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Development of tectono-sedimentary mélanges in accretionary wedges: Insights from analog modeling

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Orogenic wedges locally present chaotic tectonostratigraphic units that contain exotic blocks of various size, origin, age and lithology, embedded in a sedimentary matrix. The occurrence of ophiolitic blocks, sometimes huge, in such “mélanges“ raises questions on i) the mechanisms responsible for the incorporation of oceanic basement rocks into an accretionary wedge and ii) the mechanisms allowing exhumation and possibly redeposition of these exotic elements in “mélanges“ during wedge growth.

The tectonic evolution of the back part of doubly vergent accretionary wedges is mainly controled by backthrusting. The retrowedge is characterized by steep slopes that are prone to gravitational instabilities. We assume that these steep slopes trigger submarine landslides playing a major erosional role and therefore inducing huge mass transfers. This erosion allows exhumation of the ophiolitic fragments formerly accreted at the base of the wedge and then reworked as tectono-sedimentary “mélanges“ redeposited in proximal basins located at the base of the retrowedge slope. These basin deposits are then continuously involved in backthrusting-induced deformation.

In this study, we present the results of a series of analog experiments performed to characterize the processes and parameters responsible for accretion, exhumation and final tectonosedimentary reworking of oceanic basement lithosphere fragments in an accretionary wedge. The experimental setup is designed to simulate the interaction between tectonics, erosion and sedimentation. Different configurations are applied to study the impact of various parameters, such as irregular oceanic floor due to structural inheritance, or the presence of layers with contrasted rheology that can affect deformation partitioning in the wedge (frontal accretion vs basal accretion) influencing its growth.

The experimental results are then compared with observations on ophiolite-bearing mélanges in the Taïwan (Lichi mélange) and northern Apennines (Casanova mélange) orogenic wedges.