ICCES, 2023, vol.25, no.1
DOI: 10.32604/icces.2023.45689

PROCEEDINGS

Measuring the Tensile Strength Degradations of Mineral Grain Interfaces (MGIs) in the Granite After Thermo-hydro-mechanical (THM) Coupling

Mengyi Li[1] and Zhijun Wu[1,*]

[1]School of Civil Engineering, Wuhan University, Wuhan, 430072, China
[*]Corresponding Author: Zhijun Wu. Email: zhijunwu@whu.edu.cn

ABSTRACT

Buried in depth for decades of years, granite in the deep geological repository will be subjected to extremely complex effects of thermo-hydro-mechanical (THM) treatment, and the tensile strengths of mineral grain interfaces (MGIs) are inevitably impacted by the THM treatment [1, 2]. Originated by the failure modes of granite after THM treatment, the tensile strength of MGI plays an important role in determining the macro mechanical properties of THM-treated granite [3, 4]. However, the accurate characterization of the tensile strength degradations of MGIs with THM treatment is still lacking. In this study, the varied tensile strengths of MGIs, including the interfaces of quartz (q-q), feldspar (f-f) and the interfaces between quartz and feldspar (q-f) in the granite after different THM treatments were first directly measured based on a self-developed single-MGI mechanical test system. The degradations of tensile strengths of different MGIs were distinguished, which was the most obvious in q-f, followed by f-f and then q-q. The tensile strength degradation models of the granite related to the THM treatments were proposed based on the results of the experiment. The findings in this study can provide key references for estimating the THM effects on the meso and macro mechanical properties of granites.

KEYWORDS

Mineral grain interface; tensile strength; thermo-hydro-mechanical (THM) coupling; meso scale

Acknowledgement: We thank for Dr. Zhiyang Wang for the help of the methodology validation, Dr. Lei Weng for the help of reviewing and funding acquisition, and Prof. Quansheng Liu for the help of the supervision on the whole research.

Funding Statement: This work was supported by the National Natural Science Foundation of China (42077246, ZJW, URL: https://grants.nsfc.gov.cn/egrantindex/funcindex/prjsearch-list), and the National Natural Science Youth Foundation of China (52004182, LW, URL: https://grants.nsfc.gov.cn/egrantindex/funcindex/prjsearch-list). The authors are grateful for the financial supports.

Conflicts of Interest: The authors declare that they have no conflicts of interest to report regarding the present study.

References

1. Yin, T.B., Li, X.B., Cao, W.Z., Xia, K.W. (2015). Effects of thermal treatment on tensile strength of laurentian granite using Brazilian test. *Rock Mechanics and Rock Engineering*, *48(6)*, 2213-2223.

2. Lan, H.X., Martin, C. D., Hu, B. (2010). Effect of heterogeneity of brittle rock on micromechanical extensile behavior during compression loading. *Journal of Geophysical Research-Solid Earth, 115,* B01202

3. Hu, H.R., Li, A. B., Zavala-Torres, R. (2017). Long-period long-duration seismic events during hydraulic fracturing: Implications for tensile fracture development. *Geophysical Research Letters, 44(10),* 4814-4819

4. Raghami, E., Schrank, C. Kruhl, J. H. (2020). 3D modelling of the effect of thermal-elastic stress on grain-boundary opening in quartz grain aggregates. *Tectonophysics, 774,* 228242.