fall) reported strain changes associated with these two M2-class events. In the poster, we first briefly introduce the result with a report of our attempt to better locate seismicity with the Double-Difference method (Waldhauser and Ellsworth 2000) as the first step of further analysis.

At the Bambanani mine there are 16 stations with triaxial geophone and four with triaxial accelerometer in boreholes more or less 10m long, spacing 400-500m to each other (e.g. Moriyama et al. 2002 Fall). Geophone and accelerometer recordings are sampled at frequencies of 2kHz and 15kHz, respectively. On weekdays, several hundreds of events (M larger than -1) are recorded, routinely located with P- and S- arrival times. Location accuracies are a few tens of meters, being not good enough to discuss configuration of seismicity surrounding mainshocks or to investigate strain recordings in detail taking hypocenter location with respect to the strainmeter into an account.

It is expected that the Double-Difference method with cataloged P- and S-arrivals with 2kHz sampling seismogram can locate hypocenter within an accuracy of a few meters (Waldhauser and Ellsworth 2000). Moreover, we try to incorporate double-difference of P-wave direction to improve accuracy in depth direction. Then, we first investigate in detail a process how a final fracture plane is nucleated for the M2.5 event on 14 February with several foreshocks.

Then we expect a geological map in the mine with an accuracy of about 1m enables us to constrain absolute hypocenter location although the Double-Difference method. Taking source mechanism into account, better location of aftershocks could enable us constrain cause of significant post-seismic strain change (e.g. by dilatation or shear deformation near the fault).

Single strainmeter does not allow us to locate the source of strain change in principle. Multiple strainmeters are needed to do so. However, at the Bambanani mine, multiple events with significant strain change occurred in different orientation with respect to the strainmeter. So, composite strainmeter locations with respect to the better-located faults and the slip vectors for multiple events could allow us to locate the source of strain change, or at least to constrain the location of the source: e.g. in the middle or the edge of faults.

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