Subject offered for a contract starting october 2016

SUBJECT TITTLE: Kinematics of deformation of the intra-continental Western Kunlun mountain range (Xinjiang, China) over different time scales – implications in terms of seismic hazards.

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Financing: Doctoral contract with or without teaching assignment

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Presentation of the subject: (1 or 2 pages)

Even though the Tibetan plateau is a remarquable morphologic feature of the Earth's surface, its evolution and mechanics remain controversial. Some clues to this debate could be gained from a better knowledge of the history of deformation of the mountain ranges bordering the plateau. To the south, the Himalayan range has been well studied, but such is not the case of the intra-continental and slowly deforming mountain ranges at the edge of the plateau elsewhere. The LongMen Shan range, to the south-east, is an unfortunate case example of such lack of knowledge : characterized by a high topography and by the absence of shortening detectable from present-day geodetic data, crustal thickening and shortening – and the associated seismic hazards – had for long been debated, until the devastating Wenchuan earthquake stroke the region (Mw 7.9, May 2008).

We here focus on the Western Kunlun mountain range (Xinjiang, China), along the north-western margin of the Tibetan plateau. Such as for the LongMen Shan range, the Western Kunlun is characterized by high topography (with some peaks over 7000 m high) and extremely low deformation rates. Sediments resulting from the erosion of the mountain range are trapped within the Tarim - endoreic – foreland basin. These represent archives of the evolution of the range and provide an excellent record of the evolution of deformation towards the basin. From field observations, satellite data and seismic profiles, we proposed a structural framework for this site and estimated the shortening rate across the mountain range over a time scale of ~45-500 kyr. The recent Pishan earthquake (Mw 6.4, July 2015) illustrates that part of – if not all – the deformation across the range is accommodated seismically, emphasizing the need for a better assessment of the seismic hazards in the region.

The PhD project presented here aims at precisely quantifying the kinematics of deformation across the Western Kunlun mountain range. First, the presently active (and therefore potentially seismogenic) structures are to be precisely defined, and their respective contribution to the total shortening rate absorbed across the range is to be determined over a time scale of several seismic cycles (i.e. over several 10s to 100s kyr). The sub-surface geometry of active structures will be determined from available surface geological observations and seismic data. A geomorphologic analysis of the deformation recorded over this time scale by uplifted and dated alluvial fans and/or fluvial terraces will allow for quantifying deformation rates. Such a morpho-tectonic study will characterize the “present-day” kinematics across the mountain range.

This PhD project will then 1) either characterize the long-term (several Ma) evolution of deformation that lead to the “present-day” situation, or 2) quantify present-day short-term (few yr) interseismic deformation over the region – or both - , according to the candidate’s possibilities and affinities. Over the long-term, existing constraints on the geometry of structures and on the temporal evolution of deformation will be used to incrementally build the evolution of deformation up to the present-day situation. Short-term deformation will be investigated by InSAR to check whether active structures are locked during the interseismic period or whether they creep. The results obtained in both approaches will be used to feed a larger discussion on the mechanics of deformation over these different time scales.

Such PhD project requires a strong background in structural geology, active tectonics, mapping, geomorphology and modeling. This project will be mainly advised by Martine Simoes (morpho-tectonics), Laurie Barrier (structural framework and long-term evolution), and Raphael Grandin (InSAR).

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