Oblique extension favours pulses propagation during continental break-up

Anthony Jourdon*[1,2], Laetitia Le Pourhiet [2], Frédéric Mouthereau [1], Dave A. May [3]

1- Géosciences Environnement Toulouse, Université Paul Sabatier, CNRS
2- Institut des Sciences de la Terre de Paris, Sorbonne Université
3- University of Oxford, Departement of Earth Science

V-shaped oceanic propagators are widespread around the world. Their geometry combined with magnetic anomalies associated to their opening shows at first order that ridge propagation in the third dimension occurs by pulses. In this study we use 3D thermomechanical numerical models to show how oblique kinematic boundary conditions control both the intracontinental rift development and the oceanic ridge propagation. To do so, we apply a shortening velocity boundary condition in the direction perpendicular to the extension for “strong” and “weak” crustal rheologies. Numerical models results highlight that three ridge propagation modes can occur. For low out of plane velocities (12% to 15% of the extension rate), the ridge propagation is fast (>1.5 cm/yr) and straight. Higher shortening velocities (15% to 17%) lead to ridge propagation by pulses alternating between fast propagation (~1.5 cm/yr) and stalling phases. Finally, for higher velocities (17% to 20%) a ridge jump propagation mode occurs, localizing a new spreading centre between 100 and 200 km far from the initial ridge. We also show that ridge propagation phases are associated with dip-slip dominated deformation while stalling phases are dominated by strike-slip deformation. These deformation regimes are marked by structures reorientation while kinematic boundary conditions remain constant. We discuss these results in term of plate tectonics reconstructions and regional geological studies.

Mots-Clés : 3D numerical thermomechanical modelling, V-shaped oceanic propagators, ridge propagation, Oblique rifting, Plate tectonics

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