INTRODUCTION

Over the first decades of research into mountain building processes, it became evident that the rheology of the plates involved in processes like continent-continent collision or subduction of one plate into another plays a vital role regarding the resulting deformation patterns and mountain belt geometries. Analogue and numerical modelling are used to investigate the role of weak, decoupling horizons and lateral strength contrasts in terms of collision dynamics and orogen geometries.

Our results show that differences in rheology across and along plate boundaries may lead to a variety of deformation patterns and mountain belt geometries and thus can be used as a proxy for inferring the rheological state of continents during collision.

NUMERICAL MODELLING

Analogue Model of Collision Zones

Strength of Continental Lithosphere

Coupled vs Decoupled Lithosphere

Stages of basic model development. From Willett et al. (1994).

EXPERIMENTS WITH DECOUPLING ZONES

Decoupling at the plate interface (A1, A2)

Crust-mantle coupling on the upper and lower plates (A3, A4)

EXPERIMENTS WITH A WEAK ZONE

Decoupling between the orogenic wedge and the foreland (B1, B2)

SUMMARY OF MODELLING RESULTS

Strong Lower Plate - Weak Upper Plate (C1)

Weak Lower Plate - Strong Upper Plate (C2)

NATURAL EXAMPLES

1. strong decoupling at the plate interface favours continental subduction and dominant pro-way deformation (A1, B1, C2)
2. weak layers within the crust of the upper plate facilitate upper plate deformation (A4, C7)
3. a strong subducting plate produces anastomosing and co-current movements onto the upper plate in is through a retro-shear zone/fault (B2)
4. lateral variations in plate thickness can lead to back-stripping instead of foreland-propagation of deformation (A2)

REFERENCES


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