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Self-organized formation of a decollement in the stress field built up during the evolution of an accretionary prism

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Accretionary prism is formed along a subduction zone where sediment is supplied and has many folding and thrust structure. Along the down dip limit of the thrusts, there exists a nearly horizontal reverse fault called decollement. Spatial extent of the thrusts and the decollement is comparable to the thickness of the sediment or the prism and the whole length of deforming part of the prism, respectively.
The formation mechanism of such large-scale faults is not obvious since the stress field to form the thrusts and the decollement are different with each other and no weak structure corresponding to them always exist before accretion. For the thrusts, horizontal compression stress field is necessary but for the decollement, maximum principal axis should be inclined around 45 degree. Thus, one of these structures should be formed first and then the other formed afterwards.
In order to study the formation mechanism of the thrusts and the decollement, we performed Discrete Element simulations on the formation of accretionary prisms. As a result, we have revealed the formation process as follows. Thrusts are formed first and they rotate principal axes around 45 degree along the fault zones. This stress change is not recovered soon but other thrusts are formed continuously since it is difficult to close the dilated fault zone. Thus the stress field is modified and becomes suitable for the formation of a horizontal fault, and finally a horizontal fault is formed. Since the force to close the horizontal fault zone is only the self-gravity, the fault can exist continuously: This fault is a decollement. So it continues to slide and develop with the evolution of accretionary prism. The results also show that the thrusts near the tip of the decollement are not "splay faults" which is considered to rupture when a megathrust earthquake occur along the decollement.