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Geometry and Kinematics of the Lamu Basin Deep-Water Fold-and-Thrust Belt (East Africa)

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Even if most thin-skinned fold-and-thrust belt are generated at convergent plate boundaries, in the last decades advances in seismic exploration and acquisition of large datasets have shown that they are also notably widespread along continental passive margins, driven by gravity processes in deep-water areas. In this study a composite set of modern and vintage reprocessed seismic reflection profiles is used to investigate the internal structure and kinematic evolution of the Lamu Basin Deep-Water Fold-and-Trust Belt (DW-FTB). The Lamu Basin is an example of giant-scale, gravity driven compressional belt developed in Late Cretaceous-Early Tertiary along a still poorly explored sector of the East-African continental margin, at the Kenya-Somalia border. The compressional domain extends longitudinally for more than 450 km, is up to 180 km wide and shows remarkable structural complexity both along strike and along dip. The external part is dominated by ocean-verging imbricate thrusts, above a gently landward-dipping basal detachment. The internal part is characterised by almost symmetrical detachment folds and double verging structures, sustaining bowl-shaped syn-tectonic basins. Here the basal detachment surface is almost flat. The mean fold wavelength displays a progressive landward increase, from 2.5 km, at the toe of the belt, to about 10 km. This structural variability is thought to be related to the lateral variation of the section under shortening and particularly to the different thickness of the Early Cretaceous shaly unit involved in the deformations, increasing landward from about 400 m to more than 1 km.

Through the sequential restoration of regional cross-sections, we evaluated that the northern portion of the thrust belt experienced a shortening of almost 50 km (corresponding to 20%), with a shortening rate (during the Late Cretaceous-Paleocene main event) of about 3.5 mm/yr. Under many respects, the dimensions and internal structure of this thrust belt are comparable to that of analogue-scaled structures, developed at convergent plate boundaries, e.g. the foreland fold-and-trust belts. However, its kinematic evolution shows some peculiar characters: shortening seems largely synchronous across the whole thrust belt and the maximum shortening is achieved in its frontal part (toe thrust), diminishing landward.