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0.1 Deciphering the development of two high elevation passive margins by using low temperature thermochronology

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High elevation passive margins are characterised by the presence of an escarpment, a first order topographical and geomorphological feature that runs parallel to coast and divide a lowland coastal plain from a low relief, high elevation plateau. The erosional nature and correlation with continental breakup of such escarpment are well established, but the timing of formation and modes of evolution are still poorly constrained. The unique sensitivity of apatite fission track (AFT) and (U-Th)/He (AHe) thermochronometers to temperatures between 120 and 40˚C make them ideal techniques to study the cooling history of rocks in geological settings, such as passive margins, where rates and total amount of denudation since rifting usually do not exceed a few kilometers.

Here we present AFT and AHe data to constrain continental rifting and escarpment development of the high elevation Eritrean and south-eastern Australian passive margins in relation to the timing of the rifting processes in the Red and Tasman Seas, respectively.

AFT and (U-Th)/He data have been determined from four coast perpendicular traverses. Along both margins the aHe and AFT ages at the present coast broadly correspond to the time of sea-floor spreading (around 5 Ma in the Red Sea and around 85 Ma in the Tasman Sea) and they increase approaching the foot of the escarpments. On the plateau, He and fission track ages are much older than breakup time and the track length distributions indicate that denudation has been slow and constant since at least mid-Mesozoic times.

The combination of AFT ages, track length distributions and He ages indicates that both margins were rapidly eroded by in-situ excavation of a pre-existing plateau rather than parallel escarpment retreat. A comparison of the measured He ages from the coastal plain with He ages predicted by a forward model indicates that the main phase of denudation in the Eritrean margin started at around 15 Ma, closer to the initiation of seafloor spreading in the Red Sea than previously thought. In the south-eastern Australian case, the forward modelling suggests that denudation was enhanced at 120 Ma, some 35 Myr before sea-floor spreading, in agreement with the hypothesis that magma-poor margins evolve more slowly than magmatic ones.

The comparison of the Eritrean and eastern Australian margins indicate that they evolved in much the same way, despite differences in climate, lithology and modes of rifting. This study suggests that the primary control on syn-rift denudation is exherted by the topography, but the timing at which such denudation occurrs is predominantly influenced by the style of rifting.