Oral | Symbol S (Solid Earth Sciences) | S-SS Seismology

[S-SS32_1AM1]Fault Rheology and Earthquake Dynamics

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Thu. May 1, 2014 9:00 AM - 10:45 AM 315 (3F)

Interdisciplinary discussions on the rheology of seismogenic faults and earthquake generation processes among the following specialists; (1) fault rocks and fault zones, (2) theoretical and numerical studies on earthquake dynamics, and (3) seismology and geodesy. Presentations on fault-zone drilling projects are also welcome.

10:30 AM - 10:45 AM

[SSS32-P02_PG]Roughness of fault surfaces over a length-scale range from nano- to milimeters.

3-min talk in an oral session

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Keywords:fault surface, roughness, fractal, Hurst exponent

Geometric complexities of faults are first-order effects that complicate the mechanics of earthquakes and faulting. Here we report on the topographic roughness measurements on two natural fault surfaces with a continuous length-scale range from 1 nm to 3 mm. The fault surfaces observed in this study include (1) the Corona Heights fault in the Castro Area of San Francisco, that has been studied mineralogical and microstructural in detail, and (2) the Itozawa fault in Fukushima prefecture, a normal fault moved just after the 2011 Off the Pacific Coast of Tohoku earthquake. Both fault surfaces exhibit shiny slickensides on which various length and width of slickenlines are observed.In order to measure fault surface topography with a scale range from 1 nm to 3 mm, we performed line-measurements both parallel and perpendicular to the slickenlines using two scanner devices; a confocal whilte-light scanning microscope (measurable range: 0.15 ~ 3000 μm) and a scanning probe microscope (1 ~ 50000 nm). The topographic properties of the measured surfaces were expressed either as a Hurst exponent (H) which are calculated from power spectrum density (PSD) of topography data. As a result, the Corona Heights fault and the Itozawa fault exhibit a consistent geometrical property, a linear behavior on a log-log plot where axes are PSD and spatial length scale. A slope of the log-log plot, H, of the Corona Heights fault and the Itozawa fault shows $H_N = 0.73 \pm 0.010$ perpendicular to the slickenslide and $H_P = 0.81 \pm 0.012$ parallel to it, and $H_N = 0.87 \pm 0.013$ and $H_P = 0.94 \pm 0.014$, respectively. Smaller H_P than H_N is often reported, that interpreted as surface roughness in the slip direction becomes less pronounced selectively with progressive displacement (e.g., Sagy et al., 2007). Therefore, almost no difference between H_P and H_N in the observed fault surfaces could imply that both faults may be relatively immature due to less total displacement, or otherwise H_P and H_N are undifferentiated with displacement in the length-scale range from 1 nm to 3 mm. Candela et al., (2012) measured roughness of thirteen earthquake fault surfaces and suggested that the fault geometry can be expressed as a single geometrical description

(i.e., single *H*) over a range of scales from 50 μ m to 50 km. Our data, at least H_N = 0.81 perpendicular to the slickenlines, is consistent with their universal H_N = 0.81 ±0.04 even for lower length-scale range. Hence, the geometric complexiity of fault surfaces in nature can be maintained over length-scales from nano- to kilometer and be described as the sigle Hurst exponent.