Oral | Symbol S (Solid Earth Sciences) | S-SS Seismology

[S-SS30_28AM2]New perspective of great earthquakes along subduction zones

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Mon. Apr 28, 2014 11:00 AM - 12:42 PM Main Hall (1F)

We explore a new perspective of great earthquakes along subduction zones by integrating results of historical earthquake and tsunami surveys, seismic and geodetic observations and experiments, laboratory experiments, material analyses, and numerical modeling on pre- and co-seismic processes and slips, seismic links, and the recurrence. We welcome presentations not only on great earthquakes along Japan Trench, Nankai Trough, and other subduction zones in the world, but also on their precursory or inducing large inland earthquakes.

11:00 AM - 11:15 AM

[SSS30-P21_PG]Estimate of the contact state of microcrack from the elastic wave velocity measurement

3-min talk in an oral session

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Birch (1960) studied about the relationship between the confining pressure and the elastic wave velocity. It was indicated that the elastic wave velocity increases with the increasing confining pressure because the microcrack is closed at high pressure. The velocity includes the effect of microcracks at low pressure. We must the elastic wave velocity without the effect of microcrack to know the elastic constants of a rock. To do that, it is necessary to know the process of closing microcracks and the contact state of microcrack. The power-law relation between the elastic wave velocity and confining pressure is expressed with pressure exponent of μ (Kobayashi and Kozumi, 1976). They assume that the microcrack has single contact in this model. It is necessary to take account in multiple contacts because the microcracks of a rock have multiple contacts. We applied the single contact model to multiple contacts model with the previous study (Archard, 1953). The microcrack has the point contact, ball contact and plane contact when μ is 2/3, 3/5 and 1/2 respectively. The microcrack contacts plastically if μ is <1/2. We measured the elastic velocity of rocks with gas medium high pressure apparatus to discuss the effect of the confining pressure. We measure the velocity with the pulse transmission technique. We set the assembly, composed of a sample between two metal jig pasted piezoelectric transducers, in the pressure vessel. The sample height is about 15-40 mm and diameter is 20 mm. The frequency of transmission wave is 2 MHz. We recorded it 10^{-9}s rate. We measured Vp and Vs of the gabbro and granite during pressurization and depressurization to a maximum confining pressure of 200 MPa. The velocity increased drastically with the increase in the confining pressure up to 100 MPa. When confining pressure is lower than about 100 MPa, μ of the gabbro and granite is about 2/3, indicating that the contact state of microcrack is point contact. However, under pressure higher than 100 MPa, μ becomes under 1/2, indicating that all microcracks are closed plastically in the experiment with gas medium high pressure

apparatus. So the velocity at pressure higher than 100 MPa does not include the effect of microcracks. Furthermore, we estimated μ of several rocks from previous studies (Birch, 1960, Zimmer et al., 2002). Although μ depends on rock type at low pressure, it converges to values smaller than 1/2 at high pressure. This indicates that all microcracks are completely closed at high pressure and this result conforms to our experiment. If fluid exists in rocks, the value of μ is less than 1/2 even at low pressure. Therefore the microcrack with fluid acts as having plastic contact. We revealed the process of closing microcracks with the increasing confining pressure from the elastic wave velocity measurement.