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Cohesive Zone Length of Gabbro at Supershear Rupture Velocity (2)

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We investigated the shear strain field ahead of a supershear rupture. The strain array data along the sliding fault interfaces was obtained during large-scale biaxial friction experiments conducted at NIED in March 2013. These friction experiments were done using a pair of meter-scale metagabbro rock specimens whose simulated fault area was 1.5m x 0.1m. 2.6MPa normal stress was applied with loading velocity of 0.1mm/s. Along the fault edge parallel to the slip direction, 32 2-component semi-conductor strain gauges were installed at an interval of 50mm and 10mm off the fault. The data are conditioned by high frequency strain amplifiers (<0.5MHz) and continuously recorded at an interval of 1MHz with 16-bit resolution. Many stick-slip events were observed in this experiment. We chose unilateral rupture events in which foreshocks did not precede ahead of the main rupture and that propagated with supershear rupture velocity. One of the reasons for this selection was to improve the quality of observed data because the strain field ahead of the supershear rupture was not contaminated by elastic waves. Focusing on the rupture front, stress concentration was observed and sharp stress drop occurred immediately inside the rupture. We converted the temporal variation of strain to spatial variation of strain and picked up the peak strain and zero-crossing strain locations to measure the cohesive zone length. By compiling the stick-slip events, the cohesive zone length is 10 ˜20 mm. We could not see any systematic variation at the location but the cohesive zone length scattered between the events. We found that the cohesive zone length decreases with the total amount of slip as well as the rupture velocity increases, especially larger than root 2 times the shear wave velocity. This feature is more or less consistent with the theoretical prediction of Broberg (1999).

Keywords: cohesive zone, earthquake rupture, friction experiment, supershear rupture