S142-P017 **Room: Poster Session Hall** **Time: May 29**

Electomagnetic emission during seismic nucleation phase of stick-slips

Kumi Onuma[1]; Kenshiro Otsuki[2]

[1] Geology, Tohoku Univ.; [2] Earth Sci., Tohoku Univ.

I. Introduction

Seismic nucleation processes are key points for seismic faulting and earthquake prediction.

1) The size of seismic nucleation is determined by the characteristic wavelength of slip surface topography, and some scaling laws are derived from it (Ohnaka and Shen, 1999). Alternative characteristic wavelength should be introduced for natural faults because they are associated with layers of fault gouge. Riedel shear will be an equivalent since it is a characteristic structure inside fault zones (2007).

2) Not only experimental cosismic but also preseismic slips are associated with electromagnetic signals of piezoelectric or flow potential origins. Other mechanisms of electromagnetic signals are plausible because even non-piezoelectric materials under dry conditions emit electromagnetic signals.

II. Method of stick-slip experiments

Experimental apparatus: tri-axial apparatus of argon gas as pressure media. Samples: granite and gabbro cylinders of 20mmx40mm. Precut surface: 50 degree against sample axis and mirror-finished. Simulated fault gouge: quartz and gabbro powder of 0.25g. Sensors: strain gauges for measurements of axial stress, slip distance as well as three shear strain gauges pasted along a slip surface, three pairs of electrodes and a pair of troidal coils for measurement of triboelectric and induced potentials. Data acquisition: continuously and synchronously at 2MHz. Experimental procedure: loading of axial stress after holding at confining pressure of 80-180 MPa and shear stress at 250 MPa during 0.1-1 hour for compaction of gouge.

III. Experimental results

1) Stick-slips on bare surfaces

Fluctuations of the electrode potentials and induced potentials during main stick-slip events are 55-180mV and 0.37-4.4mV, respectively. Gabbro and granite samples do not show significant differences in magnitude of electrode potential. Any experimental runs were not associated with nucleation phases. Prior to main stick-slip events spike-like signals of electrode potentials were sometimes found synchronously with very small stress drops less than 1MPa. The amplitudes are less than 30mV, and they decayed exponentially.

2) Stick-slips with fault gouge

Stress drops and fluctuations of electrode and induced potentials at main stick-slip events are 7-400 MPa, 17-200mV+ and 1-18mV+, respectively. Significant differences in fluctuations of electrode potentials were not found between granite and gabbro samples. About 30% of all experimental runs were associated with a nucleation phase. Slip distance, stress drop, duration and the maximum fluctuation of electrode potentials were 0.02mm, 14MPa, 0.3sec and 20mV in an experimental run, and the latter three were 3.5MPa, 0.35sec and 4mV in another run. Three pairs of strain gauges recorded the initial site and its propagation of a seismic nucleation. The potentials of three pairs of electrodes also fluctuated synchronously. The pulse-like electrode signals were sometimes found also for these experiments.

IV. Discussions and conclusions

1) The reason why the stick-slips on bare surfaces were not associated with a nucleation phase is attributed to mirror-finished smooth and flat precut surfaces.

2) Irrespective of granite or gabbro powders of fault gouge, there were not significant differences in magnitude of pulse-like fluctuations of electrode potentials. This is the case for main stick-slip events. These indicate that the causes of the electric signals are not piezoelectric effect but triboelectricity and/or fracto-emission.

3) Since the fluctuations of electrode potentials are synchronous with the initiation and propagation of a nucleation, the former is attributed to the latter.

4) It is very likely that nucleation is quasi-static slip on a Riedel shear because the length of a nuclei estimated from slip during nucleation phases is the same order as the length of Riedel shears.