

Chemical and physical weathering processes of hydrothermally-altered sandstone: changes of hydraulic and mechanical properties

*Miho Kikuchi¹, Yuki Matsushi¹

1. Disaster Prevention Research Institute, Kyoto University

This study reveals chemical and physical weathering processes and weathering profile of sandstone (graywacke) in accretionary complex affected weakly by hydrothermal alteration. Network of white veins that consist mainly of calcite and laumontite influences the weathering mechanisms leading to changes of hydraulic and mechanical properties of the rock. Our study site is located in Uwajima, Ehime Prefecture in Shikoku, SW Japan. This area is underlain by alternating beds of sandstone and mudstone called Hokezu land block, in the Cretaceous Shimanto group. Many shallow soil slips (< 1 m deep) and bedrock landslides (< 10 m deep) occurred in July, 2018, by heavy rainfall with maximum hourly intensity of 36 mm/h, and total rainfall of 540 mm/4 days. In this area, we conducted geological survey for weathering grade of bedrock, and measured rock strength by using a Schmidt hammer. We obtained a 25 m-long boring core at a selected typical hillslope with a 6 m-deep bedrock landslide to investigate subsurface weathering profile. The bedrock is characterized by well-developed meshes of white veins formed by hydrothermal alteration, consisting of calcite and laumontite. We categorized the weathering grade of the bedrock to the following seven stages: 0) fresh rock; 1) pore formation within the vein; 2) oxidation along joints; 3) color changing into whole rock block; 4) open fracturing; 5) soft saprolite with closed fractures; and 6) soil. Rock strength are drastically decreased at the stage 4. We found that calcite vanished at stage 1. The interacting chemical and physical weathering and strength reduction may have promoted through calcite dissolution at the initial stage of weathering as well as the subsequent expansion and shrinking of laumontite via wet and dry cycles, resulting in the formation and connection of open fractures. The hypothesis of weathering mechanisms and changes of hydraulic properties of bedrock will be tested by lab experiments and hydrological monitoring in hillslopes.

Keywords: chemical weathering, physical weathering, graywacke, hydrothermal alteration, bedrock landslide, rainfall disaster