POINT LOAD TESTS AND LABORATORY REPRODUCTION OF WEATHERING PROCESS OF ANISOTROPIC ROCKS

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1. Introduction

Anisotropic rocks widely exist in nature, especially among sedimentary and metamorphic rocks. Their foliations are clearly and make rocks different mechanical properties.

For checking the properties of anisotropic rocks under weathering, rocks were subjected at laboratory reproduction of weathering process and then point load test was used after each 4 weathering cycles. Two strength values were obtained when load was normal to and parallel to the weakness planes of rock.

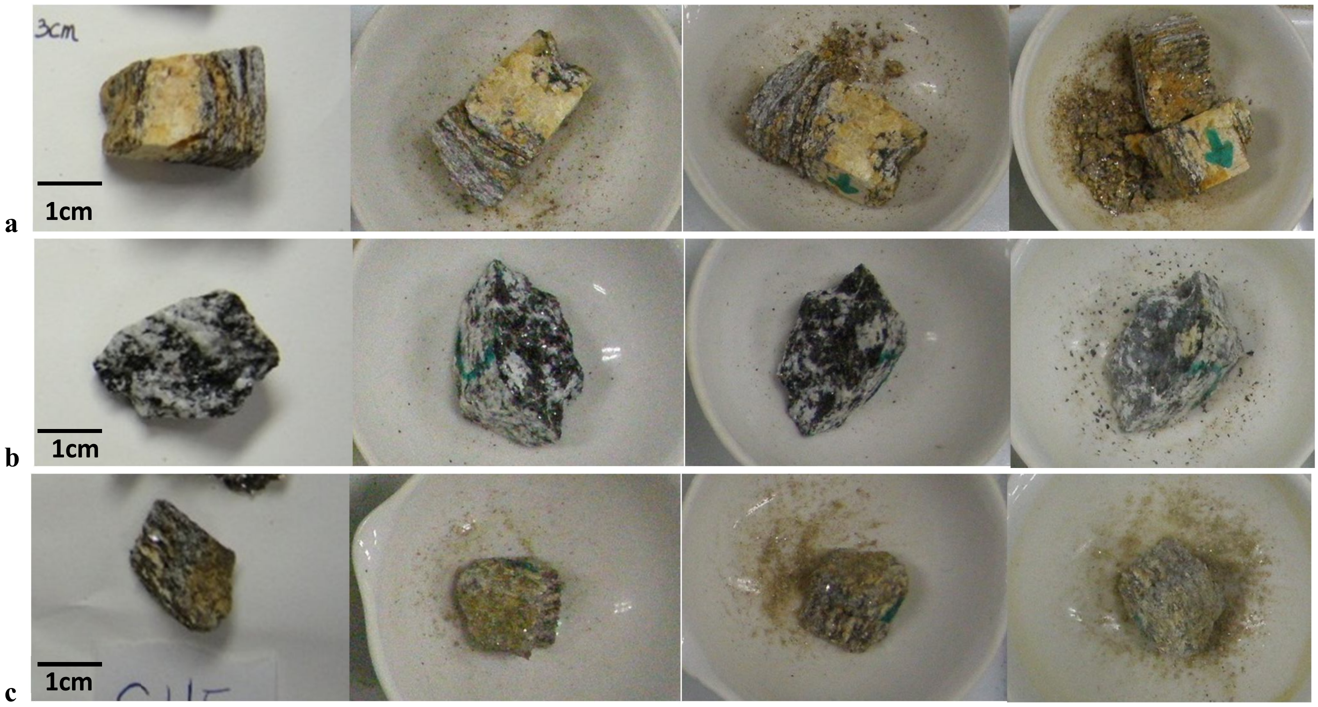
2. Specimens and test procedures

6 different specimens from slope area of Bhutan (specimen A to G) were used in this study. Material are phillite (specimen A, B and D), gneiss (specimen C), Quartzite (specimen E) and Schist (specimens E and F). These specimens were subjected at Saturation-freeze-heat (SFH) process. One SFH cycle which is last for 120 hours is comprised of vacuumed saturation (-98kPa, 72 hours), freezing (24 hours) and heating (24 hours).

Point load test was used at initial stage (Cycle0), after cycle 4 and cycle8 which are 4 cycles' interval and two strength values were obtained when load was normal to and parallel to the weakness planes of specimen.

3. Result and discussion

As laboratory reproduction of weathering process developing, fragments were seen at the beginning and specimen failure at last. At specimen B (Fig.1a), weakness planes of phillite expanded gradually and at last failure occurred along the weakness plane after 11 Saturation-freeze-heat (SFH) cycles; At specimen C



Cycle 0 Cycle 3 Cycle5 Cycle11

Fig.1 (a)Specimen B, Phyllite, Kharbandi; (b)Specimen C, Gneiss, Jhumja; (c)Specimen G, Schist, Taktacha

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(Fig.1b), foliations of gneiss are close so that water difficult to permeate. At the cycle 11 the structure of gneiss was still strong and just biotite on the surface fell off. At specimen G (Fig.1c), muscovite and chlorite fell off and structure turned loose as weathering cycle increase.

Many factors (e.g., shape and size of specimen) affect the Point Load Strength Index. In order to eliminate these factors during point load test, ISRM proposed an equation for determining point load strength index. The point load strength index $I_s(50)$ of specimen as follow:

$$I_s(50) = F\frac{P}{{D_e}^2}$$

where P = failure load, N; D_e= equivalent core diameter, ${D_e}^2 = 4A/\pi$ (For irregular lump test: A = minimum cross-sectional area of a plane through the platen contact points), mm^2 and "Size Correction Factor" $F = (D_e/50)^{0.45}$.

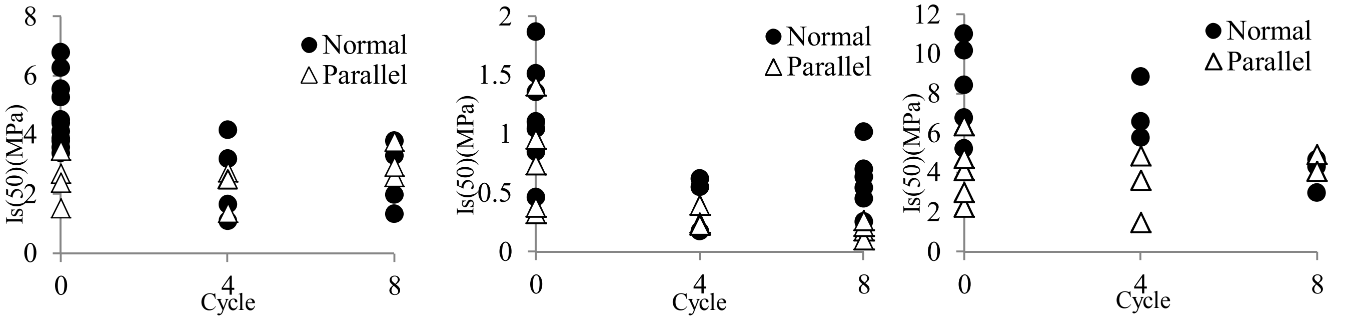

Fig.2 Weathering cycles against the normal and parallel point load strength index. (left) Specimen A, Phyllite from Kharbandi,Bhutan; (middle) Specimen B, Phyllite from Kharbandi,Bhutan and (right) Specimen C, Gneiss, Jhumja, Bhutan.

$I_s(50)$ of 3 specimens (A, B and C) were plotted in graph of scatter (Fig.2). Point load strength index $I_s(50)$ is decrease as saturation-freeze-heat (SFH) cycles increase. $I_s(50)$ when load is parallel to the weakness planes of rock is weaker than when is normal to. Deterioration of parallel direction doesn't evidently as normal direction. Specimen A (Fig.2 left) is a phillite with uniform texture with chloritoid. Its scatter points of $I_s(50)$ is more concentrated than Specimen B (Fig.2 middle, Fig.1a) which contain different size material such as mica and quartz.

4. Conclusion

Process of rock weathering include: fragment falling off, weakness plane expansion and failure. At the beginning of deterioration, soft mineral (e.g. mica) and loose material most easily fall off. Point load strength index $I_s(50)$ decreases as weathering develops and during this process. Deterioration of normal direction is stronger than normal direction. Also in these tests the point load strength index $I_s(50)$ in the normal direction is greater than in the parallel direction. Deterioration of porous structure (phillte in Fig.1a) performs greater than compact structure (gneiss in Fig.1b).

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References

1. E. BROCH. Estimation of Strength Anisotropy Using the Point-Load Test Mech Min Sci & Geomech Abstr. 1983;20:181-187.
2. A. Basu, M. Kamran. Point load test on schistose rocks and its applicability in predicting uniaxial compressive strength. Rock Mechanics & Mining Sciences. 2010;47:823-828