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Microstructures and formation process of slickenside

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”Slickenside” is a well-studied microstructure created on fault surface. It represents a shiny and smooth fault plane. However, its generation process and influence on faulting behavior have not studied in detail so far. Therefore, we aimed to study the microstructures of natural slickenside and conducted frictional experiments. We used ATEM and AFM for observing the microstructures, and a rotary shear apparatus for conducting frictional experiments.

Natural slickenside sample is collected from Glarus thrust, east of Swiss Alps. Glarus thrust is developed within 1 m layer of Lochseiten limestone (LK) calc-mylonite, which has an extremely sharp contact fault plane with a very shiny slickenside layer. The parallel striations can be seen on the slickenside. Frictional experiments were performed on cylinders of Carrara marble at slip rate of 0.1 m/s with normal stress of 1.0 - 3.0 MPa, and displacement of $<$ 5 m.

The observation of natural slickenside led the following results: 1) Slickenside is an extremely thin layer with several tens nm in thickness. 2) This thin layer consists of very fine particles with oblate shape (long axis: several tens nm, aspect ratio: ˜0.1). The results of the friction experiment are as follows: 3) Slickenside is created at the presently applied slip rate of 0.1 m/s. The microstructure of the slickenside is same as natural one. 4) The slickenside is widely developed at higher normal stress and/or with longer displacement. 5) At higher normal stress condition, the slickenside is created even at short slip displacement. 6) The generation of slickenside doesn’t decrease the frictional coefficient drastically. 7) The slickenside is created only on the grinded tiny grains of calcite, which is produced on the slip surface in the initial stage of experiment. This observation suggests that the studied slickensides (both natural and experimentally generated) are tribofilms.

Keywords: slickenside, faulting, microstructure, Glarus thrust, friction experiment