The nature of the North-South change of the magnitude of tectonic shortening in Central Andes at Altiplano-Puna latitudes: a thermomechanical modeling approach.

Michaël Pons$^{1,2}$ and Stephan Sobolev$^{1,2}$

$^1$Universität Potsdam, Institut für Geowissenschaften, Germany
$^2$GFZ - Deutsches GeoForschungsZentrum, Geodynamic modelling, Potsdam, Germany (ponsm@gfz-potsdam.de)

The Andean orogeny is a subduction-type orogeny, the oceanic Nazca Plate sinks under the continental South American Plate. While the subduction has been active since ~180 Ma, the shortening of the Andes initiated at ~50 Ma or less.

In a oceanic-continental subduction system, the absolute velocity of the overriding-plate (OP) largely controls the style of subduction (stable, advancing, retreating), the geometry of the slab (dipping angle, curvature) and the style of deformation (shortening or spreading) within the OP. In the case of the Central Peru-Chile subduction, the South American plate is advancing westwards whereas the Nazca plate is anchored into the transition zone (~660 km). As a consequence, the trench is forced to retreat and the Nazca plate to roll-back. The dip of the slab decreases meanwhile the Andes experienced a maximum shortening of ~300 km at ~19-21°S latitudes.

Previous study have shown that the strain localizes within areas of low strength and low gravitational potential of energy. In central Andes, weakening mechanisms of the OP such as lithospheric delamination have intensified the magnitude of tectonic shortening and contributed to formation of the Altiplano-Puna plateau. The deformation between the plateau and the foreland occurs in the form of pure shear or simple shear and is expressed in terms of different tectonic styles in the foreland basin, thick-skinned (e.g the Puna) and thin-skinned (e.g the Altiplano), respectively. Nevertheless, the influence of the strength variations of the OP on the subduction dynamics in the case of the central Andes has been poorly explored so far. Our hypothesis is that lateral variations of OP strength result in variable rates of trench roll-back. To test it, we have built 2D high-resolution E-W cross sections along the Altiplano and Puna latitudes (12-27°S) including the subduction of the Nazca plate. For that purpose, we used the FEM geodynamic code ASPECT. Our model includes visco-plastic rheology in addition to gabbro-eclogite phase transition. These preliminary results contribute to the discussion on the nature of the magnitude of shortening in a subduction system. They are also a first step to derive a 3D model of the entire region and to consider additional surface processes such as erosion, transportation and sedimentation.