Geophysical Research Abstracts
Vol. 17, EGU2015-15392, 2015
EGU General Assembly 2015

Exhumation by gravitational sliding up an inclined plane

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Gravity causes sliding down an inclined plane if pressure is near lithostatic. If metamorphic pressures are lithostatic pressures, the approximation is inconsistent with pressure-temperature exhumation histories of thrust nappes stacked during compression to form the thickened crust of mountain belts. Overthickened mountain roots and foreland basin-type sedimentation accompanying the downward movement component of the Moho require significant non-lithostatic pressure perturbations within the mountain belts. Relaxation of the subsequent pressure gradients can be achieved by nappe-like thrusting up an inclined plane recording near isothermal decompression and carrying young sediments to high altitudes. We present results of fully dynamic numerical modelling documenting feasibility of this process. Neither thrusting, nor large weakness zones nor S-point-type boundary conditions are kinematically prescribed in our models. Thrusting emerges spontaneously as an instability, strain localization process that may follow preexisting lithological layering or thermal gradients and able to form new zones of weakness by shear heating mechanism. The non-prescribed nature of our modeled deformation modes makes them feasible, even probable as a leading response to continental shortening. In that case, non lithostatic pressure 'cycle' is an alternative or a complement to the classical Wilson cycle invoked alone to explain elevated occurrences of deep-water sediments.