Geophysical Research Abstracts
Vol. 12, EGU2010-7635-1, 2010
EGU General Assembly 2010

The Role of the Mechanical Stratigraphy at Orogenic Fronts - Results from Analogue Modelling

Fang-Lin Wang (1,2), Onno Oncken (1,2), Nina Kukowski (1), Charlotte Cederbom (1,3)

(1) Deutsches GeoForschungsZentrum, Potsdam, Germany (flwang@gfz-potsdam.de), (2) Institute of Geological Sciences, Freie Universität, Berlin, Germany, (3) Swedish Geotechnical Institute, Olaus Magnus väg 35, 581 93 Linköping, Sweden

Accretionary wedges and foreland thrust belts exhibit structural associations at their respective deformation fronts that can be grouped in distinct families. At accretionary margins, one style involves major forethrusts with regular spacing and foreland-directed thrust propagation such as at Nankai or Barbados. A contrasting, rather rare style is characterized by dominant backthrusts with wide spacing and a more complex propagation style of thrust development as found at the Cascadia margin. In foreland thrustbelts (marine and sub-aerial) the first style is also observed, but appears to be less abundant than a second group that favours the development of triangle zones. The mechanics of the first style in both cases is successfully illuminated by critical taper theory which explains the geometry of Coulomb wedges in terms of internal strength versus basal friction at the decollement. However, the formation of the latter type in both geological settings is at odds with the model of a simple Coulomb wedge. The compilation and comparison of the lithological and mechanical stratigraphy in several examples suggest that the strength contrast between sediments and decollements, and a variable number of the latter, might be key factors controlling these opposed styles.

To better understand the role of strength contrast, mass transfer geometry and deformation process, we choose 2D analogue modelling to test this hypothesis focusing on the second group of structural styles in both, accretionary wedges and foreland thrust belts. Weak and strong strength contrast between the incoming layers and two decollements which partly overlap are implemented in the experiments. We note that the material strength contrast with respect to the decollement, the relative depth of the decollement within the sedimentary pile, and the number of decollements exert the strongest influence. These properties chiefly control the spacing of splay faults, the style of related folding in the hangingwall, and the partitioning of deformation between the decollements. For example, we note that deformation oscillates between the hangingwalls of two decollements in the case of weaker material enclosed, while stronger material appears to be less controlled by the decollements. In none of these experiments, however, were we able to observe the formation of classical triangle structures or of dominant backthrusting at the deformation front. We speculate that the additional role of erosional and sedimentary material redistribution at the surface during thrust evolution and propagation – planned for the future – needs to be included to trigger a corresponding change in style.