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Microfracture analysis of damage zone along active faults

Kazuo Mizoguchi[1*], Keiichi Ueta[1]

[1]Central Research Institute of Electric P

Brittle faulting along faults in the crust often results in the fault zone structure characterized by a fault core surrounded by a damage zone. The fault core is narrow localized shear deformation zone consisting of fault gouge, fault breccia and cataclasite. Previous studies showed a clear relationship that the width of the damage zone becomes thick with the net displacement occurred along faults (e.g., Mitchell & Faulkner, 2009). The damage zone width is important for understanding the degree of maturity of a previously unknown fault and its associated seismic hazard. In the damage zone, fractures develop at various scales, from ˜ ?m to ˜ m, and their density typically increases with proximity to the fault core. We examined the spatial distribution of the microfracture density around a newly-found active fault in Takiyama area, east of Tottori plain (Sasaki et al., this 2011 JGU meeting).

The studied fault zone consists of the 1 m thick fault core of the purple-colored clayey fault gouge and the fault breccia with cataclastic foliation, and the surrounding damage zone developed in Cretaceous Kyushozan granite. The boundary plane between the fault gouge and the fault breccia has a strike of N79W and a dip of 87N, corresponding to a fault plane. We collected ten orientated samples 19.4 m to 329 m from the fault core. The samples were coated with epoxy and then thin sections were cut perpendicular to the fault plane and parallel to a horizontal plane because the slip direction is unknown. More than 10 quartz grains per sample were analyzed for the microfracture density measurements. Quartz is suitable to estimate the damage that the rock sample has sustained because quartz without cleavage acts as an isotropic medium for fracturing. We counted the number of microfractures that intersected a line which was drawn from the edge of each quartz grain, through the center point, to the other edge of the grain. The linear microfracture density for each sample is calculated to be the total number of microfractures intersecting the lines divided by the total counting line length. The microfractures we counted are divided into (1) healed fracture (fluid inclusion planes), (2) sealed fracture filled with clay minerals and (3) open fracture. The linear density of open fractures increases as the fault core is approached. The other fractures do not show a clear relationship between the microfracture density and the perpendicular distance from the fault core. In this presentation we will discuss whether such a spatial distribution of microfractures is structural characteristics of damage zone along active faults.

Keywords: active fault, Damage zone, microfracture