Depth condition under which OSL signal of quartz gouge experiences coseismic zeroing

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Attempts to determine the age of faulting recorded on a fault rock have been made using methods such as the K-Ar dating, FT dating, and ESR dating (e.g., Murakami & Tagami, 2004, GRL). Among the proposed methods, the luminescence dating method has an applicable time range of few decades to few hundred thousand years ago, and hence it is suitable for dating an active fault. Early trial demonstrated a successful determination of the latest earthquake event along the active fault in central Japan (Ganzawa et al., 2013, JGSJ). The slip rate dependence of the condition that optically-stimulated luminescence (OSL) signal of quartz gouge resets was experimentally verified, so that the signal start to decrease from the slip rate of 0.25 m/s and becomes zero at slip rate ≧ 0.65 m/s (Minomo et al., 2018, JPGU). Here we show the clear reduction (zeroing) of OSL signal of quartz gouge after the laboratory experiments and estimate depth condition required to occur age resetting in natural fault zones. In the experiments, we used quartz powder with a particle size of <150 μm which is extracted from Tsushigawa granite, located in Awaji island, Hyogo Prefecture. We irradiated 400 Gy of gamma-ray for the quartz powder before the experiments to simulate natural radiation damage. Friction experiments were conducted under the following conditions in darkroom environment using a rotary-shear, high-velocity friction apparatus in Yamaguchi University; normal stress of 0.5–5.0 MPa and slip rate of 0.65 m/s (constant from starts to finish). To eliminate the effect of crushing on OSL signal, we measured coarse grains (75–150 μm) extracted from recovered sample.As a result of the measurement, OSL signal intensity start to decrease from the normal stress of 0.5 MPa. We found “partial resetting” which is characterized by coexistence of both particles with signal and without signal at normal stress of 0.5 and 1.0 MPa, and then frequency of the signal intensity for each aliquot is bimodal distribution.On the other hand, complete resetting of the signal was observed in all particles at normal stress ≧ 2.0 MPa.. Assuming a coseismic fault slip rate of 0.6 m/s, depth conditions required for operating partial and complete resetting of OSL age expected to be 18~36 m and 72 m respectively.

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