Numerical Study on the Forming Mechanism of Honeycomb-weathering of Rock

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Rock weathering has endangered underground stability, and became a factor in unexpected natural disaster such as the rock block failure, falling rocks and landslide. In nature there are three types of the rock weathering: physical, chemical and biological weathering. The reality might be that many natural rocks are simultaneously subjected to these three weathering patterns, and are intricately weathered with the geologic time scale. Therefore, the mechanism of rock weathering has remained less well-defined because of its diversified and complex properties. In particular, the numerical studies of rock weathering have been almost kept intact, so that there is a need for the positive use of computational sciences, and the efficient use of them is becoming more and more important.

Many rock surfaces have strange geomorphologic features such as alveoles or honeycomb, tafoni or cavernous weathering in which the cavities are separated by thin walls of unweathered rock. For example, it has been thought that the honeycomb-weathering might be intimately related to some biofilms which are made by microbes. However, although the origins of these geomorphologic patterns have been debated in the literature for many years, the mechanism controlling the growth of these weathering patterns is poorly understood. To date, there has been no consensus about their growth mechanism.

In this study I numerically discussed the formation mechanism of honeycomb-weathering of rocks based on the Reaction-Diffusion (RD) and Diffusion-Limited Aggregation (DLA) simulations. The RD simulator was developed by the finite difference method, and the DLS simulator was developed by the random walk method. The numerical results indicated that the formation of thin walls and cavities might be intimately related to the growth of microbial colonies. In this paper I show the proposed theory and numerical algorithm, and discuss some numerical results.

Keywords: Honeycomb-weathering in Rock, Tafoni, Reaction-diffusion system, Diffusion-limited aggregation, Microbial geomorphology