

The modeling indicates that the observed metamorphic and magmatic history of the root system can be neither reconciled with a simple model of visco-elastic deformation of lithosphere, nor with a model of deformation of a viscous thin-sheet in front of an indenter. We suppose that an important role for building of an orogenic

root and of a Tibetan-like plateau is played by the Andean pre-collisional thermal history. In addition, a prolonged magmatic anomaly is necessary to create and stabilize this orogenic root system, which becomes mechanically weak and deformable with ongoing thermal weakening.

## Deformation of the foreland lithosphere due to mantle flow caused by slab-retreat: a new working hypothesis

M. SCHUMACHER

*Faculty of Earth Sciences, Vrije Universiteit Amsterdam, Netherlands*

Convergence between lithospheric plates is mainly accommodated by oceanic subduction. When continents collide oceanic subduction meets its end and the slab may roll back, become steeper, delaminate and break-off. However, to a certain extent intralithospheric delamination also may allow for continental subduction. Slab retreat of the subducting plate is widely accepted as a mechanism that causes back-arc extension in the upper plate (hinterland) during ongoing convergence. To date, however, little attention has been paid to possible effects of slab retreat on the foreland, although a retreating slab implies considerable mantle deformation (mantle flow) behind itself and below the foreland lithosphere. Whenever a slab retreats mantle material has to escape from behind it and material is drawn in in front of it. Analogue models show that this generally leads to a divergent flow behind and to a convergent flow in front of the slab. Moreover the mantle flow pattern induced by a retreating slab strongly depends on the dimensions of the slab, the geometry of ambient lithosphere and the viscosity distribution in the mantle. The question now is whether and under which conditions such mantle flows can deform the foreland litho-

sphere. For example is the viscous drag exerted at the base of the lithosphere effective enough to deform the lithosphere by flow or failure? It seems possible that this second order mantle flows can trigger or contribute to foreland deformation. The coupling between the asthenosphere and the lithosphere, i.e., essentially the viscosity gradient across the lithosphere/asthenosphere boundary layer, seems to allow transmission of stresses into the lithosphere which may locally contribute to overcoming yield strength or flow resistance. Horizontal divergent flows behind a retreating slab may cause foreland extension parallel to the collision belt, resulting in foreland rifts more or less orthogonal to the belt. Furthermore deviatoric flows at the base of the lithosphere may lead to contrarotating lithospheric domains. Such a scenario may throw new light on fan shaped graben systems in the Hercynian and Alpine forelands. Under certain circumstances mantle flows due to sublithospheric displacements (like push down of orogenic roots, slab retreat etc.) may also escape upwards arching pre-existing weak zones of the lithosphere. However, additional quantitative modelling is required to test this hypothesis.