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# Evaluation of temporal change in spectrum amplitude of wave transmitting through a fault, South African gold mine

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It has been shown that the amplitude of transmitting wave through a fault decreases prior to unstable sliding in laboratory experiments (e.g., Yoshioka and Sakaguchi, 2006). However, there are few studies on natural faulting to show similar phenomena. It is difficult to set controlled wave sources and receivers at the proximity to the natural faulting source. South African gold mine where induced earthquakes occur in the vicinity of mining faces due to stress concentration is a suitable field for near-source observations because planned mining enables us to anticipate where, when, and how large earthquakes would occur.

To monitor the details over an M2˜3 earthquake life-span near the source, we installed a strainmeter and accelerometers around a potential source area (a part of Tanton fault) of normal faulting earthquakes in Bambanani gold mine and carried out the continuous observation from 2001 to 2004 together with geophones maintained by mine (Ishii et al. [SSJ fall meeting 2000]). As was expected, earthquakes of M˜2 occurred in February 2002, February 2003, and April 2003.

A few hundred of clusters of smaller repeating earthquakes were observed within 250m from Tanton fault, using Geophone No.6 (basic sampling frequency of 2kHz), from June 2001 to June 2003 (e.g., Yamamoto et al. [SSJ fall meeting 2006]).

Source locations and mechanisms can be regarded to be identical to each other in lower frequency band.

Using one of these clusters of repeating earthquakes as a controlled source system, Yoshimitsu et al. [SSJ fall meeting 2007] estimated temporal change in transmitting efficiency through the fault during the period including the M˜2 earthquakes.

The cluster contains 20 repeating earthquakes (-1.5˜M˜0.0) from October 2002 to June 2003. M˜2 earthquakes on February 4th 2002 and April 12th 2003 occurred in this period. The sources of two M˜2 earthquakes in 2003 were located between the cluster and Geophone No.6.

Yoshimitsu et al.(2007) found that S-wave amplitude of UD component passing through the fault decreased in high frequency component (higher than 100Hz) coseismicly after the M˜2 earthquakes using the ratio between spectrum for repeating earthquakes before and after M˜2 earthquakes.

Additionally, they found transmitting efficiency of high frequency component (higher than 100Hz) through the fault slightly lowered in the preseismic period. Thus, they suggested small cracks were formed in the source region both before and after the earthquakes, which were sensitive to the waves in a frequency range higher than ˜100Hz.

However, if aligned cracks are formed and a single S-wave splitting observed, apparent decrease in spectrum ratio can be seen due to the phase interference in some frequency bands.

So, we investigate whether the change in spectrum ratio of high frequency found by Yoshimitsu et al. (2007) was apparently made by S-wave splitting. We estimate S-wave splitting for the repeating earthquakes by means of the cross-correlation method with band-pass filtered waveform between 20-160Hz whose range is the same as the analyses by Yoshimitsu et al. (2007).

We also estimate the temporal change in P-wave spectrum ratio.