Mechanisms of single-vergent vs. double-vergent orogens:

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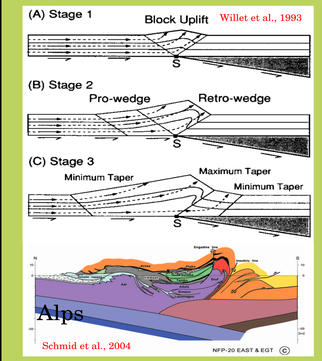
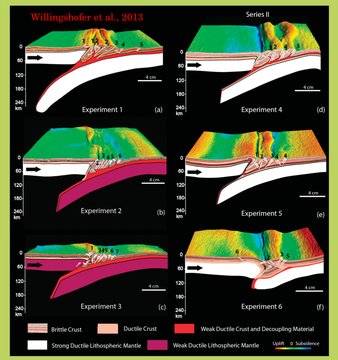
Abstract

We use numerical models to investigate the physical processes of continent collision zones.
We demonstrate that compression of two continental blocks, separated by a rheologically weak suture zone can result in (i) **double-vergent** or (ii) **single-vergent orogens**, with **distinct geometries, deformation and exhumation patterns**.
The transition between these different modes of collision is strongly controlled by the **rheology** of the continental lithosphere.

double-vergent: **single-vergent:**



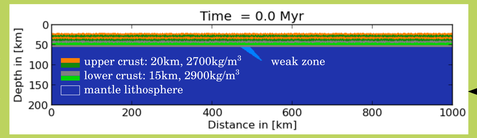


Double-vergent orogens
are formed in response to the gradual accretion of crustal material to the upper plate along retro-shears. In these models continental subduction results in upper plate deformation and nested exhumation against retro-shears. Typical examples include the collision recorded by the **Swiss Alps and the Pyrenees**.

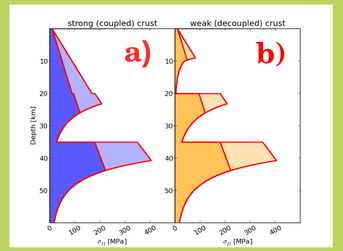
Single-vergent orogens
are characterized by large-scale lower plate deformation and are accompanied by the subduction of lower crustal material. Modeling infers that shortening and associated exhumation will gradually propagate towards the foreland. Natural examples of such single sided orogens are common the **Mediterranean** (Carpathians, Dinarides, Apennines, Betics) or the **SE Asia subduction zones**

Initial setup

All numerical experiments were performed with the I2VIS code [Gerya and Yuen, 2003] The model uses non-Newtonian visco-plastic rheologies to simulate multiphase flow.



total convergence: 1cm/year

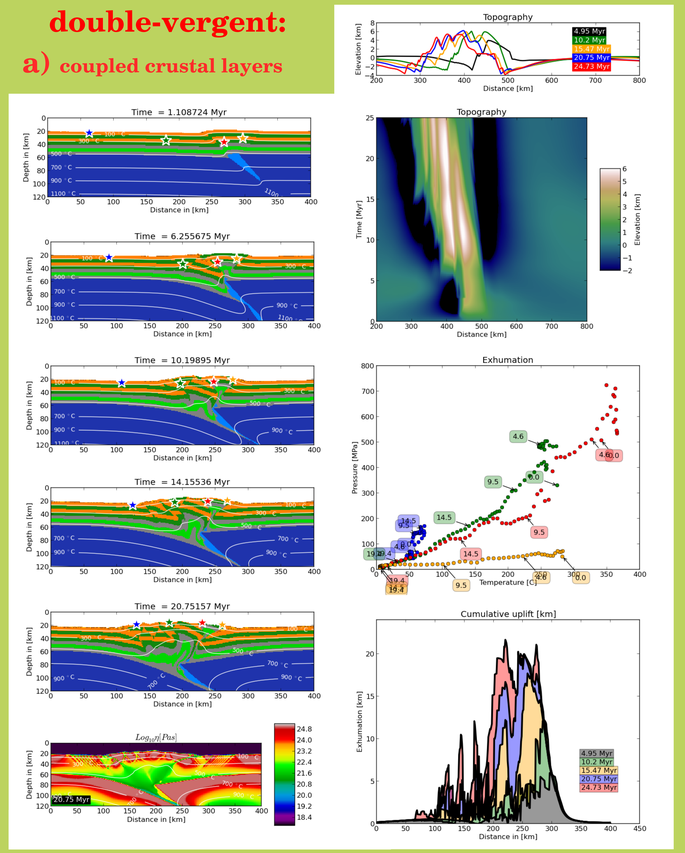


Rheology:
upper crust:
a) plagioclase an75
b) wet quarzite
lower crust:
plagioclase an75
mantle: dry olivine (Ranalli, 1995)
Frictional strength is subjected to strain softening.

Results & Implications:

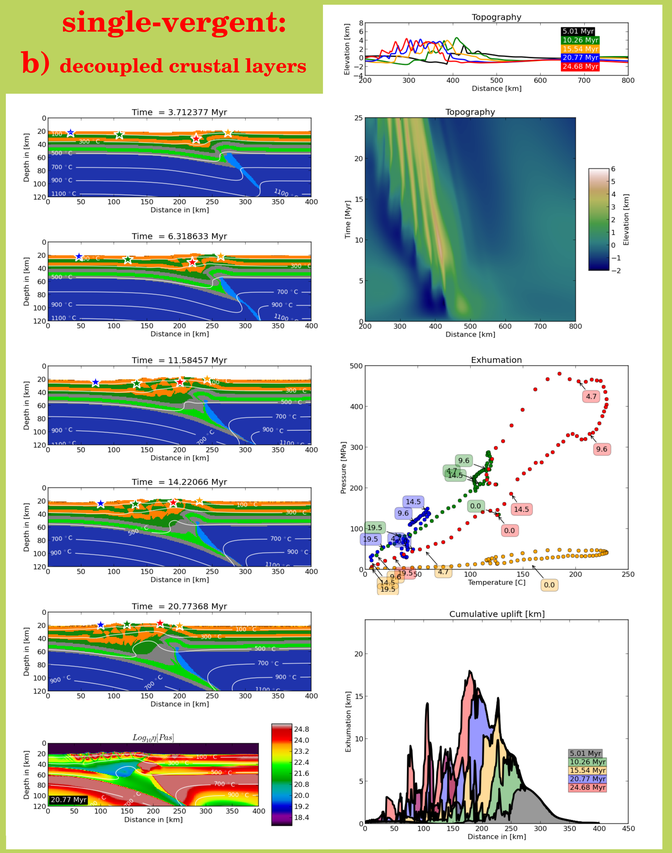
double-vergent:

a) coupled crustal layers



single-vergent:

b) decoupled crustal layers



Summary:

We conclude that deformation in continent-continent collision zones may occur in foreland or hinterland settings, depending on the **rheological structure** of the continental lithosphere, forming **single-vergent** or **double-vergent orogens.**

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