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Impact of erosion on dynamics, internal structure and exhumation in accretionary wedges: insights from analogue modeling.

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We studied the effects of erosion on fault propagation and exhumation history in accretionary wedges by experimental and geological approaches. Different parameters are tested (basal friction, rate and angle of erosion, presence of décollements and subduction window). A model Coulomb wedge is submitted to erosion under flux steady state conditions. The volume of eroded material remains equal to the volume of newly accreted material, maintaining a constant surface slope during shortening. The material is exhumed along a series of inclined (20˚–50˚) thrusts in the rear of the high-friction wedge with critical taper 8˚. Presence of a low-friction décollement layer in the accreted series of high-friction wedge (erosion slope 6˚) allows underplating of basal thrust units and developing of an antiformal stack in rear part of the wedge like a dome-shaped structure. The growth and exhumation of the structure is favored by major back thrust at the final stages of shortening. The basal material is transferred to the surface along a series of high-angle (60˚–70˚) thrusts. Above the décollement, the upper thrust wedge is thickened mainly by frontal accretion with formation of paired thrust faults (typical mechanism for low-friction wedge). The coupling of the thrust faults in the upper wedge at the final stages of shortening leads to formation of a compressed synformal “klippe” completely detached from the basal layers of the model. Presence of two décollement layers in the accreted series changes the fault propagation in thrust wedge inducing development of independent system of thrusts above each décollement. The formed dome-shaped antiformal structure is wider, no major backthrust occurs, and exhumation of basal layers is less pronounced occurring along less steeper thrusts (35˚- 40˚) if compared to the one-décollement wedge. The

upper wedge above décollement layers is nearly completely eroded. If steeper slope of erosion (8˚) is applied to the high-friction thrust wedge with two décollement layers, a smallest extent of basal material exhumation is observed, and the upper wedge remains preserved. Presence of subduction window in eroded low- and high friction thrust wedges induces the development of a major long-lived out-of-sequence thrust fault that controls transfer of material across the wedge toward the window. The former accreted material is transferred to the subduction window along curve-shaped trajectory, never being exhumed. The later accreted material is transferred to the surface in front of the out-of-sequence thrust fault. The two-times slower surface erosion applied to high-friction thrust wedge allows to faster vertical growth of the wedge at early stages of shortening, thus the area of major exhumation is shifted from rear to the middle part of wedge in the final model. Observed model structures provide constraints on the internal thrust wedge dynamics as a function of certain parameters that allows to better understand fault geometry, kinematics, material transfer and fluid flow localization in fold-thrust orogenic belts.