Department

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Supervisors

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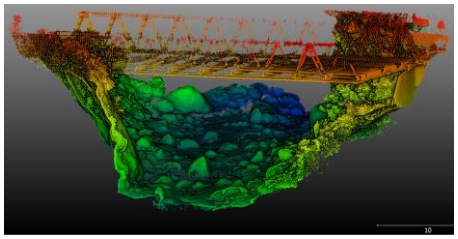
Subject

Title: **Impact of fractures on the erosion of mountain belts**

In mountain ranges, the bedrock is characterized by fractures that developed at the millimeter scale to the crustal scale. It has long been postulated that bedrock surface fracturing strongly modulates erosion processes such as river incision or hillslope landsliding. The geometry of the fracture network is also likely to control the shape and distribution of the sediment size entering the fluvial network, largely influencing watershed sediment transfer and the ability of rivers to incise (tool and cover effect). Despite its importance, the role of fracturing on erosion has never been explicitly demonstrated and no theoretical model has been proposed to include fracturing in the laws of landscape erosion and sediment production. The aim of this thesis is to fill this important gap in understanding the dynamics of mountain belts erosion. The PhD student will integrate a team with unique skills in the analysis and modeling of erosion processes and rock fracturing. The thesis will address the following points:



1. **Demonstration and in situ quantification of the role of fracturing on river incision in New Zealand**. The PhD student will complete a multi-year survey of 3D topographic data of mountainous rivers obtained by terrestrial lidar. It will develop methods of characterization of 3D fracturing, automatic analysis of dominant erosion processes (abrasion vs plucking) and joint analysis of erosion / fracturing relationships.
2. **Relationship between fracturing of source rock and particle size of sediment debris produced during landslides**. Using high-resolution 3D data of landslide material, the PhD student will study the relationship between fracturing of the source rock and the size / morphology of debris generated by landslides. The PhD student will continue to develop an existing algorithm that extracts the size and shape and sediment grains from 3D data.
3. **Experimental study of the relationship between 3D geometry of the fracture network (density, orientation, connectivity) and the type and rate of fluvial incision processes**. The PhD student will use a new laboratory experimental device in which rocks, with an artificial network of fractures printed in 3D, are eroded by a flow of water and pebbles.
4. **Development of a new theoretical framework, that accounts for an implicit description of fracture geometry and density, to be implemented in river or landscape evolution models**. This part will integrate the previous results and the latest fracturing models developed in the team (e.g., DFN).

Host scientific team: The DIMENV (Dynamics, Imagery and Modeling of the Environment) team is one of the leading international groups in the advanced processing of 3D lidar data, geomorphology, fracturing modeling and experimental and numerical modeling of river dynamics. Previous PhD students are now employed either in the academic sector or in industry in France and abroad.

Candidate profile: Quantitative Earth Sciences training (geophysics, rock mechanics, geological fluid mechanics, image processing), physics (rock mechanics, fluid mechanics) with an appetite(!) for geomorphology and field work (New Zealand), laboratory and / or numerical modeling. Basic knowledge in one of the following programming language is desirable: matlab, python, C / C ++. Good level in English is imperative. **International students are welcome and a proficiency in French is not required.**

How to Apply? Please contact Philippe Steer and Dimitri Lague for any enquiry about the subject or to apply. Application can then be made directly online here: https://thesesenbretagne.ueb.eu/sdlm/theses-2017/impact-de-la-fracturation-sur-l2019erosi/++add++ueb.thesesenbretagne.candidate

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