Effect of preferred orientation on the frictional strength of montmorillonite gouge

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Clay minerals have been found in the sliding zones of natural faults and landslides. Most clay minerals are composed by the stacking of 1-nm thick structural layers, and shows large surface specific area. The surface of most clay minerals has high affinity with water and some clay minerals swell at highly humid conditions and in aqueous solutions. Since the presence of interlayer water alters the frictional properties of simulated gouges composed by swelling clay minerals, understanding of the swelling state at various environmental conditions is important for fault and landslides mechanics.
The morphology of clay minerals is plates with large aspect ratio. The preferred orientation of the particles along with the sliding plane can change the frictional properties of gouge [1]. Since the degree of preferred orientation depends on the environment of clay mineral formation [2], frictional properties of simulated gouge having clay minerals should be investigated for various degrees of preferred orientation. Here we measured the shear stress of montmorillonite gouges with two different degrees of preferred orientation under dry conditions.
The degree of the preferred orientation of montmorillonite gouge was evaluated by X-ray diffraction method. To prepare the dry montmorillonite particles without interlayer water, thermal analysis (TG-DTA) was conducted before the shear measurements. Highly oriented montmorillonite gouges shows long dehydration time relative to low orientated montmorillonite gouges. This can be interpreted by the difference of permeability of gouges.
Shear experiments were performed at the normal stress from 5 to 40 MPa. Highly orientated montmorillonite gouges shows high shear stress and strong normal stress dependence compared to the gouges of low orientation. This implies the cohesion force acting between montmorillonite basal planes at dry condition have a large effect on the frictional properties of highly orientated montmorillonite gouges.

References
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