



Deformation of a brittle-ductile continental lithosphere: Observations vs models

Jean-Pierre Brun

Géosciences Rennes UMR 6118, Université de Rennes 1

One decade after the emergence of plate tectonics, in the late seventies, Goetze and Evans proposed a simple way to calculate lithosphere strength profiles from laboratory derived rheological laws. This illuminating principle contributed to launch new trends in lithosphere mechanics with various applications to process-oriented interpretations of geological and geophysical data. A review of around twenty years of lithosphere deformation studies in extension and compression is presented using mostly laboratory experiments carried out on sand-silicone models. In extension, it is argued that “narrow rifts” result from the necking instability of a cold and strong lithosphere whereas “wide rifts” correspond to a distributed mode of extension in hot and weak lithospheres. This provides simple mechanical models for the exhumation of ductile rocks in extension from mantle at passive margins to “core complexes” in orogenic belts. In compression, “cold and strong” versus “hot and weak” lithospheres also give contrasted modes of thickening: thrust wedge-type and pop-down-type, respectively. These end-member-types of lithosphere behaviour, in both extension and compression, directly control the mechanics of mountain building as it can be illustrated from Mediterranean and Tibet examples.