

Micro-meso-macro interface correlation processes and cross-scale cascade effects in red-bed soft rocks softening

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Abstract: The water-rock interaction at micro-meso-macro interface is closely related to the catastrophic changes in red-bed soft rocks. The study of the correlation process and cross-cascade effect at micro-meso-macro interface of water-rock interaction is of great significance to reveal the catastrophic mechanisms of soft rocks under water reaction. At present, the research on soft rock softening mainly focuses on the external characteristics of the meso-macro interface and its cascade effect. The correlation properties and cross-scale cascade effect of micro-meso-macro interface in red-bed soft rocks are in the exploration stage and still need further improvement. To address this problem, in this study, the correlation process of water-face interaction within red-beds soft rock is established by the analysis of micro-scale chemical reaction, meso-scale physical properties and macro-scale mechanical action of interface reaction process during soft rock softening. Based on the energy flow theory and the concept of cascade, the cross-scale cascade effect during the failure process of soft rocks was analyzed. The results show that the correlation process of water-rock interface can be well explained by three factors as follow: the cation concentration of aqueous solution, proportion of pores outside the framework of soft rock particles as well as quality of soft rock disintegration. During the softening process of soft rock, the micro and macro cascade factors show a gradual increasing trend. The imperfect correlation process of water-rock interface and cross-scale problem of cascade effect during the process of soft rock softening was solved and the references for revealing the deep mechanism of soft rock softening was also provided.

Keywords: Rock mechanics; Red-bed soft rocks; Softening; Micro-meso-macro; Interfacial correlation; Crossscale; Cascade effect