Geophysical Research Abstracts
Vol. 17, EGU2015-10808, 2015
EGU General Assembly 2015

Inherited basin inversion: thermo-mechanical modeling and comparison with the western External Alps.

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Basement involved shortening in the external zones of orogen is a common structural style and most of the time deformation patterns are controlled by reactivation/inversion of inherited structures, as continental collision commonly involves stretched and thinned continental margins. If inversion of inherited basins and reactivation of normal faults were documented in several fold-and-thrust-belts, it is not the case in more internal domains. We are here interested in the case where the crust experiences significant tectonic burial (down to greenschist facies) before its shortening.

Here, we present thermo-mechanical models in order to investigate the relative influence of fault friction and tectonic burial depth on reactivation patterns in inherited syn-rift basins during shortening. The results of the parametric modeling study show that, for only 2 km of tectonic burial, the presence of weak basins on its own is sufficient to localize the strain by increasing the rate of growth of the crustal scale folds. Even for relatively small friction angle within the inherited faults, i.e. 10°, those are only partially reactivated in presence of weak basin when burial is small (2 km). From moderate (4 km) to large tectonic burial (8 km), fault reactivation is inhibited. Normal faults become strongly deformed and nearly vertical and lock after only few percent shortening. From low burial to high burial, the normal faults tend to be less reactivated, the basement tend to be more folded and the cover dysharmonically folded.

We compare these results to the external Western Alps from the Valence basin to the Penninic frontal thrust (at the latitude of Bourg d'Oisans). We show that External Crystalline Massifs basement and cover geometries can indeed be explained by shortening under a 10 km tectonic burial. In such conditions, the normal faults are not reactivated, the basement presents distributed shear zones, and no cover décollement. Further West, where no tectonic burial occurred, reactivation of normal faults is a common process.