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Estimation of Peak stress, Fracture energy and Critical distance from natural fault

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New methods based on the technique of calcite twin piezometer can estimate seismic frictional parameters of peak stress, fracture energy (Gc), critical distance (Dc). Though these are fundamental parameters of fault friction, it has been hard to know from a fault rock.

The calcite records paleo-stress as stress dependent intracrystalline deformation of mechanical twinning. Calcite grains, interleaving between rigid grain aggregate, will deform during elastic deformation of the whole body. The record of stress may be preserved by the indicator after elastic rebound of the whole body. This concept was documented by tri-axial sandstone experiment and numerical simulation of discrete element method (Sakaguchi et al., 2011).

This method is applied to natural fault at Pseudotachylyte bearing ancient seismic Okitsu fault, Cretaceous Shimanto complex. High peak stress of 350 MPa was found at center of fault zone, and it drops to 260 MPa with short distance of several 10 m perpendicular to the fault. Such a localized high stress may result in stress-concentration at rupture front. If dynamic fracture energy is close to concentrated strain energy at rupture front, fracture energy can be estimated from paleo-stress and elastic modules of the fault rock. In fault energy model, peak stress, critical distance and fracture energy are plotted at simple triangle diagram. The critical distance can be assumed from other two parameters.

Keywords: seismic fault, paleo-stress, calcite twin, Dc, Gc