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Direct and indirect evidence of material transfer from the upper to the lower plate: the integration between fossil and modern convergent erosional margins

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The integration of data from fossil and modern subduction zones shows evidence of material transfer from the upper to the lower plate taking place from the shallower to the deeper part of the system and shedding light on the mechanism of tectonic erosion. The contribution of the upper plate to the trench input can be directly observed in fossil examples of the Northern Apennines, where the dynamic change of the margin frontal wedge during the Early Miocene transition from oceanic subduction to continental collision is preserved in a sedimentary complex called the Sestola Vidiciatico Unit. There, oceanic rocks accreted and deformed within the Late Cretaceous to Middle Eocene accretionary prism have been successively involved in the plate boundary through underthrusting in a process of rock recycling. The older deformation phase recorded in this fossil subduction channel is of widespread extension: at first pervasive and without veins, then more concentrated and with vein precipitation. The same structures are present at the top of the foredeep turbidites indicating deformation with the rocks of the incoming plate and involvement in the footwall of the megathrust fault representing the plate boundary. As deeper parts of the system are approached the deformation change from widespread extension to contraction. The presence of a deforming sedimentary wedge of material recycled from the slope is also present at the front of the erosional Middle America convergent margin. Here ocean drilling has penetrated the décollement close (1.5 km) to the trench revealing the lack of mineralization, despite the abundant circulating fluids, and the presence of extensional structures in the downgoing plate. As the deeper part of the margin has not been reached, yet, the evolution of the subduction channel has to be inferred from indirect observations. Modelling and seismic reflection images indicate that the plate boundary under

the frontal sedimentary wedge is overpressured. The plate boundary rapidly decreases reflectivity inboard until it reaches the area below the continental slope, to decrease again under the shelf. The high reflectivity area has been interpreted as an area of high fluid pressure and by abundant faults on the upper plate by Ranero et al. (2004). Comparing the record of subsidence to the location of the highly pressurized plate boundary, we observe severe subsidence, suggesting that basal subduction erosion is triggered by overpressured fluids and high effective stress.