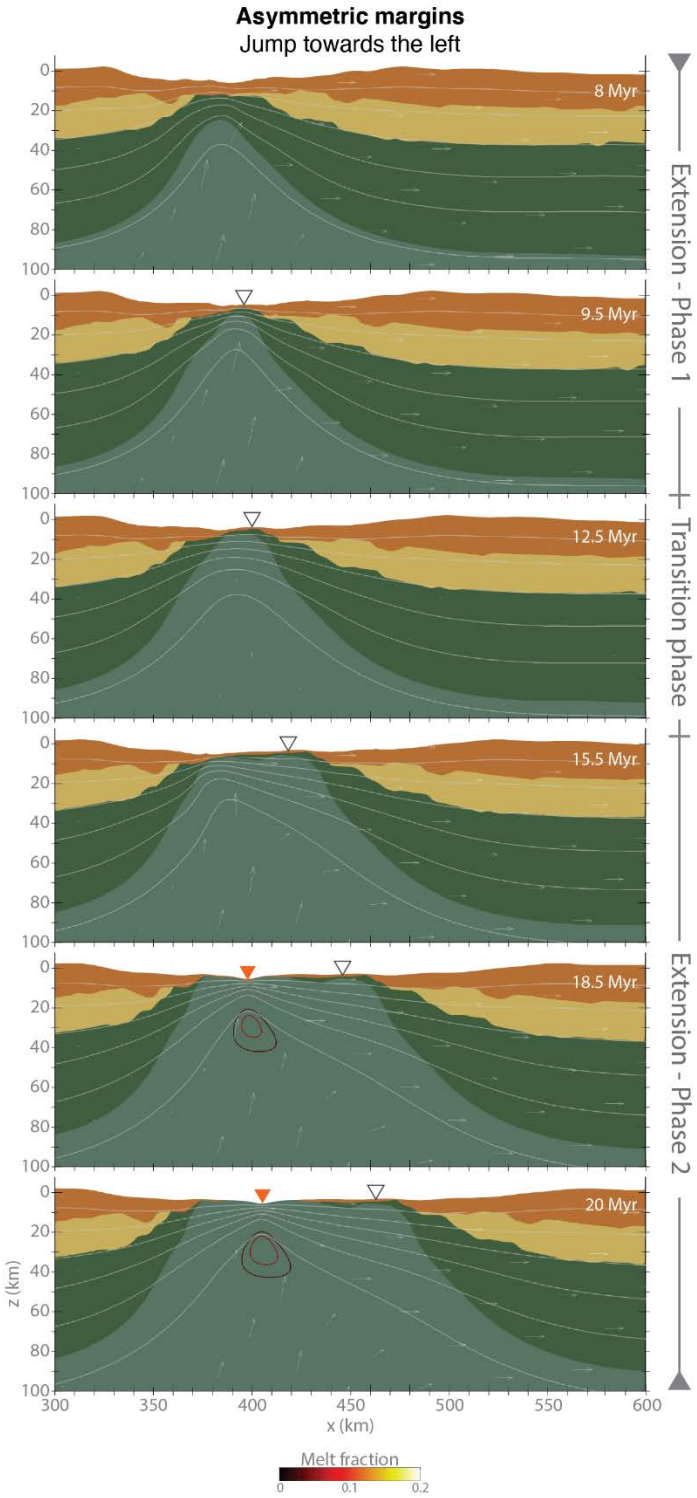

Figure S1. Continental fragment formation. Evolution of model with v_1=1 cm/yr, v_2=1 cm/yr, and t_1=10 Myr. Differently from the reference model of Fig.3, here, the jump happens to left of the first rifting location (or away from the trench). Therefore the longest margin is the one to the right of the basin. However, similarly to the reference model, the final structure of the basin is characterized by a hyperextended margin with a distal part made of exhumed mantle material, an abandoned rift, , and a new spreading ridge that produces new oceanic crust. Colours show the compositional fields (see Fig. 2 for legend). When melt is present, contours of melt fraction are shown. Isotherms are plotted every 200°C. Black triangles show the first rifting location, while orange triangle show the location of the spreading ridge during the second phase of extension.

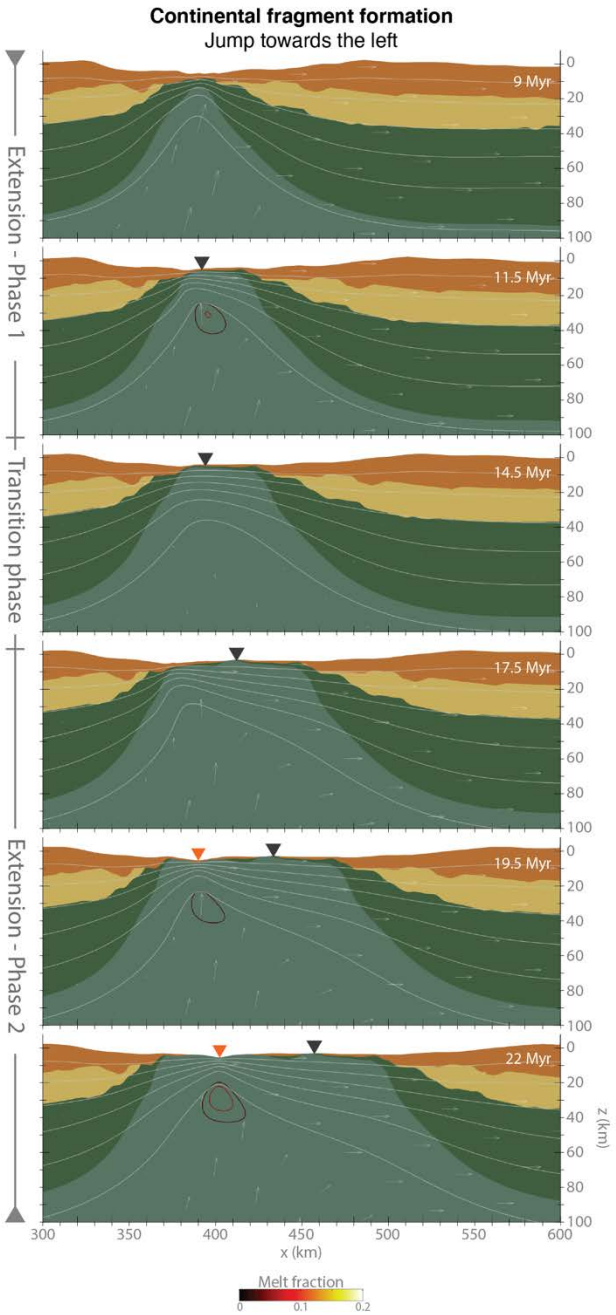

Figure S2. Continental fragment formation. Evolution of model with v_1=1 cm/yr, v_2=1 cm/yr, and t_1=12 Myr. Differently from the reference model of Fig.4, here, the jump happens to left of the first rifting location (or away from the trench). However, similarly to the reference model, the final structure of the basin is characterized by exhumed mantle material, an abandoned spreading ridge, a continental fragment of upper crust and lithospheric mantle, and a new spreading ridge that produces new oceanic crust. Colours show the compositional fields (see Fig. 2 for legend). When melt is present, contours of melt fraction are shown. Isotherms are plotted every 200°C. Black triangles show the location of the first spreading ridge, while orange triangle show the location of the spreading ridge during the second phase of extension.

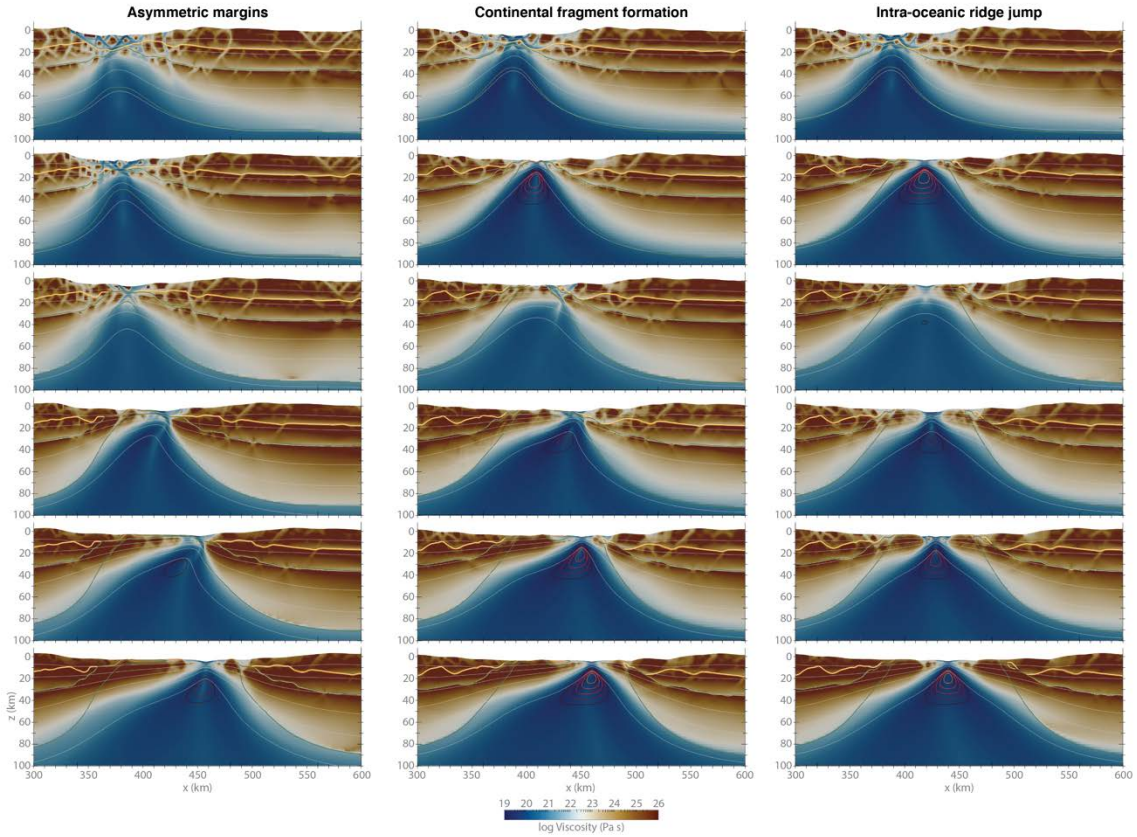

Figure S3. Effective Viscosity plots of the reference models for each scenario. Each panel represents the same time steps of the figures in main text: asymmetric margin (Fig. 3), continental fragment formation (Fig. 4), and Intra-oceanic ridge jump (Fig. 5). When melt is present, contours of melt fraction are shown. Isotherms are plotted every 200°C.