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Linking tectonics and sedimentation along hyper-extended magma-poor rifted margins: a joint industry-academic point of view

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Mature magma-poor rifts and rifted margins are commonly understood as resulting from polyphase rifting. Avoiding semantic discussions, their evolution can be simplified as a possible succession of two maturation phases preceding seafloor spreading: an “early rifting phase” and a “hyper-extension rifting phase”. Before stable seafloor spreading occurs, if it does, these phases are respectively separated from each other by the crustal necking and the lithospheric break-up transitions. The early rifting phase is recorded by the development of archetypal half-graben basins overlying domains of weakly thinned continental crust. These basins result from distributed extension of continental lithosphere corresponding to the McKenzie-type rifting model. Used as a background for conceptual models of rift sedimentation, McKenzie-type predictive basin models have been successfully used in industry domains.

The hyper-extension rifting phase is recorded outboard along and ocean-ward of crustal necking zones. In addition to the presence of half-graben basins, formed by supra-detachment structures are the common expression of this strain localized mode of extension above tapering and hyper-thinned continental crust until OCTs. In contrast to its early rifting counterpart, predictive generic syn-rift tectono-sedimentary models are still lacking for hyper-extended domains of rifts and margins. Nevertheless, the increasing amount of data in present-day and fossil margins provides an unique opportunity to develop and test new models by combining both academic and industry observations.

Based on observations along and ocean-ward of crustal necking zones (both fossil and active) and further supported by kinematic numerical modeling, this presentation aims to discuss the radical impact of hyper-extension on the way accommodation space forms and also for the dynamics of sedimentary sources. Like foreland basins in convergent settings, we show that understanding rift basin evolution in these domains requires integration of: 1) the implications of tectonic migration; 2) the importance of the evolving rheological profile while extending the lithosphere (mantle-decoupled to coupled; pre-tectonic decoupling salt layer…); 3) sedimentation rate; 4) feedbacks between sedimentation and tectonics.