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Episodic burial and exhumation of the southern margin of Africa before and after breakup

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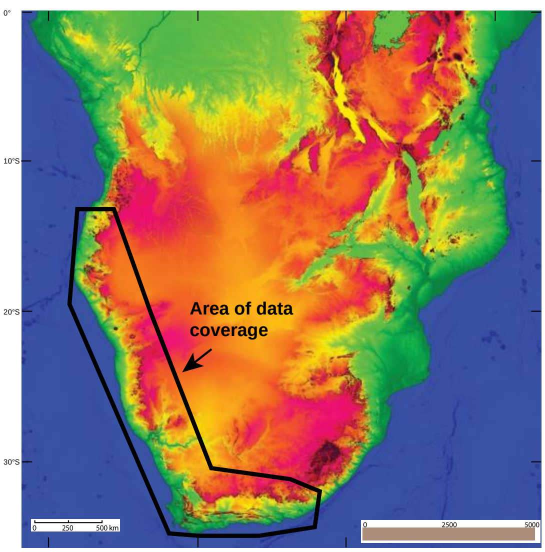
Apatite fission track analysis (AFTA) data from southern Africa, spanning a region from the Namibe margin of Angola [1], through Namibia [2] to the Cape and eastwards to the Algoa and Gamtoos Basins in the southeast [3], reveal a number of regional cooling episodes through the Phanerozoic which display a broad synchronicity across this wide region. Major cooling episodes began in the Late Carboniferous (between 320 and 285 Ma), Early Jurassic (195-180 Ma), Early Cretaceous (145-130 Ma), mid-Cretaceous (120-100 Ma), Late Cretaceous (85-75 Ma) and Late Cenozoic (30-20 Ma). The effects of most of these episodes are identified across the entire study region, although some episodes dominate in particular areas and in many areas the effects of earlier episodes may be overprinted by more recent events.



Available evidence suggests that these cooling episodes dominantly reflect exhumation (i.e. uplift and erosion). Evidence of Late Cretaceous cooling in sandstones of Late Jurassic to Early Cretaceous age in Namibia (Twyfelfontein Formation) and the Cape region of South Africa (Uitenhage Group) and underlying basement rocks requires that these units were buried by km-scale thicknesses of cover after deposition of the sedimentary (and volcanic in Namibia) successions and prior to Late Cretaceous exhumation. While the mid-Cretaceous burial revealed by these results can only be demonstrated with confidence where Late Jurassic to Early Cretaceous deposits are preserved, the ubiquitous nature of the evidence suggests that this burial may have affected much, if not the entire, region.

Figure 1: Southern Africa topography, showing the area from which data are discussed.

These observations indicate that the margins of southern Africa subsided and were buried following Early Cretaceous breakup. This in turn shows that the elevated topography of southern Africa was not produced as a result of continental rifting and separation but is much younger. Late Cretaceous paleotemperatures of ~100°C in rocks now at outcrop around the Great Escarpment suggest that this feature was buried by perhaps 3 km of section or more when Late Cretaceous exhumation began. Thus, conventional models of continental margin development, involving denudation of a margin that was already elevated at breakup, coupled with progressive backwearing of the escarpment, are not realistic. These results, combined with similar observations at other margins, require new models of passive margin development which take full account of the constraints provided by thermochronological data.

References:

[1] Green and Machado (2015) Geological Society Special Publication 438.

[2] Green et al. (2009) PESGB/HGS Africa Meeting 2009 (London), extended abstract

[3] Green et al (2016) Basin Research in press.