Fluid migration in poro-viscoelastic slab

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Fluids play a key role in controlling seismic and volcanic activities in subduction zones, and many previous studies have investigated where in the slab fluids are released. However, the detailed fluid behavior after its release is still an open question. A recent numerical study suggested that a large part of fluids does not simply go up vertically but rather migrates in high-permeability layer in the slab. They assumed, however, that the slab behaves as viscous fluid when it changes its volume in response to fluid migration. In this presentation we will show how fluid migration changes when the slab is treated as poro-viscoelastic medium.
We use numerical approach based on a theory of two-phase flow, which allows us to simultaneously consider the movement of matrix and fluid phases. We consider 2D model domain inside the slab. A thin layer of fluid source is assumed. Bulk modulus and bulk viscosity which characterize elastic and viscous deformation with volumetric change, respectively, are assumed to be constants. We fix bulk modulus to be 130 GPa and change only bulk viscosity to see its effects on fluid behavior.
Preliminary results show that when the viscosity is lower than ~10^22 Pa.s, viscous deformation is dominant in the slab and almost all the fluids go up vertically soon after its generation, producing porosity waves. When we use bulk viscosity of 10^24 Pa.s, the slab behaves as an elastic medium and a large part of fluids is trapped in the slab. Considering that the slab has a high shear viscosity due to its low temperature and that bulk viscosity is at least as high as shear viscosity, bulk viscosity in the slab is likely to be very high. Therefore the slab may deform as an elastic medium in response to fluid migration and a large part of fluids will remain in the slab.

Keywords: fluid migration, poro-viscoelasticity, subduction zones

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