An investigation of physicomechanical properties change of sulfide-bearing granitic gneiss by accelerated chemical weathering

Gyoo Ho Lee (Korea Atomic Energy Research Institute),
Jae Gon Kim*, Tack Hyun Kim, Chul-Min Chon
(Korea Institute of Geoscience and Mineral Resources),
Ik Woo (Kunsan National Univertisy),
Won-Jin Cho, Pil-Soo Hahn (Korea Atomic Energy Research Institute)

1. Introduction

Sulfide minerals in rocks are oxidized and generate acid drainage during chemical weathering. The acid drainage accelerates weathering and deteriorate the physical and mechanical properties of rocks. In order to investigate the influence of content and occurrence of sulfide on physicomechanical properties we performed an accelerated weathering experiment using a double soxhlet extractor. The changes of quick absorption ratio, elastic wave velocity, uniaxial compressive strength were measured on granitic gneiss with different contents of sulfide before and after the weathering experiment.

2. Material and Method

Three groups of core samples from a mass of granitic gneiss (32mm diameter * 60mm length; group A: massive with < 0.1% of pyrite, group B: massive with 5 % of disseminated pyrite, group C: 6 % of vein type of pyrite) were used for the weathering experiment. A double soxhlet extractor was used to accelerate weathering for one month. The double soxhlet extractor consists of condenser, two flushing barrels and reservoir (Fig. 1). The reservoir at the base of the extractor was filled with 1L of deionized water. The water in the reservoir was heated to boiling point, the steam generated rose, was cooled, and condensed in the condenser, from which it dripped into the upper barrel. When the upper barrel was filled with water, it siphoned out to lower barrel, flushed the core samples in the lower barrel and promptly siphoned out to the reservoir. This type of soxhlet extractor were contrived to give the core sample a relatively uniform weathering. Two core samples were piled up in each lower barrel and duplicated for each core group. Before and after the weathering experiment, quick water absorption ratio, elastic wave velocity and uniaxial compressive strength were determined.

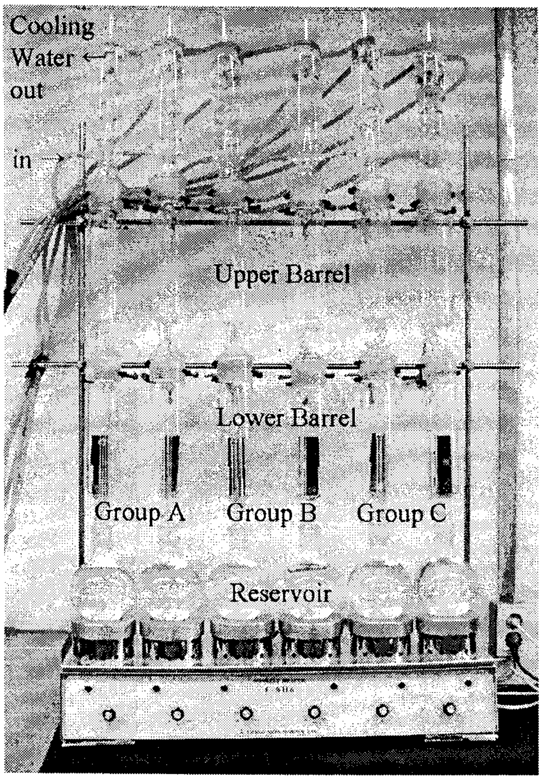

Fig. 1. Double soxhlet extractor used for the weathering experiment.

3. Results and Discussion

3.1 Quick absorption ratio

The quick absorption ratio for group A and B did not significantly changed after the one month weathering experiment but the water absorption ratio for group C increased about 10 % (Fig. 2).

3.2 Elastic wave velocity

The elastic wave velocity generally decreased after the weathering experiment with a little difference among samples. S-wave velocity showed 7-10 % decrease for whole samples. P-wave velocity for group C decreased more than those for other groups.

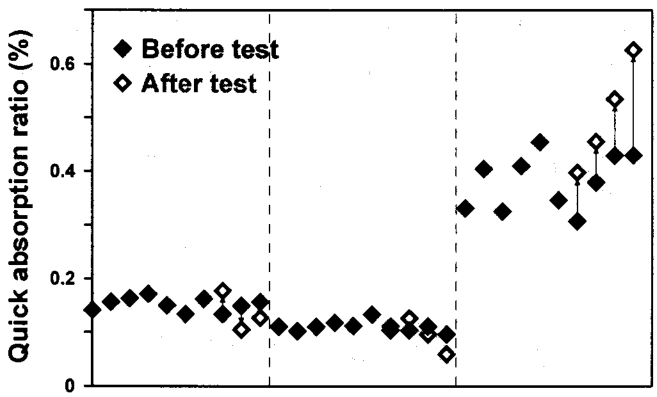

Fig. 2. Change of quick absorption ratio before and after the weathering experiment.

3.3 Uniaxial compressive strength

As the uniaxial compressive strength is measured by failure test, it is impossible to compare the strength of a sample before and after weathering experiment. In this experiment rocks with similar physical properties were assumed to have similar mechanical properties. The values with extremely large deviation were excluded for analysis. The uniaxial compressive strength decreased by 14 % for group A, 10 % for group B and 45 % for group C after the weathering (Fig. 3).

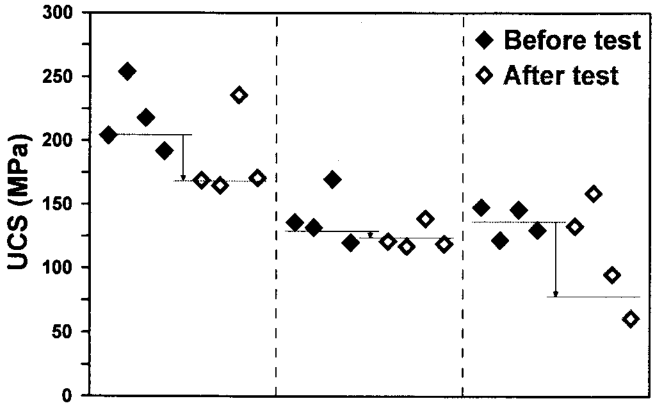

Fig. 3. Change of uniaxial compressive strength(UCS) before and after the weathering experiment.

The rupture feature for group A and B for both before and after the weathering showed a normal rupture feature of rock without defects such as vein and fracture. The group C showed the normal rupture feature for the sample before the weathering experiment but a rupture along the pyrite veins after the weathering. The group A did not visually showed any precipitates of secondary mineral on the surface after one month weathering but group B and C showed a red colored coating (Fig. 4).

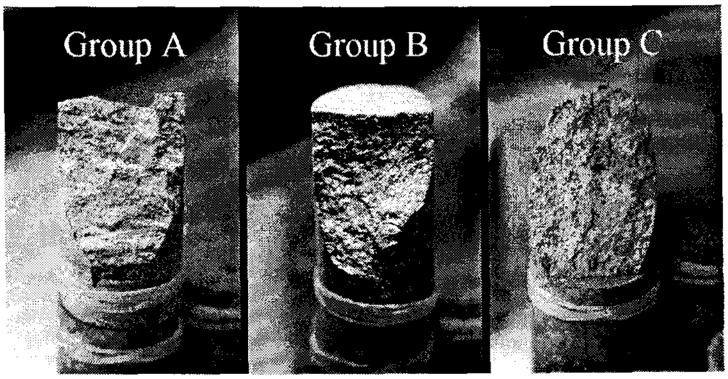

Fig. 4. Rupture features and red colored coating after the weathering experiment.

The massive group A and B had a limited weathering on the surface but the group C with pyrite vein experienced the weathering on the surface as well as along the pyrite vein. The weathering type regulated by the occurrence of pyrite apparently controlled the mechanical properties of rock samples and the chemistry of the drainage.

4. Conclusion

The sulfide contained in the rock generated acid drainage during the weathering. The disseminated pyrite contained in a massive rock did not significantly reduced the mechanical properties of the rock during weathering but the vein type pyrite accelerated the weathering resulting in deterioration of mechanical soundness of rock mass. The pyrite vein induced the infiltration of water into the inside of rock body and the mass weathering.

▩ References ▩

1. Lee, G.H., Kim, J.G., Lee, J.S., Chon, C.M., Park, S.K., Kim, T.H., Ko, K.S., and Kim, T.K. (2005). "General Characteristics and Prediction of Acid Rock Drainage of Cut Slope", Econ. Environ. Geol., 38(1): 91-99.
2. Lee, G.H., Kim, J.G., Kim, T.H., and Lee, J.S. (2006). "Iron Phosphate Coating on Pyrite Surface for Reduction Acid Rock Drainage", Econ. Environ. Geol., 39(1): 75-82.