Subject offered for a contract starting october 2015

SUBJECT TITTLE: Interactions between tectonics and surface processes, and morphological evolution of the central-western foothills of the Taiwan mountain range.

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Financing: Doctoral contract with or without assignment

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The interactions between tectonics and surface processes have been extensively studied over the last decades. These interactions are particularly intense and dynamic within the foothills of mountain ranges : indeed tectonic deformation is localized within these particular settings on active faults that propagate to the foreland, while sediments are being transported through the foothills from the high peaks to the foreland. To characterize the dynamics of foothills systems, studies usually rely on the analysis of present-day geomorphic markers (ex : fluvial terraces, sedimentary deposits, knickpoints) that represent relicts of ancient landscapes. These markers offer temporal snap-shots of past landscapes, but put together, they help reveal the landscape dynamic response to « recent » variations of tectonic (ex : forward propagation of deformation, reactivation of structures), climatic (ex : variations of sediment fluxes within drainage basins) and/or morphologic (ex : drainage captures) conditions. In this PhD project, we propose to analyze the morphological and structural evolution of a foothills system, in which the landscape is presently in *disequilibrium*. The field example proposed is that of the central-western foothills of the Taiwan mountain range, in the region of the intra-mountainous Puli basin.

The Taiwan mountain range results from the collision between the Chinese passive margin and the Luzon volcanic arc ~6 Ma ago. This range is characterized by some of the most extreme deformation and erosion rates in the world. Despite the southward propagation of the collision over time, the Taiwan range shows an overall structural and topographic continuity along strike. The region around Puli, in central Taiwan, has long been recognized as an anomaly within this general along-strike continuity. Indeed, this area is characterized by its topography and relief that are lower than further north and south, and its overall sub-critical regional slope in contrast with the overall critical slope of the mountain range elsewhere. Several intra-mountainous basins (Puli, Yuchi, Sun Moon Lake and Toushe) exist within this region. These basins are now recognized as *piggy-back* basins that formed behind the frontal faults of the foothills. The timing of sedimentation initiation within these basins remains poorly constrained and debated, but recent age data on the most recent sedimentary deposits within the Puli basin suggest that sedimentation stopped by ~40-50 ka in this area. Chronological constraints remain to be provided for the other basins. Several observations in

this region suggest that the landscape is in a disequilibrium state: markers of erosive regression or of drainage basin captures, probable presence of endoreic basins, etc, are some examples. The overall morphological observation of the landscape in this region suggests that these intra-mountainous basins probably formed initially as endoreic systems, behind the topographic and tectonic barrier related to the frontal active faults. These basins were subsequently captured (or are presently being captured) by the main rivers draining into the foreland. However, this scenario remains preliminary, and a more precise morphological analysis of this region, combined with additional age constraints, is needed to confirm and refine these ideas. Such morphological analysis will benefit from the existing constraints on the structural and tectonic evolution of the foothills in this region. Altogether, this field example should help better understand the links between the evolution of drainage basins, the formation and subsequent capture of piggy-back basins and the forward propagation of active tectonic deformation into the foreland.

The PhD project presented here will first rely on a detailed geological and geomorphological analysis of the Puli region, to be then related to the structural evolution of the foothills in this area. The main objectives of this morphological analysis are : 1) to precisely constrain the geographic extent, the geometry and the sediment volumes of the intra-mountainous basins, and 2) to map the geomorphic evidences for the capture of these basins. Such study will first rely on mapping and landscape analysis tools, based on DEMs (Digital Elevation Models) and satellite images. Field work will allow for checking observations and interpretations, and for sampling key geomorphic markers for additional age constraints.

This PhD project could then evolve following different perspectives and orientations, according to the student's affinities and choices. One of these possibilities could be a geochemical analysis of present-day sedimentary fluxes out of these basins, of rates and paleo-rates of erosion related to the evolution of the drainage basins over time. This would be based on the geochemistry of cosmogenic isotopes (collaboration : Eric Gayer, IPGP / Jérôme Van der Woerd, IPG Strasbourg). Physical (collaboration : Fabien Graveleau, LOG, Lille) and /or numerical (collaboration : Philippe Steer, Géosciences Rennes) models, exploiting and synthetizing the previously acquired data, are other possibilities.

Such PhD project requires a strong background in structural and field geology, mapping, and geomorphology. An additional background or interest inq geochemistry and/or modeling would be appreciated.

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