

Pattern formation of crack in drying process of granular water systems

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During the drying process of mixtures of granular material and liquid, such as soil or mud, the network of cracks emerge by the non-uniform shrinkage. Typical examples are observed at the bottom of dried dam or rice paddy. Especially, in the case of starch-water system, following facts are experimentally known: (1) two types of crack exist and (2) one of them has prismatic structure which is similar to those of columnar joints.

The columnar joints, one of the most intriguing geomorphological example, exhibit spectacle polygonal columnar structure found in cooled basaltic lava. Detail observations of outcrops clarify several characteristics such as angle distribution, side number distribution and tier structure and striae structures. Most of them, however, are reports based on the observations and theoretical modelings. Difficulties in realization of physical condition and visualization prevents us from experimental study.

Here, the drying crack of starch-water system is realizable under an easy experimental setup and the three dimensional structure of the crack network can be observed directly. In this paper, two visualization techniques are reported: resin solidification planing (RSP) method and real time measurement of water content distribution with MR instruments. Cross section with polygonal structure is visualized in both experiments. The depth dependency of cell size is measured. The similarity and diversity between the columnar joints from the viewpoint of directional crack propagation process and the water evaporation process from the porous media are also discussed.