EGU21-12331
https://doi.org/10.5194/egusphere-egu21-12331
EGU General Assembly 2021

Escarpment retreat on a viscoelastic lithosphere

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Rift escarpments have long been the subject of coupled geodynamic/landscape evolution studies. Many of these studies have shown that the flexural unloading response of the lithosphere plays a significant role in the rate of divide migration and the longevity of the escarpment topography, with lower elastic thickness values allowing for more localized isostatic rebound of the lithosphere in response to erosional unloading. However, rift escarpments are thought to last hundreds of millions of years, and therefore the lithosphere may exhibit viscoelastic behavior on this timescale. Here we present a simplified model of a viscoelastic response to erosional unloading during escarpment evolution, and show that this drastically alters the behavior of the escarpment system. Specifically, the escarpment retreat rate is significantly reduced, and topography maintained, when compared to a purely flexural model. Additionally, the area in front of the retreating the scarp (i.e., seaward of the scarp) experience delayed uplift response and topographic rejuvenation many millions of years after the divide passes.