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Formation of ophiolite-bearing tectono-sedimentary mélanges in the Alpine-type mountain belts: Insights from analogue models and the Apenninic Casanova mélange case study

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S2 Session “Ophiolite related processes in the Alps: rifting, subduction, magmatism, accretion”

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 redeposition of these exotic elements in “mélanges" during wedge growth.
To address these questions, we present the results of a series of analog experiments performed to characterize the processes and parameters responsible for accretion, exhumation and tectonosedimentary reworking of oceanic basement lithospheric 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 (Fig. 1). Image correlation technique allows extracting instantaneous velocity field, and tracking of passive particles. Using the particle paths determined on models the pressure-temperature path of mélange units or elementary blocks can be discussed.
The experimental results are then compared with field study and Raman spectroscopy of carbonaceous material (RSCM) observations from the ophiolite-bearing mélange in the northern Apennines (Casanova mélange). A geological scenario is proposed following basic observations (Fig. 2). The tectonic evolution of the retroside of doubly vergent accretionary wedges is mainly controlled by backthrusting and backfolding. The retro wedge is characterized by steep slopes that are prone to gravitational instabilities. It triggers submarine landslides inducing huge mass transfers. This erosion combined with backthrusting could favour exhumation of the ophiolitic fragments formerly accreted at the base of the wedge along the rough seafloor-sediments interface. Such an exhumed material can be reworked and deposited as debris-flows in proximal basins located at the foot of the retrowedge slope forming a tectono-sedimentary mélange. These syntectonic basins are continuously deformed and involved in prograding backthrusting-induced deformation.

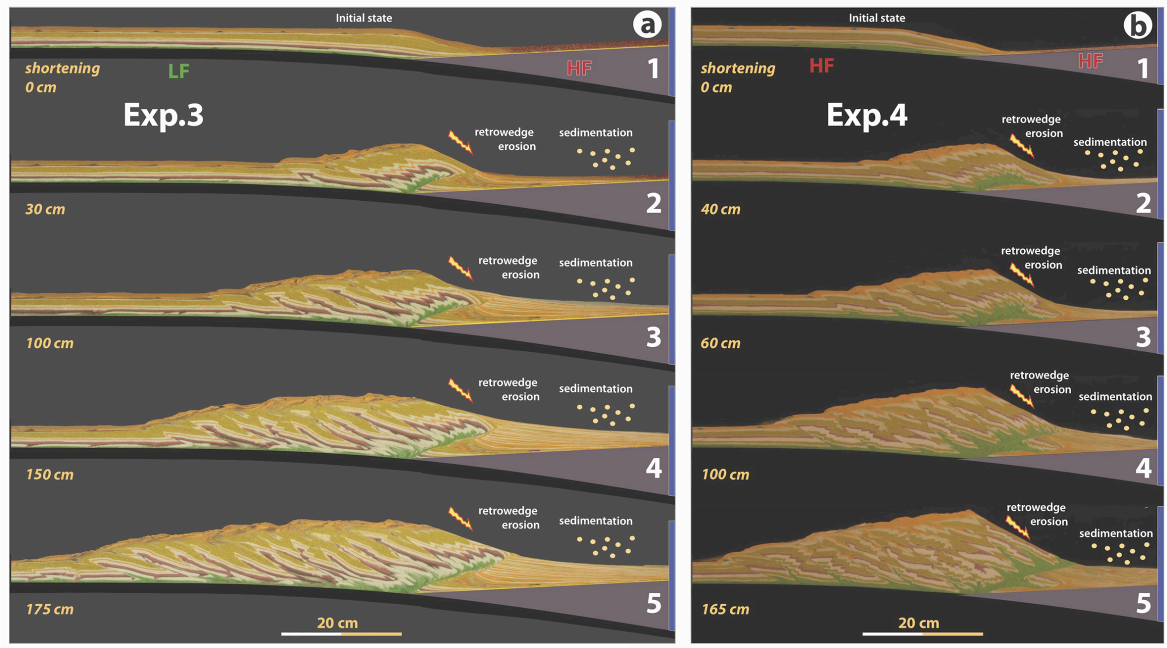

Figure 1: Evolutionary stages of experiments 3 and 4 outlining the impact of basal friction on wedge dynamics and exhumation.

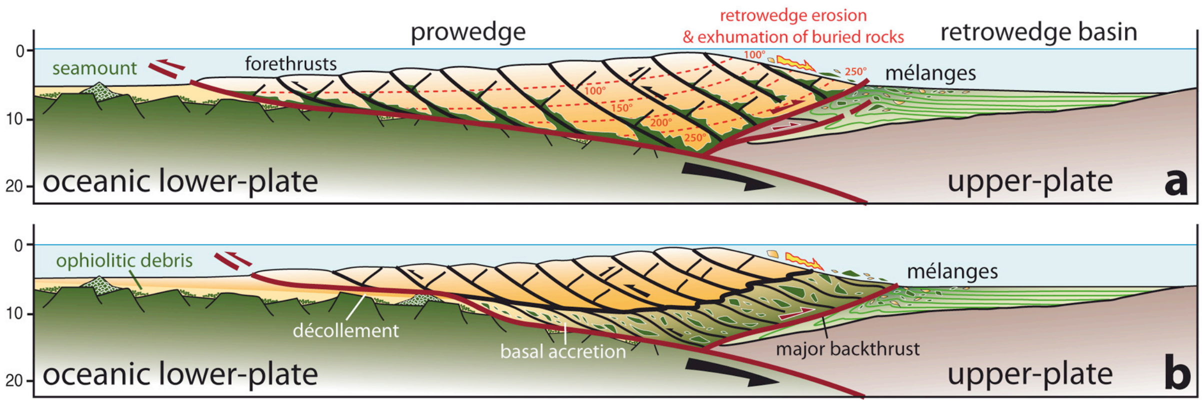

Figure 2: Cartoon illustrating the proposed model for exhumation and redeposition of ophiolitic debris and wedge rocks as tectonosedimentary mélanges in the retrowedge setting. Major backthrusting and gravity driven submarine erosion allows exhumation and deposition of exotic blocks in the syn-tectonic retrowedge basin. a) First setting, the wedge grows by frontal accretion of imbricated thrust units. The red dotted lines suggest the shape of isotherms registered by peak temperature thermometry. b) Second setting, deformation partitioning occurs, the wedge grows by frontal accretion and basal accretion at depth.

Keywords: *tectono-sedimentary mélanges, ophiolites, analog modeling, Raman spectrometry, submarine erosion, Casanova mélange, Apennines.*