Progressive mélange formation during subduction: The Makimine mé lange in the Shimanto accretionary complex of eastern Kyushu, southwest Japan

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Mélanges are commonly observed in accretionary complexes. However, the origin of mélange has remained controversial. Detailed field and microstructural studies of the Makimine mélange in the Late Cretaceous Shimanto accretionary complex of eastern Kyushu have revealed the progressive mélange formation during north-northwest directed subduction at the thickly sedimented convergent margin. The mélange preserved the ocean plate stratigraphy composed of basalt slabs in the argillaceous matrix, brown tuff, and mixed sandstone and mudstone, in ascending order. The mélange was imbricated at least two times possibly due to a duplex underplating after subduction. Early deformation in the mélange was recorded in the upper part of thrust sheets and is marked by mixing and layer-parallel shear of partially lithified sandstone and mudstone, resulting in the sandstone blocks in the mudstone matrix with mud intrusions and disaggregated sandstone blocks. These features suggest the deformation under elevated pores pressure beneath the décollement. Late deformation in the mélange occurred in middle to lower parts of thrust sheets and is characterized by stretching, and layer-parallel extension and shear of lithified sediments under the operation of pressure solution creep, resulting in development of stretching lineation, boudined layers, and composite planar fabrics with pressure solution seams. Basalt slabs were incorporated into the mélange during late deformation. Kinematic indicators consistently show the north-northwest directed shear from early to late deformation that is perpendicular to the general strike of the mélange. Overall, the mélange recorded the margin-perpendicular subduction-related deformation, with its distribution and deformation mechanisms spatially and temporary changed with depth.

