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Effects of uplift on the long term development of experimental erosion landform

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Landform evolution with erosion and uplift has long been away from the stage of geomorphology, but numerical simulation of landform evolution helped by the development of computer and DEM seems to pull the subject back onto the stage. The numerical simulation, however, still requires information based on the evidence of real landform evolution, which is usually erased by the erosion. Rainfall erosion experiments show the development of erosion landforms under the real physical condition on the earth, although in a much smaller scale, and possibly provide useful information to understand the landform evolution. I have been conducting a series of experiments in this perspective. The rainfall erosion experiments reported here are the latest two runs. Run 13 is the experiment in which the slow uplift started after a low-relief surface develops, and the rainfall erosion proceeded without uplift in Run 14. Comparison of these two experiments is expected to reveal the effect of slow uplift on the long-term landform development. (Run 15 with a different rate of uplift is underway).

Run 14: Miniature erosion landform was developed by applying artificial rainfall (ca. 38mm/h) on the square mound of a mixture of fine sand and kaolinite (ca. 90x90x12cm). The valley incision and the development of valley system proceeded form the beginning, and the average height decreased exponentially with erosion. The minimum height, which indicates the bottom height of the main valley, decreased rapidly at first and then slowed down. It tended to keep a certain level while alluvial fans developed around the mound. The rate of lowering increased once again when the relief became small and the dissection of alluvial fans started. The dissection concentrated to a large alluvial fan after one dominant drainage basin captured other basins. The maximum height, which indicates the height of the main ridge, decreased slowly at first and rapidly, followed by the long period of minimum decrease. A very flat surface developed at the end (1759 hours of rainfall erosion).

Run 13: The mound was slowly uplifted (ca. 0.1mm every 3 hours) after the landform of low relief developed (255h) and to the end of the experiment (1759h). The minimum height stopped decreasing with the uplift and kept the higher level while the alluvial fan development was prolonged by the increase in supplied material. The average height reduced the rate of decrease significantly after the uplift started, and nearly kept the level while alluvial fans were developing. When the dissection of alluvial fans started while the uplift continued, both the average and minimum heights started decreasing with a slower rate. This was the time when small drainage basins were unified into one large drainage basin. The maximum height decreased gradually at first and then rapidly, regardless of the uplift. It slightly increased with the uplift later and some low relief still remained at the end.

Without uplift the average height decreases exponentially, but its long-term change cannot be expressed completely by a simple curve. The development and dissection of alluvial fans, and the change in drainage network, affect the way of erosion. The slow uplift apparently prolonged the development of alluvial fans, and helped the local base level perch high. The slow uplift seems to generate the flux steady state between erosion and uplift, while alluvial fans are developing. However, after the dissection of alluvial fans due to the reduction of material supply and the unification of drainage basins occur, the average and minimum heights lower, while the maximum height show some increase. The erosion changes its phase according to the change in the dominant base-level during a long period, and the uplift has effects on the change and maintenance of the base-level through the relief and sediment supply. This makes it difficult to presume the equilibrium between uplift and erosion.