Intermittently uplifting of Coulomb wedges by sandbox experiments

Sayaka Kuwana[1], *Satoshi Tonai[1]

1.Department of Applied Science, Faculty of Scienece, Kochi University

The critical taper model is a basic model to study developing processes of Coulomb wedges. However, the amount of change in natural Coulomb wedges varies intermittently in comparison with the critical taper model. It is important to understand the intermittent changes in order to study Coulomb wedges. We paid attention to uplift processes of Coulomb wedges and had two purposes in this study. The first is to examine spans and rates of the intermittently uplift. The second is to understand the origin of the intermittent uplifts. So, we made Coulomb wedges by scale analog model experiments, observed them, took pictures and videos and did an analysis of PIV (Particle Image Velocity).

The apparatus used in this study was a glass-sided, rectangular acrylic box of which internal dimensions were 69.3 cm x 11.8 cm x 15.4 cm. We laid a cutting seat to the bottom of the box and laid dry sand on the seat. Initial thicknesses of dry sand are between 1.5 cm and 3.0 cm. We made Coulomb wedges by pulling the seat at a constant rate and pressing sands to the rigid backstop. 25 experiments in total show some features as follows. First, the uplifted areas change repeatedly part and whole of the wedge. Second, the uplift rates at several points in Coulomb wedges by experiments change dramatically, which are divided into the rapid uplift period and the slow uplift period, although match roughly the uplift rates calculated by the critical taper model.

Based on the experiments, we point out two findings. Firstly, the feature of uplifting intermittently was revealed more concretely than previous studies. The time spans of the rapid and slow uplift periods correspond to the time of pulling the seat 1-7 cm and 1-6 cm, respectively. The uplift rates are 0.05- 0.13 mm/sec during the rapid uplift period and 0.00-0.05 mm/sec during the slow uplift period. Being converted them to the time scale in nature, two uplift periods change every 8-120 k.y. And the uplift rates were converted to 4-10 mm/yr during the rapid uplift periods and the 0-4 mm/yr during the slow uplift periods. It shows that it is possible to find intermittent uplifts of natural wedges by geological surveys. Secondly, the intermittent uplifts causes of deformation in Coulomb wedges. Especially, the origin of this deformation is to move “back strain zone”, which is one of concentrating strains in wedges, to the rigid backstop. Because of this, timing of changing uplift velocities depends on the distance from a fixed wall to a certain point.

Future prospects show as follows. The first is to research the intermittent uplifts in nature. The second is to study mechanism of “back strain zone” that is the origin of intermittent uplifts in detail. These studies will reveal the intermittent uplift’s processes more detail.

Keywords: Coulomb wedge, accretionary complex, uplift, thrust, analogue model experiments

