Geophysical Research Abstracts
Vol. 14, EGU2012-10997, 2012
EGU General Assembly 2012

Stress and strain evolution in foreland basins and its relation to the structural style : insights from the Bighorn Basin (Wyoming, USA)

N. Beaudoin (1,2), R. Leprêtre (1,2,3), N. Bellahsen (1,2), O. Lacombe (1,2), K. Amrouch (1,2,3), J.-P. Callot (4), L. Emmanuel (1,2), and J.-M. Daniel (3)

(1) UPMC, ISTeP, France (nicolas.beaudoin@upmc.fr), (2) CNRS, UMR 7193, ISTEP, F-75005, Paris, France, (3) Geology Geochemistry Geophysics Direction, IFP Energies Nouvelles, Rueil-Malmaison, France., (4) UMR CNRS TOTAL 5150 "Laboratoire des Fluides Complexes et leurs Réservoirs", Université de Pau et des Pays de l'Adour, I.P.R.A. Avenue de l'Université BP 1155, 64013 PAU Cedex

The Rocky Mountains in western US provide amongst the best examples of thick-skinned tectonics: following the thin-skinned Sevier orogeny, the subsequent compressional reactivation of basement faults gave birth to the so-called Laramide uplifts/arches. The Bighorn basin, located in Wyoming, is therefore a key place to study the stress evolution during the transition from thin- to thick-skinned tectonics in orogenic forelands in terms of structural, microstructural and stress/strain evolution.

We report the results of the analyses of fracture populations, inversion of fault-slip data and calcite twin data for stress as well as of calcite twinning paleopiezometry performed in two famous Laramide basement-cored structures located on each side of the basin: the Rattlesnake Mountain Anticline (RMA) and the Sheep Mountain Anticline (SMA). The comparison between the stress evolution in both folds allows to unravel (i) the pattern of both paleostress orientations and magnitudes and their evolution in time and space and (ii) the tectonic history at the basin scale. Structural and microstructural analyses show that both folds share similar kinematics. Most of the fractures are related to three main events: the Sevier thin-skinned contraction, the Laramide thick-skinned contraction, and the Basin and Range extension. During the thin-skinned period, in the innermost part of the foreland, the stress regime evolved from strike-slip to reverse while it remained strike-slip in the outermost part of the basin. Moreover, some fracture sets related to layer-parallel shortening during the early Sevier contraction formed only close to the Sevier deformation front and remained poorly expressed further away. Stress attenuation toward the craton interior is thus clearly shown by the dataset and illustrates the prominent role of the distance to the front of deformation in the way fracture sets developed in orogenic forelands. Alternatively, during the thick-skinned period, the evolution of stress trends and magnitudes is quite similar throughout the whole basin. In such context, differential stress magnitudes seem to be primarily controlled by the structure and the kinematics of the basement-cored anticlines themselves. This in turn suggests that basement faults were active since the very beginning of the Laramide shortening phase. In contrast to previous studies, our work thus supports the influence of the tectonic style on the evolution of stress magnitudes in orogenic forelands.