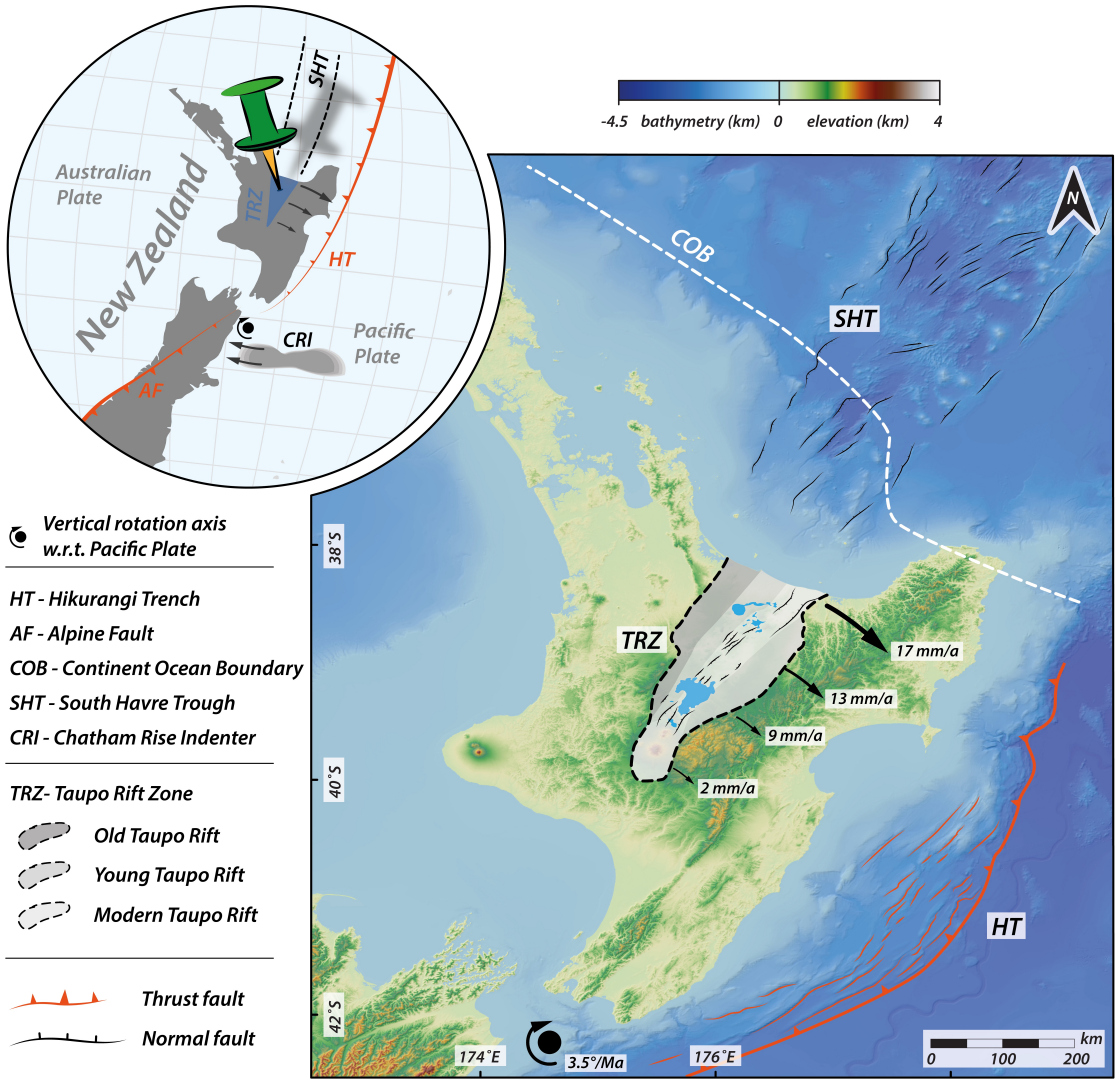
Fault growth and rift propagation during rotational continental rifting

Insights from an analogue modelling study

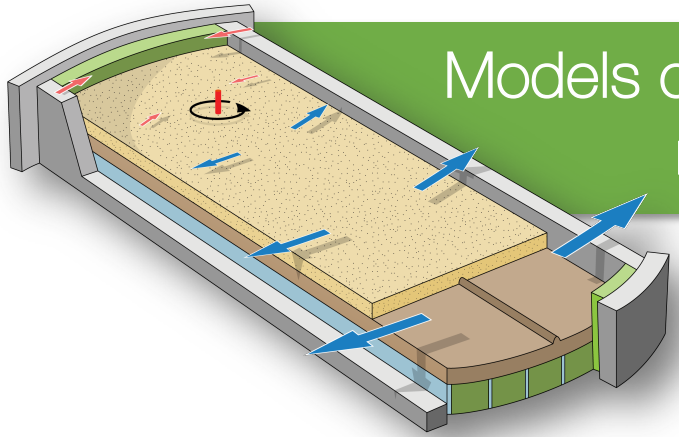
Timothy Schmid, Guido Schreurs, and Jürgen Adam

ROYAL HOLLOWAY UNIVERSITY OF LONDON

TS9.1 – EGU22-1970

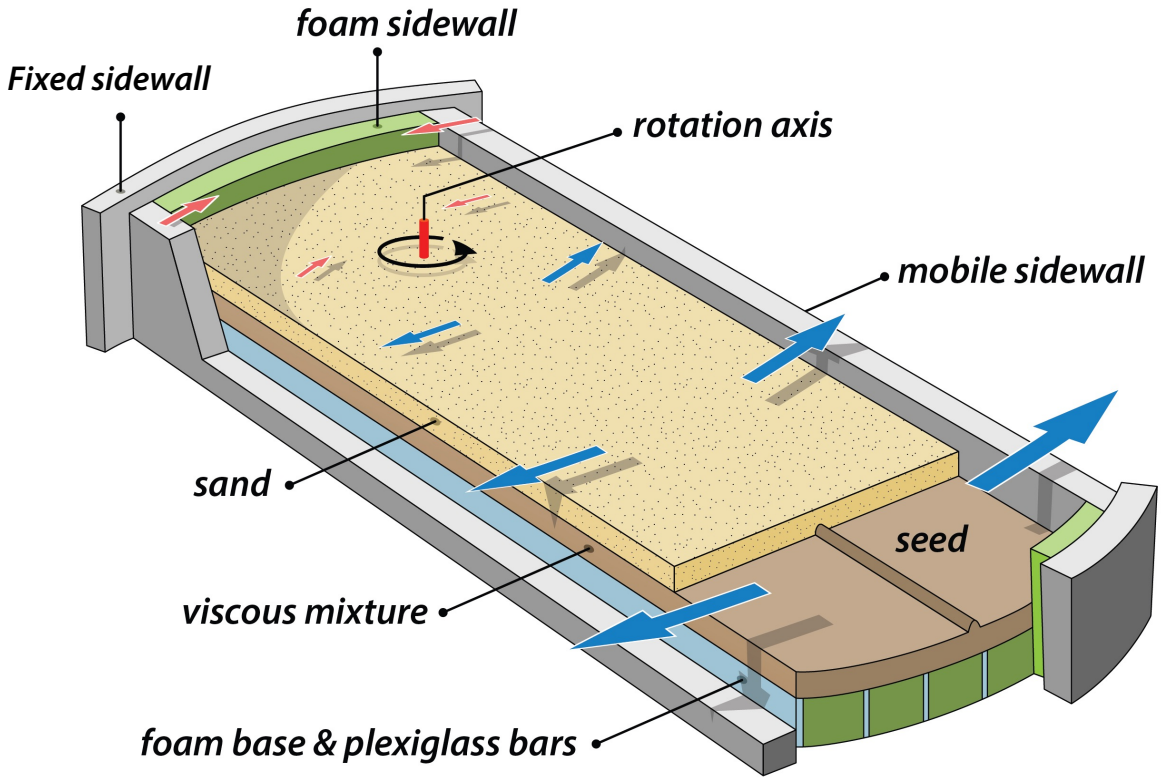


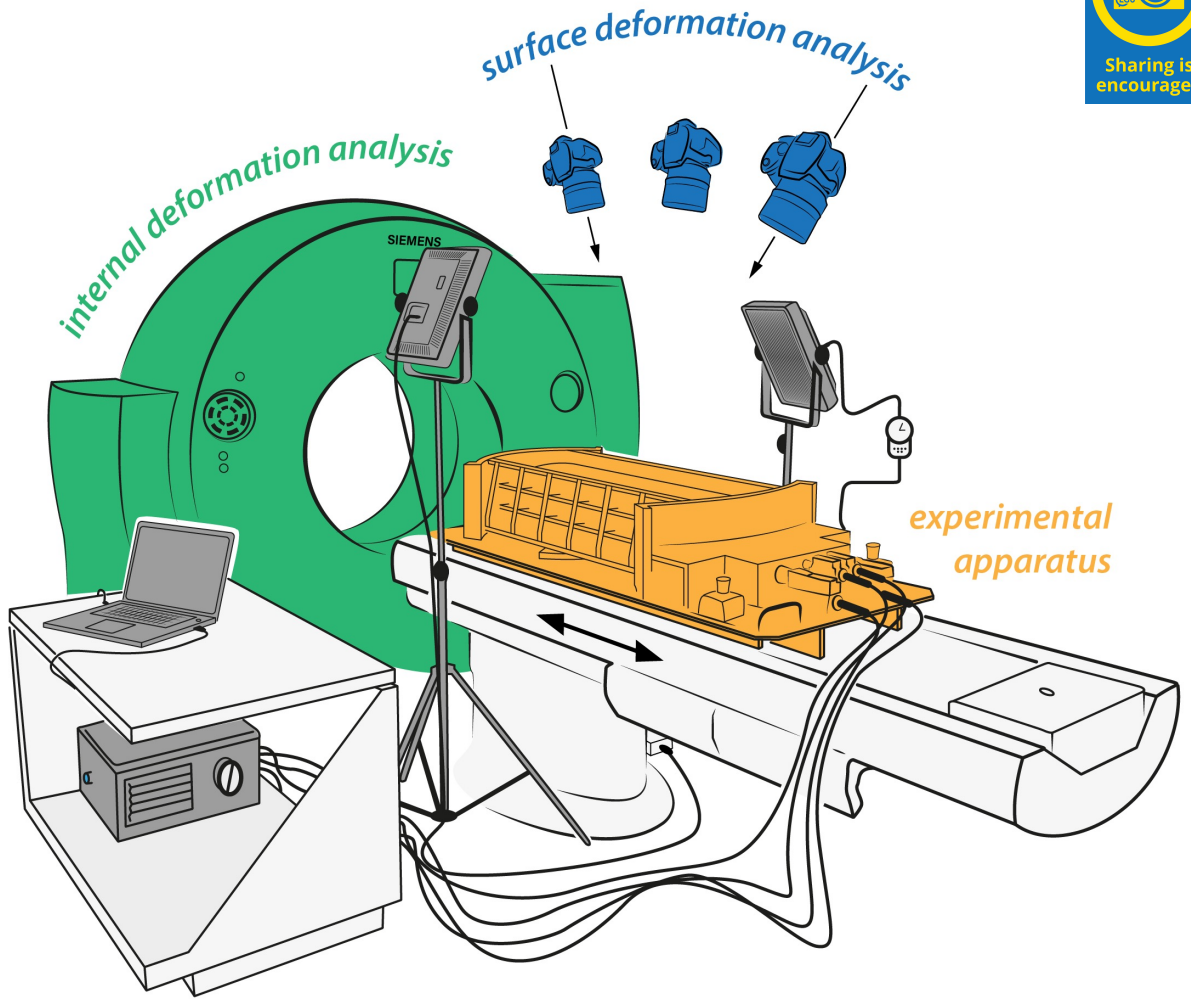
Fault growth and its contribution to rift propagation under rotational extension remains unclear and poorly resolved in nature!



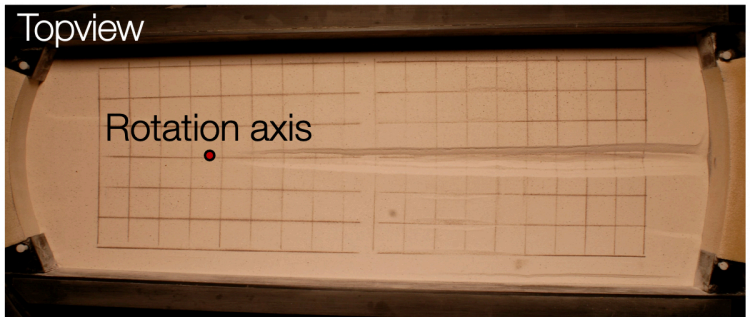
Models of rotational rifting help!

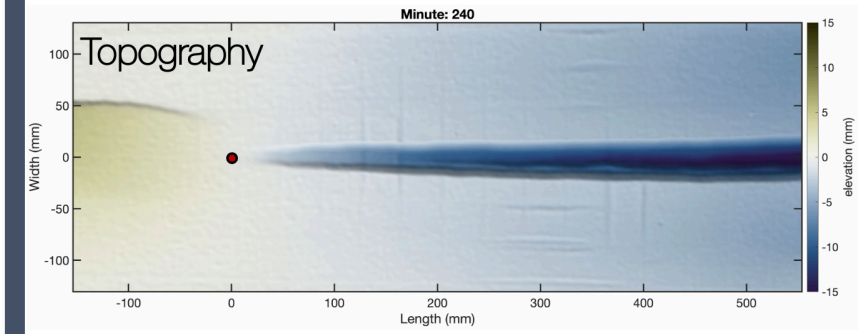
Setup and quantification

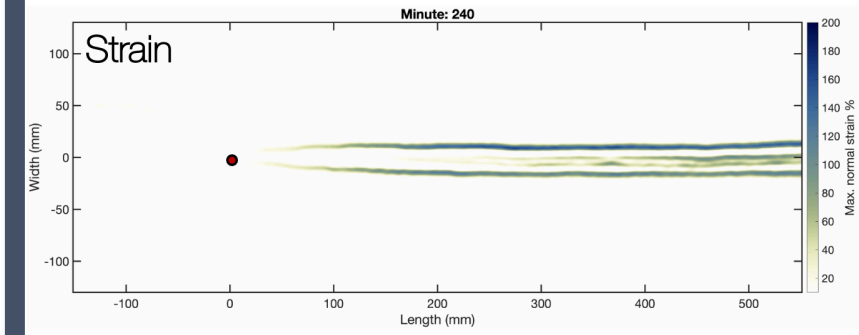


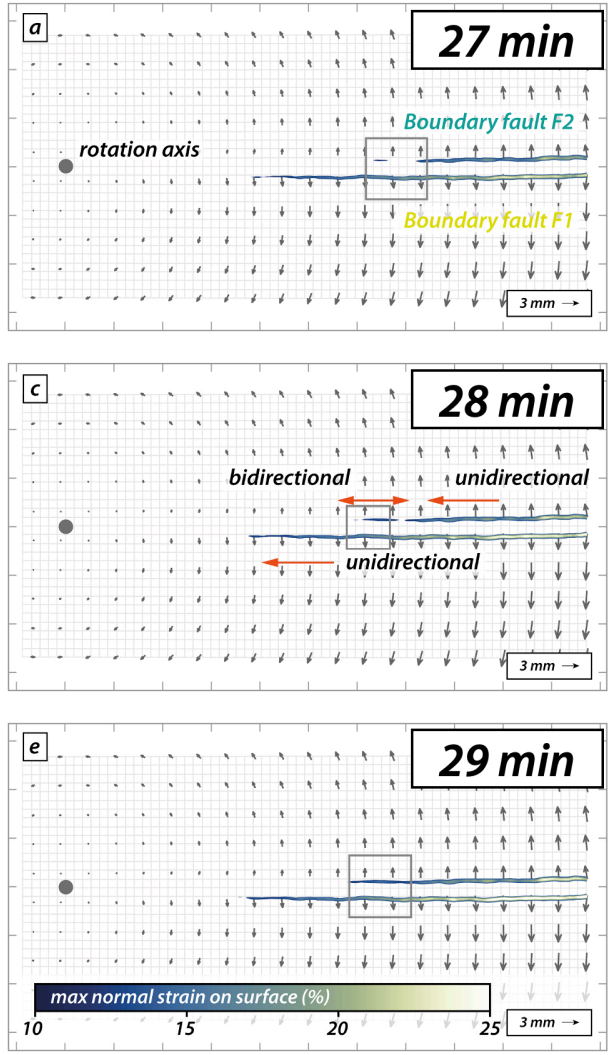


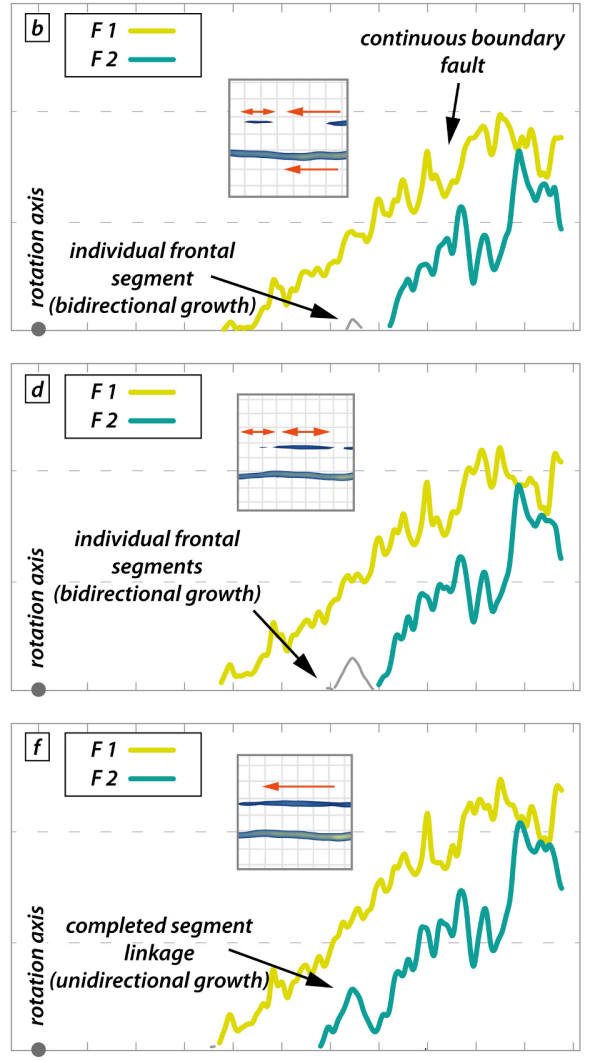
Fault growth and rift propagation





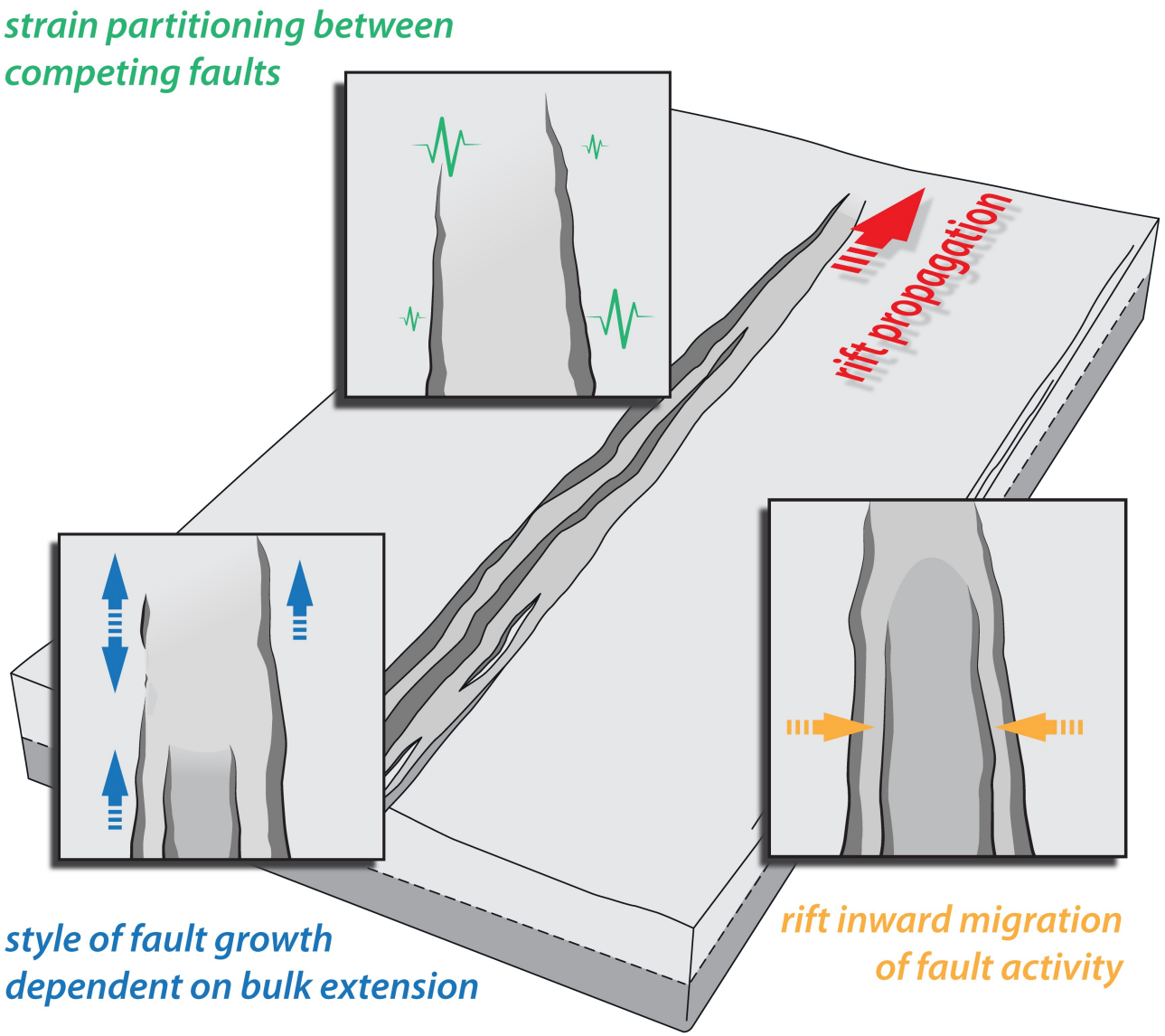






temporal evolution

Key mechanisms



More details

timothy.schmid@geo.unibe.ch

SCAN ME

Tectonophysics 822 (2022) 229174

Contents lists available at ScienceDirect

Tectonophysics

journal homepage: www.elsevier.com/locate/tecto

Characteristics of continental rifting in rotational systems: New findings from spatiotemporal high resolution quantified crustal scale analogue models

Timothy C. Schmid [a,*], Guido Schreurs [a], Jürgen Adam [b]

[a] *Institute of Geological Sciences, University of Bern, Baltzerstrasse 1+3, Bern CH-3012, Switzerland*
[b] *Earth Sciences Department, Royal Holloway University of London, Egham TW20 0EX, United Kingdom*

ARTICLE INFO

Keywords:
Analogue modelling
Rotational rifting
Continental rifting
Rift propagation
3D stereoscopic Digital Image Correlation

ABSTRACT

Continental rifts are the expression of regional horizontal stretching and are in modelling studies often assumed to be the result of orthogonal or oblique extension. However, naturally occurring V-shaped rift geometries infer an underlying rotational component, resulting in a divergence velocity gradient. Here we use such analogue models of rifting in rotational settings to investigate and quantify the effect of such a divergence velocity gradient on normal fault growth and rift propagation towards a rotation pole. Particularly, we apply different divergence velocities and use different brittle-ductile ratios to simulate different crustal configurations and analyse its effect on rift propagation and surface deformation. Surface deformation is captured using stereoscopic 3D Digital Image Correlation, which allows for quantifying topographic evolution and surface displacement including vertical displacement. In combination with X-Ray computed tomography, we gain insights into the three-dimensional structures in our two-layer models. Based on our models, we present a novel characterisation of normal fault growth under rotational extension which is described by 1) an early stage of bidirectional stepwise growth in length by fault linkage with pulses of high growth rates followed by a longer and continuous stage of unidirectional linear fault growth; 2) segmented rifting activity which promotes strain partitioning among competing conjugate faults and 3) along-strike segmented migration of active faulting from boundary faults inwards to intra-rift faults allowing different fault generations to be simultaneously active over the entire rift length. For models with higher divergence velocities, inward migration is delayed but other first-order observations are similar to models with lower divergence velocities. Our quantitative analysis provides insights on spatiotemporal fault growth and rift propagation in analogue models of rotational rifting. Although natural rifts present complex systems, our models may contribute to a better understanding of natural rift evolution with a rotational component.