Friction increase along plate boundary fault and structure features in accretionary wedge off Muroto in numerical simulations

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To examine the effect of increase in internal friction along the basal fault on structural features (e.g., an out-of-sequence thrust; OOST) and a break of the surface slope in an accretionary wedge off Muroto southwest Japan, we employed the distinct element method (DEM). Using this numerical simulation, we tested two different models; A) keep constant low-friction and B) increased friction along the basal fault from landward to front of the wedge. In model A structure aspects such as a low angle surface slope and in-sequence fold-and-thrusts observed. On the other hand, in model B break of the surface slope and the OOST were observed. The friction increase along the basal fault induces the strong internal deformation such as back thrusts. Because the back thrusts cut and steepen the upper part of the pre-existing thrusts, the pre-existing thrusts become inactive. Then OOST is formed by connecting segments of two adjacent thrusts; lower part of the landward thrust and upper part of the seaward thrust. These thrusts still have low angle and are favorable to reactivate. The OOST changes the thickening mode of the wedge from thrust sheet rotation in low friction zone to thrust sheet underplating in high friction zone. These different thickening modes in seaward low friction zone and landward high friction zone make evident break of the surface slope; landward is steeper than seaward.

The structure aspects in the constant low friction model correspond to structure features in the deformation front of the wedge, whereas the structure aspects in the increased friction model correspond to structure features of the further landward from the deformation front in natural accretionary wedge off Muroto. The increased friction along the basal fault may cause the two OOSTs and the break of the surface slope indentified in the accretionary wedge off Muroto. The seaward sigmoidal OOST may just connect two adjacent thrusts, and the landward planer OOST may be earlier-formed. The break of the surface slope at the tip of the seaward OST corresponds to the area where the thickening mode changes to underplating.