3D fluid migration in subduction zones caused by the effects of slab geometry

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It is essential to understand the detailed fluid behavior in subduction zones to better constrain the mechanisms of seismic and volcanic activities there. However, previous studies have mainly focused on its behavior only in the across-arc cross-section. One possible observation showing the along-arc variation in the fluid behavior is episodic tremor and slip (ETS), which is a recently discovered slip at the plate interface including deep, non-volcanic tremors and slow slip events (SSEs). Its generation may be related to the presence of fluid and its activities have a close connection with slab geometries in some regions. In Cascadia, for example, the amount of slip due to SSEs is largest where we observe the bend of the subducting Juan de Fuca Plate. In this presentation, we demonstrate how fluid migrates in 3D by the effects of slab geometry and how it is related to the observed spatial variation of ETS.

We construct a 3D numerical model for Cascadia subduction zone based on finite element approach. We assume that fluid migrates as porous flow. We also assume that the fluid released from the slab migrates in the direction subparallel to the slab surface due to the permeability anisotropy of serpentinite. We find that fluid migrates in the maximum-dip direction of the slab, not parallel to the direction of plate motion. Furthermore, the fluid concentrates at the bend of the slab and it leads to an increase in porosity by more than 50% there. Thus, the 3D fluid migration obtained here could be a good explanation for the spatial variation of ETS in Cascadia.