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Preliminary results of analog modeling to test the reactivation of transfer systems: the case of the Santander Transfer System (Bay of Biscay - Pyrenean realm)

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The architecture of transfer zones separating segmented fault systems are mainly controlled by extensional/contractional rates, changes in stress direction, lateral variations in rheology and inheritance. Transfer systems can develop in extensional settings as well as in contractional or inverted systems (e.g. Bay of Biscay – Pyrenean system) and in both oceanic and continental domains. However, few studies have addressed the rift segmentation (transfer zones) and its role during the inversion leading to structural variability during the development of mountain belts.

The Bay of Biscay – Pyrenean system corresponds to a Mesozoic hyperextended rift system that was subsequently reactivated during Late Cretaceous to Cenozoic time leading to the formation of the Pyrenean orogen along the Iberian-European plate boundary. The structure of former rift domains and its role during subsequent compressional reactivation has been extensively studied over the past years. Nevertheless, the investigations concerning the segmentation of the Bay of Biscay – Pyrenean system (e.g. Santander Transfer System and Pamplona fault) are still in an embryonic stage of knowledge despite the important amount of available data. Thus, the Pyrenees are a perfect natural laboratory to study such transfer zones.

At the scale of the Bay of Biscay – Pyrenean system, the Santander Transfer System represents a key area to unravel the evolution and the linkage between the former Bay of Biscay and the Pyrenean hyperextended rift systems. To the east, the Basque-Cantabrian Basin is interpreted as an inverted salt-detached ramp-syncline basin filled by up to 12 km of sediments from Jurassic to Paleogene and to the west the Asturian Basin is interpreted as a E – W mildly inverted asymmetric rift basin bounded by a major fault to the south and filled by up to 10 km of sediments from Triassic to Quaternary. In between, the previously called "Santander Soft Transfer Zone" connects both the Bay of Biscay and Pyrenean systems but its structure and evolution remains unclear and non-well-defined. In our study, we use an experimental approach (sandbox models) to model the Santander Transfer System with the aim to determine the role of (I) the inherited basement structures, (II) the presence of an effectively pre-rift decoupling level, and (III) the implications of the lateral termination of this decoupling level during extension and reactivation of the transfer system. Our results emphasize that the Triassic extensional fault system as well as the distribution of the Upper Triassic evaporites played a major role during the segmentation of the Late Jurassic-Early Cretaceous rift system as well as during the subsequent inversion. This study is developed as part of the OROGEN project and uses the GEOMODELS Analog Modelling Laboratory.

Keywords: Santander Transfer System, Bay of Biscay, Pyrenees, segmentation, rift-inheritance, analog models