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Deformation of accretionary wedges based on 2D distinct element modeling

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This study explores the dominant role played by décollement basal friction μ_b on the deformation style or pattern of accretionary wedges and the critical value between low and high basal friction. The Particle Flow Code in 2 Dimensions (PFC2D), a special implementation of distinct element method (DEM) using circular elements, is applied. In this study, basal friction coefficient of the décollement is designated to range from 0.05 to 0.9, and the interparticle friction coefficient is fixed as 0.5. Based on the modeling results with different basal frictions, two modes of deformation are clearly observed. For the low basal friction case ($\mu_b \leqq$ 0.3∼0.4), the frontal accretion is prominent and is dominated by 'pop-up' structures at or near the toe of the wedge. For the high basal friction case ($\mu_b \geqq$0.3∼0.4), underthrusting is the principal feature during deformation throughout the wedge. We can observe not only the difference in the evolution but also the variation of thrust angle in the accretionary wedge during the experiments. Thrust angle varies from about 50° at μ_b=0.05 to about 10° at μ_b=0.9. Furthermore, we find a transition mode of deformation presents in μ_b=0.3∼0.4 observed from growth rate of distance to deformation front, deformation zone, and uplift rate of maximum height. The range of this transition zone gives us another way to distinguish the critical value of the transit from low to high basal friction. Moreover, the surface slope changes from 3°±1° at μ_b=0.05 to 19°±1° at μ_b=0.9 and reaches stable at μ_b=0.35. Based on analyses on growth rate, uplift rate, and surface slope in the numerical models, geometric steady state of accretionary wedges is achieved when

μ_b=0.3~0.4.