

Impact of crust rheology on the dynamics of converging lithospheres

Convergent zones are places of intense deformation. For both ancient (hot) and young (cold) mountain ranges, their structuring is controlled at first-order by the rheology of involved lithospheres: the subducting lithosphere of course, but also the overriding lithosphere. Over the past few years, the role of the overriding plate in the dynamics of convergent zones has been more and more pointed out but its influence (especially the impact of its crustal part) on orogenic systems is still puzzling.

Convergent zones involve different materials (oceanic crust, continental crust, sediments), which evolve in different contexts (oceanic subduction, continental subduction, obduction). The observation of resulting structures shows differences in units size, presence or lack of plateau, and in metamorphism. The global dynamics for each case remains controlled by the subduction but resulting orogens (Alps, Andes, Aegean, Himalayas, ...) are unique, in part because the degree at which the overriding plate is involved differs.

The aim of this thesis is to specify the influence of the rheology of involved crusts in the structuring of mountain ranges, with an emphasis on the role of the overriding plate crust.

The study will be divided in two parts:

- The first part will be centered on the tectonic control of the crustal rheology for hot and cold lithospheres on the produced deformation style. Analog models already exist but the fundamental roles of temperature and rocks composition have been only partially addressed.
- The second part will focus on the role of the overriding plate crust in the structuring of mountain ranges. The first tested key parameters will be the rheological structure, the composition and the thickness of the crust.

The study will rely on field examples (Alps, Andes Himalayas, Aegean, ...) where numerous data already exist. A synthesis on the composition and degree of involvement of the crust in these different examples will be required. Fieldwork dedicated to the Andean case study is more particularly considered for a better understanding of the role played by the crustal rheology on the N-S segmentation of the Andes.

This study will involve:

1. A study of the rheological parameters that control at first-order the dynamics of convergent zones (role of the lower crust, role of the initial geotherm, impact of metamorphic reactions on the rheological evolution of the crust).
2. A validation of the models through a compilation of existing data in terms of differences between old and young lithospheres but also in terms of differences between young mountain chains involving variable upper crusts.

3. An additional fieldwork particularly focused on the Andes will allow confronting the results coming from modeling to a geological case study for which the role of the overriding plate crust appears fundamental.

Keywords : convergent zones, rheology, crust