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Acoustic properties across the high velocity sheared zone

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We investigated the transmitted waves emitted from a piezo-electronic device during the high velocity slip experiments. We modified the high velocity shear apparatus installed at NIED to make it possible to measure the transmitted waves across the sliding interfaces. In this experiment, we used a pair of solid cylindrical sample of monzodiorite from Zimbabwe whose length and diameter are 43mm and 40mm, respectively. Input signal was a single sine pulse with 20Vpp and 0.5MHz. Since the resonance frequency of piezo device is 2MHz for parallel motion and 0.5MHz for perpendicular motion, the received signal is expected to be dominant in shear wave motions.

Before the experiment, we measured the transmitted waves under various normal stress conditions without rotating the samples. As expected, amplitude increases linearly with increasing the normal stress (from 1MPa to 8MPa), indicating the increase of contact area in the interface.

Then, we conducted a friction experiment with continuously monitoring the acoustic amplitudes. The experiment was done under constant slip velocity of 0.08m/s under constant normal stress of 3MPa. Under this condition, no visible melting occurred. A single 0.5MHz sine pulse was shot at an interval of 1KHz. To monitor the averaged variation of the amplitude, 10000 traces were stacked to get a single observed trace, therefore the stacked traces were obtained every 10s. Since total amount of slip was 110m in about 20 seconds, we obtained 125 stacked traces during the sliding. We measured the maximum amplitude of each trace between 30-50 micro seconds after shoot time, which mainly includes S-wave arrival time. The variation of maximum amplitudes seem to be related to the friction coefficient. When the friction decreases, maximum amplitude increases.

We could get some information on the high slip friction from the above amplitude variation of transmitted waves.

Keywords: high-velocity friction experiment, amplitude of transmitted wave, friction, fault