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Cenozoic thermal evolution of the Livingstone fault, North Basin, Malawi Rift: insights and implications for the morphotectonic evolution of the East African Rift.

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The East African Rift system (EARs), widely accepted as the analog for young continental rifts, provides an exceptional region in which to investigate ongoing extensional processes. The Malawi rift is located at the juncture of the western and eastern EARs rift branches, but does in fact represent the southern continuation of the western branch. Diverging views exist concerning the onset of extensional processes in the different rift segments of the EARs, and if there are spatiotemporal trends in rift evolution. Low-temperature thermochronometry, particularly apatite (U-Th)/He dating (AHe), is a powerful tool to investigate exhumational cooling along the footwall of major normal faults and is especially useful in assessing tectonic processes in low-strain environments. Here, we report 11 new apatite-helium (AHe) ages from the north basin of the Malawi Rift, the southernmost Cenozoic rift basin of the Western Branch, located at the southern margin of the Tanzanian Craton. We focus on documenting the low temperature (˜40-85°C) regional cooling history and identifying episodes of rapid cooling and exhumation. Our data compliment existing apatite fission-track (AFT) ages from the region (van der Beek et al., 1998). These new data provide, for the first time, a good constraint on the onset of rifting in the Malawi Rift, and furnish insights into the mechanisms and patterns of regional extensional processes. Our ages constrain the onset of rifting at ˜22 Ma, significantly earlier than previously believed (˜12

Ma) for the western rift. This early onset is potentially related to the emplacement of a mantle plume beneath the Tanzania Craton, and has important implications for the timing of rifting along the western branch of the rift. Furthermore, our new ages show that the rate of vertical exhumation has remained unchanged since the onset of rifting, such that climate variations do not appear to have had a significant influence on the rates of vertical exhumation in this portion of the East African Rift. Along-strike age variations in individual segments of the Livingstone Fault furnish new insights into the patterns of faulting and exhumation within the North Basin of the Malawi Rift and suggest that the presently observed fault segmentation is a long-lived phenomenon.