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Modeling of wind gap formation and development of sedimentary basins during fold growth: application to the Zagros Fold Belt, Iran.

Marine Collignon (1), Philippe Yamato (2), Sébastien Castelltort (3), and Boris Kaus (4)

(1) Centre for Earth Evolution and Dynamics, University of Oslo, Norway (marine.collignon@geo.uio.no), (2) Géosciences Rennes, Université de Rennes 1, France, (3) Département des Sciences de la Terre, Université de Genève, Switzerland, (4) Institute für Geowissenschaften, Johannes Gutenberg-Universität, Mainz, Germany

Mountain building and landscape evolution are controlled by the interactions between river dynamics and tectonic forces. Such interactions have been largely studied but a quantitative evaluation of tectonic/geomorphic feedbacks remains required for understanding sediments routing within orogens and fold-and-thrust belts. Here, we employ numerical simulations to assess the conditions of uplift and river incision necessary to deflect an antecedent drainage network during the growth of one or several folds. We propose that a partitioning of the river network into internal (endorheic) and longitudinal drainage arises as a result of lithological differences within the deforming crustal sedimentary cover. We show with examples from the Zagros Fold Belt (ZFB) that drainage patterns can be linked to the incision ratio R between successive lithological layers, corresponding to the ratio between their relative erodibilities or incision coefficients. Transverse drainage networks develop for uplift rates smaller than 0.8 mm.yr-1 and -10 < R < 10. Intermediate drainage network are obtained for uplift rates up to 2 mm.yr-1 and incision ratios of 20. Parallel drainage networks and formation of sedimentary basins occur for large values of incision ratio (R >20) and uplift rates between 1 and 2 mm.yr-1. These results have implications for predicting the distribution of sediment depocenters in fold-and-thrust belts, which can be of direct economic interest for hydrocarbon exploration.