MECHANISMS OF EXTREME LITHOSPHERIC THINNING IN THE ALPINE TETHYS RIFTED MARGINS: INSIGHTS FROM FIELD OBSERVATIONS AND NUMERICAL MODELING

MOHN, Geoffroy* (1); PETRI, Benoit (2); DURETZ, Thibault (3); SCHMALHOLZ, Stefan (3); MANATSCHAL, Gianreto (2)

1: Géoscience Environnement Cergy, Université Cergy-Pontoise, F-95 000 Cergy, France; 2: Institut de Physique du Globe de Strasbourg; CNRS-UMR 7516, Université de Strasbourg, 1 rue Blessig, F-67084; 3: Institute of Earth Sciences, University of Lausanne, Géopolis, CH-1015 Lausanne

Geoffroy.Mohn@u-cergy.fr

Rifting, Hyper-extended domain, Austroalpine nappe

The mechanisms of extreme lithospheric thinning leading to the formation of severely thinned continental crust (< 10km thick) documented in present-day passive margins remain a major question. The remnants of the Jurassic Alpine Tethys rifted margins in the Alps represent a critical place where the different levels of the pre-rift lithosphere, from the upper crust through the lower crustal level and eventually the lithospheric mantle, can be reached and studied.

This contribution aims to explore how the crust thins, which structures can accommodate the extreme crustal thinning observed and eventually how far the initial architecture of the lithosphere may control subsequent rifting development.

The Austroalpine and South Penninic nappes in SE-Switzerland and N-Italy, were only weakly affected by Alpine deformation. This situation enables us to: 1) characterize the initial pre-rift architecture of the lithosphere and 2) investigate the subsequent rift-related deformation in distinct portions of the continental lithosphere. This field-based study is combined with two-dimensional thermo-mechanical models of the lithospheric thinning addressing the importance of the initial pre-rift mechanical heterogeneities.

Our results show that the initial Permian post-orogenic event significantly modified the continental lithosphere creating an “inheritance” that had a first-order importance on the following Jurassic rifting. The control of inheritance is well shown by the complex interaction of large-offset normal faults associated with the development of anastomosing shear zones and decoupling horizons in a composite crust strongly modified by the Permian post-orogenic event. We propose that the complex, inherited crustal structure controls localization of major decoupling levels responsible for the lateral extrusion of mid-crustal layers in the necking zone and juxtaposition of “brittle” strong levels originating from the upper and lower crust in the hyper-extended domain.

Altogether these results will enable us to propose a new model for the formation of the hyper-extended rifted margins and to discuss its implications for the evolution of the Alpine Tethys margins.