High-Velocity Wear Property of Gabbro: Implications for coseismic fault strength

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Natural faults undergo continual wear of fault surfaces during slip, leading to a progressive increase in the thickness of the fault gouge zone with net displacement. The ratio of the thickness to displacement is often called as a *wear rate* for gouge generation. Several laws of wear rate on the frictional sliding have been established based on the wear theory and experiments, in order to understand the process of gouge generation and its effects on fault strength. However these laws were verified by comparing the experimental data at *low* slip rates. It is not certain whether the laws valid for low slip-rate data can be applied to natural faults, since the gouge materials are formed significantly at *high* slip rates of over 0.1 m/s during earthquakes.

In this study, hollow-cylindrical specimens of gabbro with inner and outer diameters of 15 and 25 mm were slide dry at high slip rates of 0.02-0.3 m/s (nearly coseismic slip rates) and normal stresses of 0.3-3 MPa using a rotary shear apparatus. Amount of wear of rock was determined by measuring axial shortening of the specimens. The results indicate that the wear rate increases drastically as velocity and normal stress increase. The significant increase in wear rate must be caused by a subtle thermal cracking owing to the frictional heating on the sliding surfaces. The relationship between the wear rate and shear stress can be fit well with an exponential equation. By putting the natural wear rate (the ratio of thickness of fault zone to net displacement curve; ˜10^{-2} in the relationship between the wear rate and shear stress, one can estimate average shear stress on faults during earthquakes. The estimated stress is several MPa. The low coseismic stress of a fault is consistent with the lack of a heat-flow anomaly in major crustal faults such as the San Andreas.