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雰囲気コントロール下での断層摩擦実験による希ガスの脱ガスと挙動
Noble gas release and frictional degassing from faults during coseismic sliding: under controlled gas environment

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Noble gases very limitedly react with other elements because of their inert nature. Therefore, isotope ratios of noble gases in certain minerals are believed to reflect well those of their ambient reservoirs when the temperatures of the minerals containing them went up to their closure temperatures, or higher.

We have reported the resetting of isotope signatures of noble gases released during rotary-shear high-velocity friction experiment on the Aji granite samples shaped as cylinders and rotated at 1.6 m/s at a constant normal stress of 1.4 MPa. Friction increased with slip and reached maximum value at ˜ 5 seconds (”first fuse”; Hirose et al, 2005) after the beginning of the slip. Completely melted glass formed by frictional heat was found only on the sliding surface. The most part of the post experiment specimen were little or not melted, which is possibly due to very short duration of the experiment.

Under controlled gas environment of gabbroid experiment, limited ”first fusion” occurred at the first temperature maxima (corresponding to the displacement of Magnitude -2 ˜ -3). Then, friction suddenly dropped down, and decreased gradually further in several seconds associated with moderate melting (”second fuse”, corresponding to the displacement of the Magnitude 5 or larger, e.g. Kanamori et al., 2005).

Compared with gabbroid experiments, Ar gas degassed at the ”first fusion” when a granite was used for the starting material for the experiment because the granite used, with an age of 77.2 ˜ 87.1 Ma (Yuhara, 2008), contained abundant radiogenic 40Ar. Ar was clearly emitted after only 5 seconds sliding, and with more amounts than with the gabbroid sliding. Also, the timing of melting depended on the atmospheres of the experiment; whether moist-air, dry-air, He or Ar was used in the experiment. These results suggest that the dissipation of friction-induced heat depends on the mass numbers of the ambient gases. Furthermore, in the case that a sedimentary rock containing much higher potassium is in contact with a fault, emission of 40Ar may be faster and much intense during the fault motion. Thus, the liberation of volatiles believed to be detected in some large earthquakes may be controlled by ambient condition of the fault.

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