Subject offered for a contract starting october 2016

SUBJECT TITTLE: Role and physicochemical influence of bedrock landsliding on erosion in Reunion Island

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Financing: Doctoral contract with or without teaching assignment

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Presentation of the subject: (1 or 2 pages)

The understanding of the erosion processes taking place in volcanic islands is important not only for a scientific purpose but also because of the societal concerns associated to erosion. Most of the volcanic islands have large climatic gradient and suffer extreme precipitation events during the tropical summers. Such intense precipitation allows erosion that creates dramatic landscapes and that can result in socio-economic and ecosystem damages.

Over the past decades, the increase of population on volcanic island forced people to migrate into the islands because of the lack of space on the coast. In addition, excessive sediment supply can smother reefs and then accelerate reefs decline. Thus, a better understanding on erosion processes and rates in volcanic islands is needed for better lands and reefs management.

The study of erosion processes and rates is also a big scientific question and matter of long-standing and continuing debate. Chemical weathering and physical erosion (and associated sediment transport) that allows the denudation of the continental surfaces are among the most important processes that drive earth's surface morphology. The physical erosion that controls topography and slopes produces fresh surfaces for chemical weathering that in turn consumes atmospheric CO_2, making these erosion processes important players in the feedbacks between climate and tectonics.

Tropical volcanic islands are excellent natural laboratories to study erosion processes since 1) the reconstruction of volcanoes initial topographies is easy and the age of the initiation of erosion can be determined by dating the volcanoes remnants. 2) Most of the volcanic island suffers extreme precipitation events and large climatic gradient and 3) the direct path between drainage areas and ocean makes these islands very interesting places to study sediment transfer. The Reunion Island that is composed of two volcanoes (Piton des Neiges and Piton de la Fournaise) suffers contrasted precipitations regimes between the windward and the leeward sides and between summer and winter, making this island an excellent example of natural laboratory.

Our preliminary results on erosion rates estimation show that intense erosion in Reunion is mainly due to stochastic bedrock landsliding. Although landslides affect only a small proportion of the landscape they can provide to the river huge amounts of sediment and organic matter that are available for weathering and transport. Despite the fact that the link between chemical weathering

and physical erosion is a matter of big scientific interest, it has been only studied in mountain ranges, and thus Reunion appears as the perfect natural laboratory to explore such feedbacks in non mountainous environment.

This thesis offers the opportunity to study these links using two directions: 1) the geochemical characterization of landslide products as well as river sediments and water from drainage areas affected by landslides, using chemical analysis (major and traces elements). This will allow (i) to establish the link between bedrock, erosion processes, weathering products and erosion rates, and (ii) to look at sediment transfer at different timescale, using geochemical mass balance. Samples have been already collected but a new field trip will be necessary to sample landslides across the island. The second direction 2) will be to use databases from remote sensing analysis to map landslides and to estimate the related volumes of eroded material. In addition, the influence of vegetation on erosion processes in Reunion will be studied by comparing remote sensing databases and the results from geochemical erosion rates. Finally these two directions will be completed, depending on the student progress, with geochronological methods (cosmogenic 3He at IPGP, OSL dating or U-Th with Pierre Valla) or with isotopic analysis (Li, Sr, Rb, Si at IPGP) in order to bring new insights on the erosion processes and erosion rates estimated by geochemical mass balance and remote sensing.