Laboratory experiments on the landform development

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Geomorphic experiments with uplift and rainfall erosion are expected to provide some important knowledge to interpret the development of landform, which has left only scarce and hard-to-find evidence. This type of experiments had not been conducted so often, probably because no one had a good idea to scale down the processes of landform development. In recent years, however, laboratory experiments on the development of landform were increasingly conducted for the purpose to verify numerical/analytical models, which have been promoted by the development of computer technology and the spread of DEM, while the fundamental problems of huge scale difference have not been solved yet. Some of these recent experiments demonstrated a certain mechanism or a law governing the experimental landform development, such as the self-organized criticality or the competition between diffusive hill slope transport and advective transport in channels, which was suggested by numerical analyses. This indicates the applicability of numerical models to the experimental landform, but not to the real landform yet, although the authors believed it. Real landforms we see today have developed in the geographical space through the historical time, and inevitably have infinite varieties. We can find landscapes similar to the experimentally formed landscapes somewhere in the world, but this does not mean that mechanisms or laws dominated in the experiment also work on the real landform. The experimental landform develops within a certain setting, which is restricted by the facilities and arranged for the purpose. We still have a lot to do before taking the experiments as a bridge between numerical models and natural landscapes. I have been conducting a series of geomorphic experiments with changing experimental settings (40 runs by now), and I here try to make clear the significance of experiments in the study of geomorphology on the basis of these experiments.
A mixture of fine sand and kaolinite (10:1 by weight) compacted in a square prism-shaped stainless container (ca. 60×60×40cm) is pushed up by the uplift-generating device put under the bottom plate of container. Mist-type rainfall is generated by a pump through spray nozzles. The results of experiments suggested the existence of two thresholds of uplift rate, which is the most important independent controlling factor. Below the lower threshold, fluvial erosion offsets the surface rising by slow uplift, and gentle landforms reflecting the mound erodibility and rainfall intensity appear (Characteristic relief phase). Above the upper threshold, uplift overwhelms and a massive mountain grows until it hits the limit of experimental facilities (Mountain building phase). When the uplift rate is between the lower and upper thresholds, average surface height stops increasing and changes around a certain height depending on the uplift rate, after valley systems develop and slopes grow enough to cause landslides (Steady state phase). This steady state phase is the most common condition through the series of experiments. Rainfall intensity is expected to affect the amount of surface flow; and therefore, the rate of erosion. Low rainfall generates less surface flow, and this reduces erosion and make the surface grow higher. Permeability of the sand mound is considered to have a similar effect concerning the surface flow. However, more permeable material, associated with lower sear strength, promotes slope failures even in the earlier stage. The surface, therefore, becomes lower even with less rainfall. These factors, which relate each other themselves, apparently have complex effects on the development of experimental landform. The relationships among these controlling factors can be compared to those concerning real landform. Revealing these relationships and their effects on the experimental landform is probably the key to make

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geomorphic experiments meaningful in the study of geomorphology.

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