Subject offered for a contract starting in September 2013

Structure and geodynamics of the Andean subduction margin and Altiplano orogenic system.

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The subduction zone at the western margin of South America is the geodynamic system that appears to have generated the largest earthquakes and tsunamis, as well as one of the largest mountain belt - and high-plateau- systems of our planet, the Andes. At the subduction interface, there is a fundamental partitioning between mechanisms leading to these two processes. It is now clear (contrary to expectations ascribed to C. Darwin) that crustal deformation associated with large subduction earthquakes leaves no measurable contribution to mountain building. The alternative idea attributing the Andean orogenic growth to large-scale accretion of intrusive bodies and volcanism is in conflict with the tectonic shortening mechanisms now admitted for explaining the orogenic relief in collision belts (Alps, Himalayas). Simply, no first-order unified theory is available for present-day orogeny occurring in our planet. The growth of the Andean orogen by tectonic shortening (associated with plate convergence) can now be measured over the 10^3-10^7 yr time scale, which is barely longer than the seismic cycle observed for subduction earthquakes. However, how those two fundamental processes interact is unknown and no current geodynamic model appears to explain satisfactorily both, the generation of the large earthquakes and the topographic relief generated (by some combination of accretion and tectonic shortening) as an end product of the same subduction system.

The present PhD subject aims to study the permanent deformation of the western Andean margin. Our aim is to characterise the evolution of the west-vergent geological structures in relation with the subduction processes, and to understand the coupling between geological, geomorphological and seismogenic processes. In particular, using recently published results and new observations (to be collected: field-work, sampling, dating, 3D (4D) mapping), we want to construct a mechanical model involving tectonic accretion at the subduction interface (boundary conditions similar to continental collision) consistent with the tectonic and morphological evolution of the Central Andes and the Altiplano.

This subject comes in the frame of the International Associated Laboratory Montessus de Ballore (LIA-MB, which is centred on the understanding and the monitoring of the seismic hazard along the Andean subduction), of the ANR MegaChile (2013-2015, coPi C. Vigny, R. Lacassin) and of the LABEX UnivEarthS.