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Effects of changing pore pressure conditions on aseismic slip events

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In recent years, GPS observations have caught the aseismic slip events at some subduction zones, for example, in the Hyuganada region [*Hirose et.al (1999)*] or the Tokai region [*Ozawa et.al (2002)*]. These events have occurred in the deeper zone than the large slip zone of the previous great interplate earthquakes [*Kawasaki (2004)*]. Such events often involve the low-frequency earthquakes [*Shelly et.al (2006)*].

To clarify the mechanism of these aseismic events, model calculations using a laboratory-derived rate- and state- dependent friction law have been done heretofore [e.g. *Liu and Rice (2005)*]. However, any studies have not considerd effects of changing pore pressure conditions on the plate interface. Therefore we present the effects of changing pore pressure conditions on the aseismic slip events. In addition, we do not use a small cutoff velocity [*Shibazaki and Iio (2003), Kato (2003)*] in the friction law, since this constitutive response has not yet been confirmed by laboratory experiments [*Liu and Rice (2005)*].

Liu and Rice (2005) simulates the aseismic transients along the strike. They set the steady pore pressure profiles on the plate interface to be overpressurized, namely max[hydrostatic, lithostatic-x (a certain pressure)]. It is derived under the assumption that steady flow exists along the sealed fault zone, introduced by *Rice (1992)*. The steady flow is assumed to originate in the fluid released from metamorphic dehydration reactions. With respect to the metamorphic dehydration reactions of subducting oceanic crusts, we can refer to petrologic studies [*Shmidt and Poli (1998), Hacker et al. (2003)*] which investigate maximum H_2O contents bound in hydrous phases in H_2O-saturated MORB. In a low-angle subduction, the metamorphic dehydration reactions are considered to occur approximately above temperatures of 350 degrees C. Hence the dehydration zone includes the aseismic event zone, because the aseismic event zone is deeper than the seismogenic zone which is considered to be in the temperature range of 150 to 350 degrees C [*Hyndman et al. (1997)*].

Here, we execute 2D model calculations taking into account pore pressure conditions reflecting the metamorphic dehydration reactions. However, the implication of the metamorphic dehydration reactions for pore pressure conditions remains unknown yet. Hence, we set three different models: (1) the dehydration strengthening the overpressurization, (2) the dehydration releasing the overpressurization, (3) the dehydration not affecting the overpressurization.

As a result of calculation, model (2) is more appropriate to cause the aseismic slip events than the other models. This result seems to be against the propositions of the previous observational studies [e.g. *Kodaira (2004)*], but the propositions are just inference from high poisson's ratio or V_p/V_s ratio on the ground of an experimental study [*Christensen (1984)*]. There are another possibilities to explain the high Poisson's ratio or V_p/V_s ratio such as the differences of rock types [*Christensen (1996)*]. In addition, our result is indirectly supported by an experimental study [*Tenthorey and Cox (2003)*] whose experimental results indicate that the metamorphic dehydration reactions lead to increasing permeability by several orders of magnitude larger, because we may interpret it as a relaxation of excess pore pressure.