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Stratigraphy and sediment signal transmission in a flexural foreland basin dynamically linked to an uplifting range

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Foreland basins that develop at the foot of collisional mountain belts accumulate sediments eroded from the ranges. They thus represent valuable archives of the evolution of orogenic systems through time. A few numerical models have investigated the infilling of foreland basins during the growth of an orogenic range and they provide conceptual frameworks for foreland stratigraphy. However, surface processes (erosion, sediment transport and deposition) are often quite basic in these models, and in the last decade, progress has been made in the description of surface processes and its implementation in numerical models. Recently, we developed a landscape evolution model able to describe the evolution of an eroding source coupled to a flexural sedimentary basin (Yuan et al, 2019, JGR; Guerit et al, 2019, Geology). This model takes into account erosion and deposition at the same time, and it thus allows a full dynamical coupling of the range and its foreland. We take advantage of this efficient numerical model to take another look at the stratigraphic evolution of a foreland basin and at the transmission of sediment signal from source to sink.

We use the model to simulate the evolution of a flexural retro-foreland basin coupled to an uplifting range and subjected to temporal variations in uplift and precipitation rates. Such variations affect the topography of the range: a lower uplift rate or an higher precipitation lead to a lower range. As a result, because the accommodation space available in the foreland is purely flexural, a decrease in uplift rate or an increase in precipitation rate will be marked by an erosional surface in the foreland basin. On the contrary, an increase in uplift rate or a decrease in precipitation rate will be preserved in the stratigraphy. Interestingly, although the two scenarios induce a different sediment signal from the sources, they are both recorded in the foreland basin as a transient increase in accumulation rate. Such a signal alone can therefore not be used to decipher the type of perturbation that affected the source.

Finally, we discuss the evolution of a natural range and coupled foreland basin, the Pyrenees and the Aquitaine Basin. We show that the spatial pattern of sediment deposition in the Aquitaine Basin is very consistent with the topographic evolution of the Pyrenees. However, this topographic evolution is not consistent with the climatic and tectonic reconstruction in the area since the Eocene, opening discussions among others about local vs regional effects. This work is part of the

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