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The Moho in extensional tectonic settings: insights from thermo-mechanical models

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We review consequences for the crustal and lithospheric configuration of different models for the thermo-mechanical evolution of continental lithosphere in extensional tectonic settings. The lithospheric memory is key for the interplay of lithospheric stresses and rheological structure of the extending lithosphere and for its later tectonic reactivation. Other important factors are the temporal and spatial migration of extension and the interplay of rifting and surface processes. The mode of extension and the duration of the rifting phase required to lead to continental break-up is to a large extent controlled by the interaction of the extending plate with slab dynamics. We compare predictions from numerical models with observational constraints from a number of rifted back-arc basin settings and intraplate domains at large distance from convergent plate boundaries. We discuss the record of vertical motions during and after rifting in the context of stretching models developed to quantify rifted basin formation. The finite strength of the lithosphere has an important effect on the formation of extensional basins. This applies both to the geometry of the basin shape as well as to the record of vertical motions during and after rifting. We demonstrate a strong connection between the bulk rheological properties of Europe's lithosphere and the evolution of some of Europe's main rifts and back-arc system. The thermomechanical structure of the lithosphere has a major impact on continental breakup and associated basin migration processes, with direct relationships between rift duration and extension velocities, thermal evolution, and the role of mantle plumes. Compressional reactivation has important consequences for post-rift inversion, borderland uplift, and denudation, as illustrated by polyphase deformation of extensional back-arc basins in the Black Sea and the Pannonian Basin.