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Sedimentation controls on thin-skinned fold-and-thrust belts and application to the Southern Pyrenees

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The interactions between tectonics and surface processes in mountainous area are well known now for being of first-order importance on the development of an orogenic belt. Among these, the feedback between thin-skinned deformation in external zones and wedge-top sedimentation can be very important when the décollement level is efficient and the amount of sediments important enough. Therefore, we use an Arbitrary Lagrangian Eulerian finite-element model (Sopale) to model a thin-skinned fold-and-thrust belt at upper crustal scales (7 km depth and 200 km length) and its response to several patterns of wedge-top sedimentation. Sopale takes into account the main features and processes that influence the development of a fold-and-thrust belt including detachment horizons, strain-softening, flexural isostasy, and erosion and sedimentation processes. Initial, more conceptual modeling focuses on wedge development coupled with syn-orogenic sedimentation. Wedge-top sedimentation directly affects the taper angle and clearly modifies the behavior of the wedge; a clear relationship between average thrust-sheet length and the thickness of syn-tectonic sediments is highlighted.
Subsequently, a sediment cover that progrades towards the foreland with time is added to reproduce the late syn-orogenic burial of the southern Pyrenean fold-and-thrust belt by conglomerates. As a matter of fact, both syn- and post- orogenic deposits may have influenced the range evolution in the Southern Central Pyrenees. During middle to late Eocene, thrust deformation in the Pyrenean fold-and-thrust belt migrated to the south with in-sequence piggy-back thrust development with long thrust sheets and important sedimentation. From Oligocene to Miocene, combined thermochronometric, modeling and field studies showed that conglomerates sourced from the axial zone buried the fold-and-thrust belt until the Ebro foreland basin. At the same time thrust activity migrated from the front to the internal parts of the orogen reactivating major proximal thrusts in the foreland fold and thrust belt and in the south of the Axial Zone, but the reason for the out of sequence activity is still a matter a debate. We will investigate the causes for out-of-sequence thrust activity and the possible relationship with conglomeratic wedge top sedimentation, as well as the effects of different modes of deposition (prograding or aggrading) on the fold-and-thrust belt.