

The origin of elevated plateaus along passive continental margins



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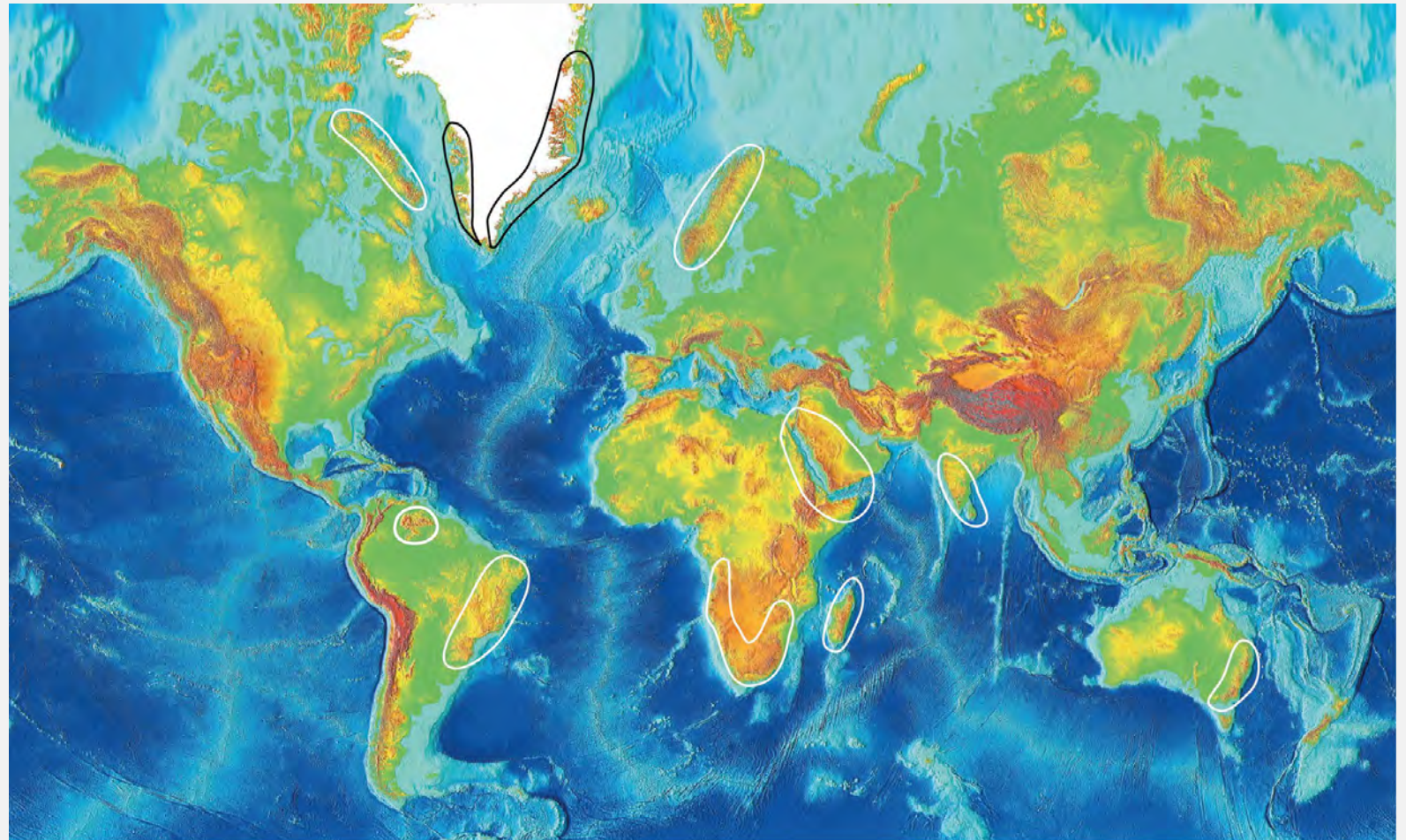
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Elevated passive continental margins (EPCMs)

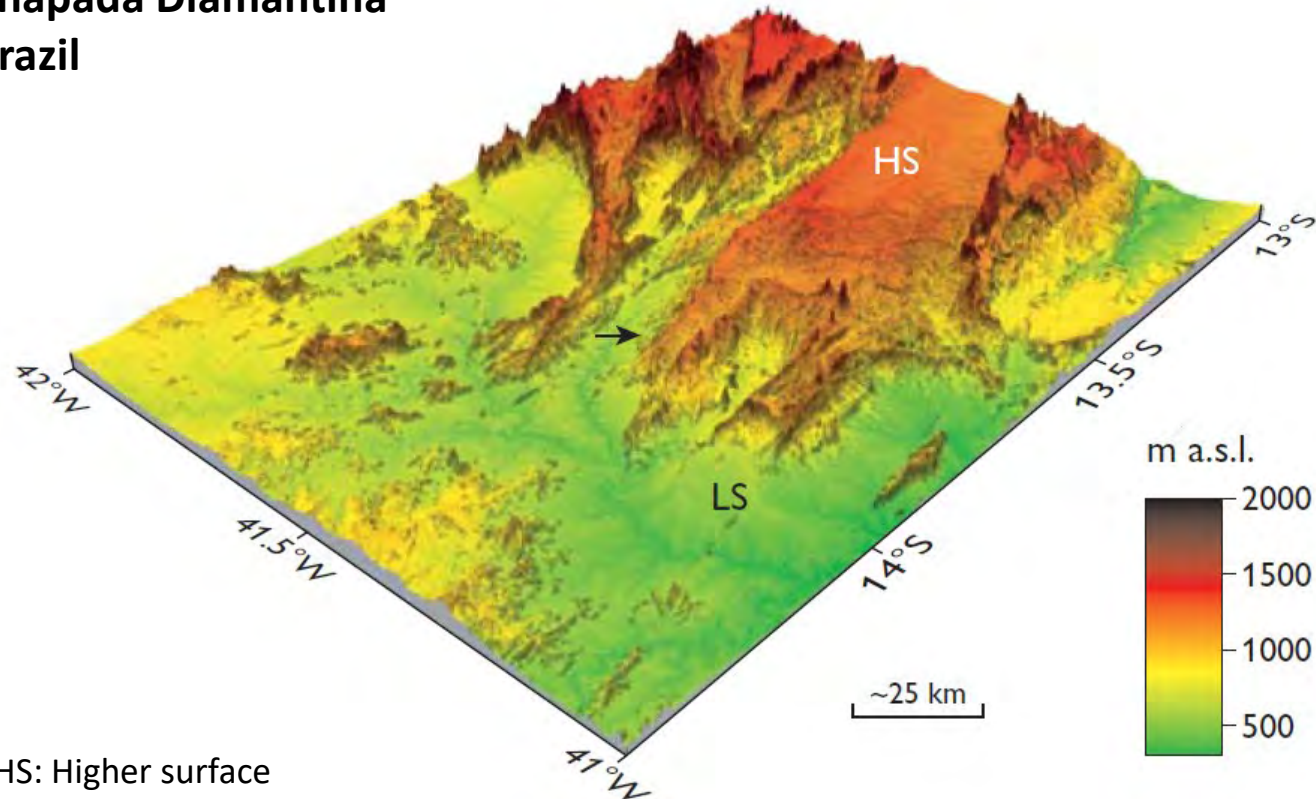


OO Elevated, passive continental margins



Elevated plateaus, deeply insised valleys and escarpments are characteristic features of EPCMs

**Chapada Diamantina
Brazil**

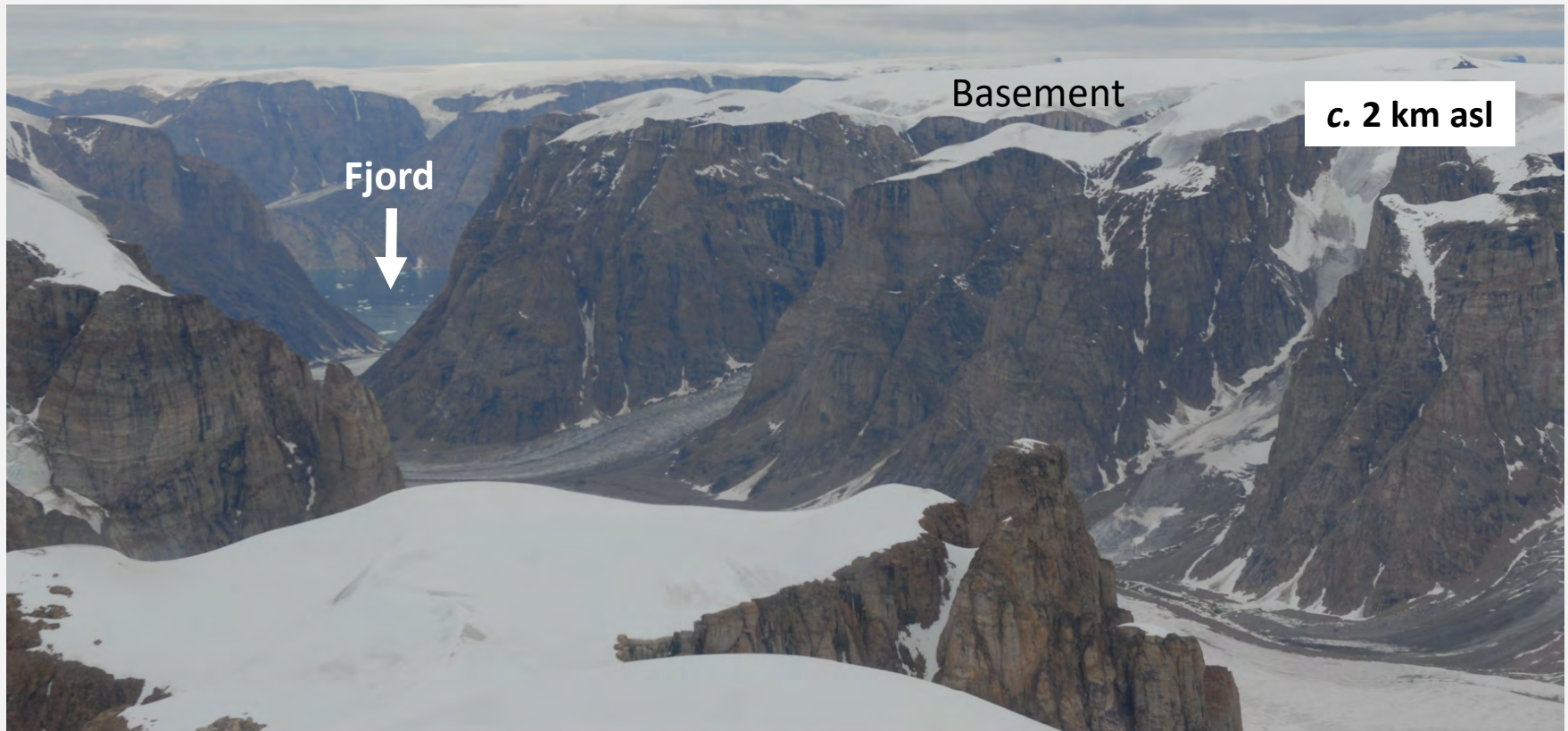


HS: Higher surface
LS: Lower surface

Milne Land, East Greenland



Plateau cut across basement



Disko, West Greenland



Plateau cut across Palaeogene basalt



ES – weathering front, UPS – Upper planation surface

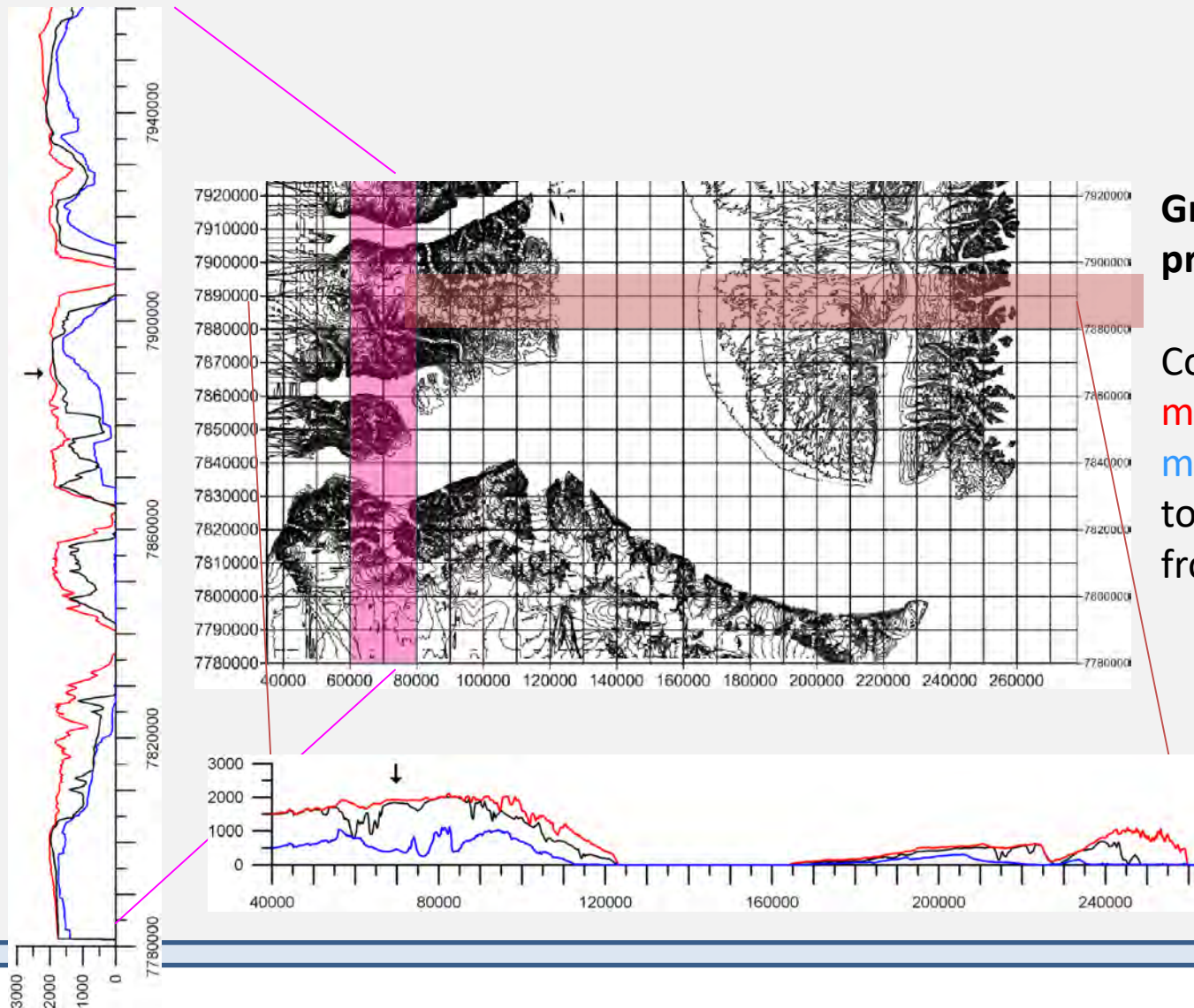
Japsen et al. 2006; Green et al. 2019

Oribi Gorge, South Africa

Plateau and a deeply incised valley



Identification of plateaus as remnants of peneplains



Grid of topographical profiles (black lines)

Corridor profiles of **maximum (red)** and **minimum (blue)** topography within 20 km from the profile line



Penplain definition

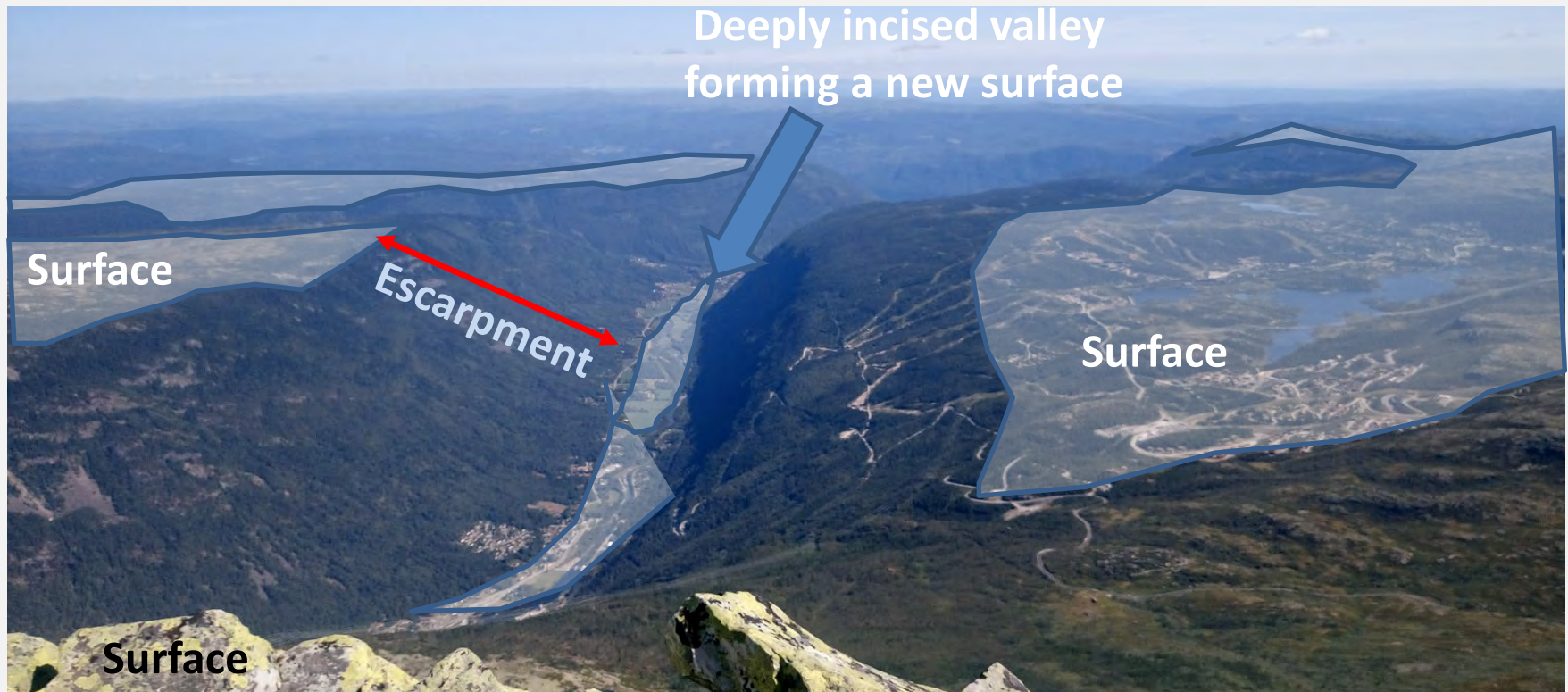
- Peneplains are extensive erosion surfaces that are governed by a former base-level, cross-cutting different geology
- In the long-term development of landscapes, the base-level is dominant relative to other controls



Landscape in steps, Beaufort West, South Africa

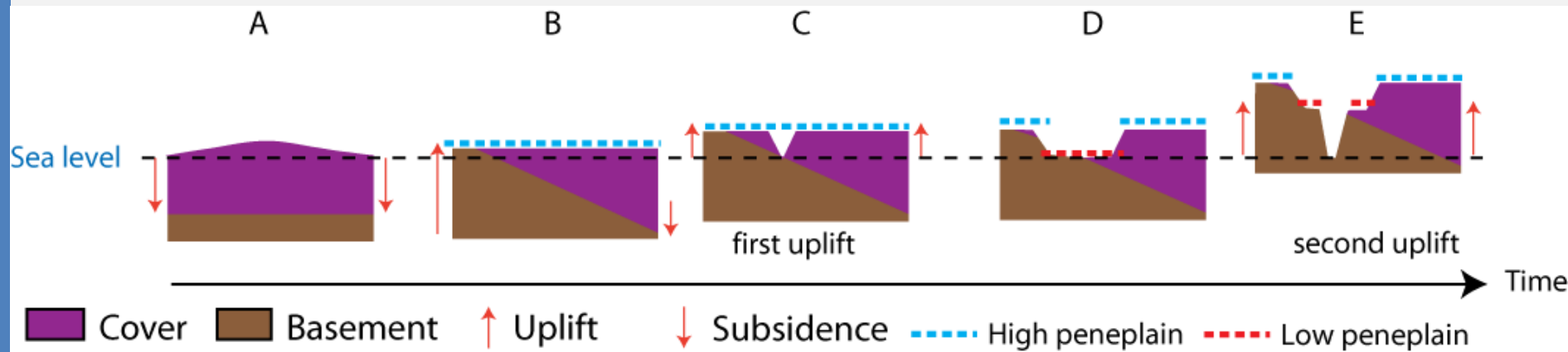


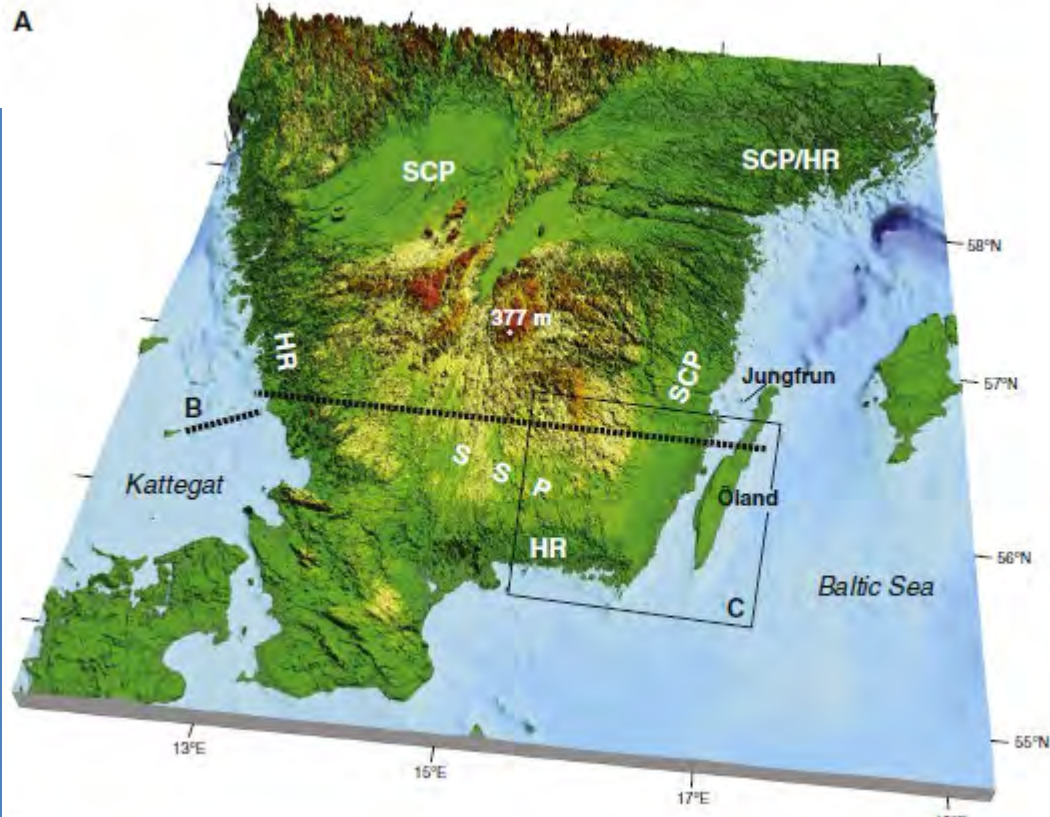
Landscape in steps, southern Norway



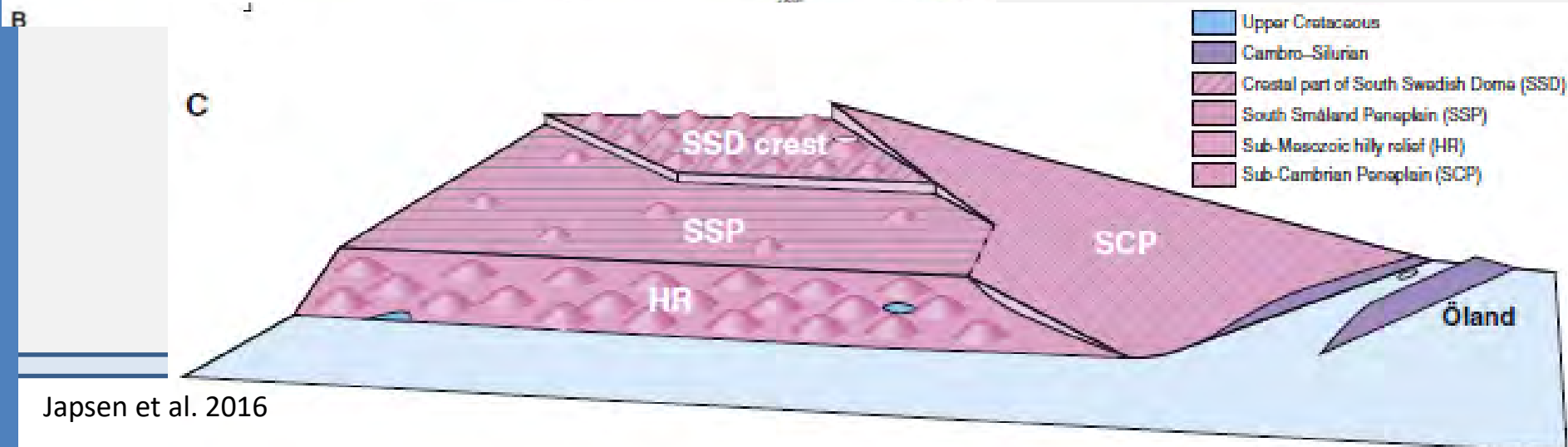
View from Gausta towards the east

How to form steps in the landscape

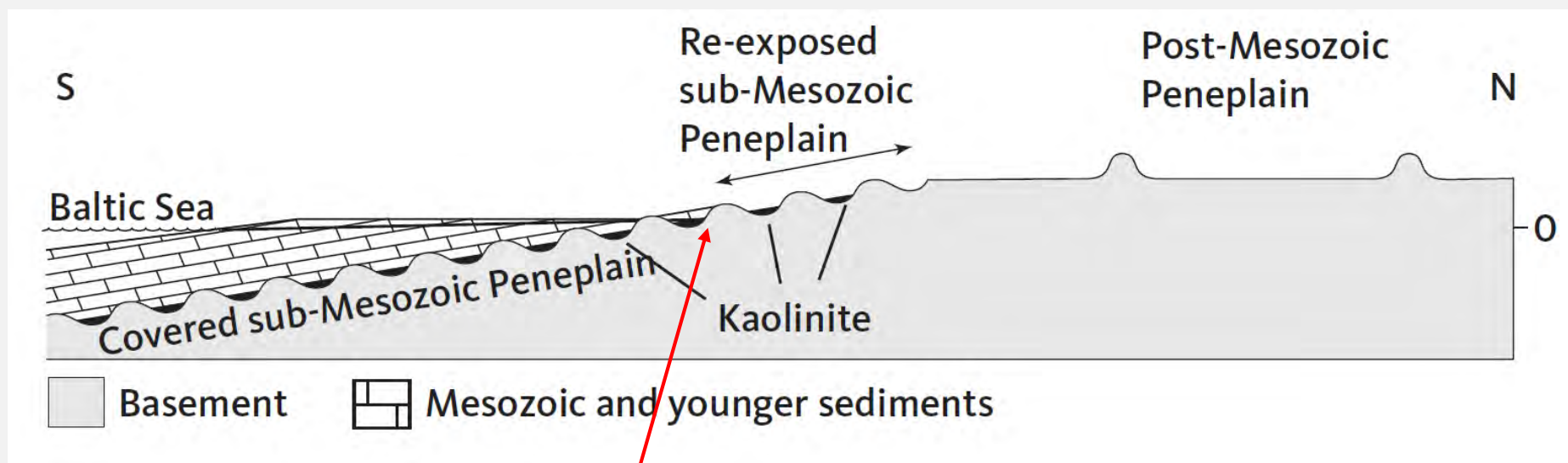




Erosion surfaces related to cover rocks, southern Sweden



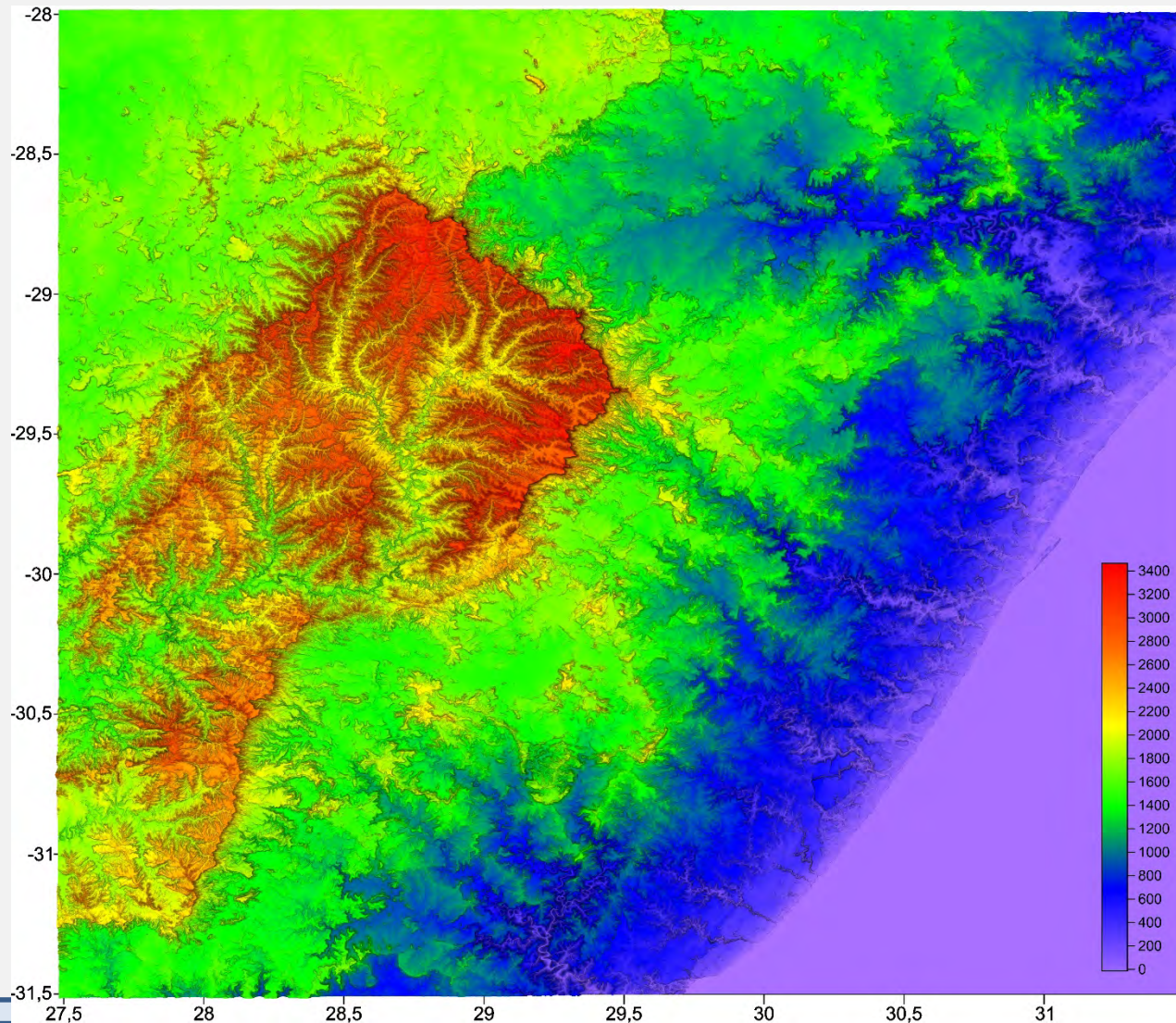
Relative age of peneplains from cross-cutting relationships, southern Sweden



Mesozoic peneplain preserved below cover rocks



Stepped plateau surfaces, deeply insised valleys and escarpments



Drakensberg,
South Africa



Take-home message:

Peneplains are independent time markers for tectonic events and should be regarded as onshore unconformities, reflecting former base-levels for erosion

Abstract

Many passive continental margins around the world are characterised by elevated plateaus at 1 to 2 km or more above sea level cut by deeply incised valleys and commonly separated from an adjacent coastal plain by one or more escarpments. Mesozoic–Cenozoic rift systems parallel to the coast are commonly present offshore with a transition from continental to oceanic crust further offshore. These landscapes occur in arctic, temperate and tropical climate and in different geological settings independent of the time span since break-up (e.g. along the Atlantic from south to north).

The plateaux are typically more than 100 km wide, much larger in some cases, and extend hundreds of kilometres along the margin, cutting across bedrock of different ages and resistances. The key to understanding the formation of regional, low-relief erosion surfaces is the base-level, as this is the level to which fluvial systems grade the landscape. The most likely base level is sea level, particularly for locations along continental margins during the post-rift development of passive margins.

It is commonly assumed that the characteristic, large-scale morphology of elevated, passive continental margins with high-level plateaux and deeply incised valleys persisted since rifting and crustal separation. Further, it is assumed that the absence of post-rift sediments is evidence of non-deposition, despite continental-stretching theory predicting deposition of a thick post-rift sequence overlying both the rift and its margins.

However, our studies of the passive continental margins of West and East Greenland, Norway, NE Brazil and southern Africa provide evidence of km-scale, post-rift subsidence and that the plateau surfaces were graded to sea level long after break-up and subsequently lifted to their present elevations. In some of these cases, the presence of post-rift marine sediments at high elevation provide direct proof of this interpretation. Since elevated plateaux cut by deeply incised valleys are a characteristic feature of these and other margins, this similarity suggests that such topography elsewhere in the world may also be unrelated to the processes of rifting and continental separation. We present a wide range of evidence from passive margins around the world in support of this hypothesis,

Bonow et al. 2014: High-level landscapes along the margin of East Greenland – a record of tectonic uplift and incision after breakup in the NE Atlantic. *Global and Planetary Change*.

Green et al. 2018: Post-breakup burial and exhumation of passive continental margins: Seven propositions to inform geodynamic models. *Gondwana Research*.

Japsen et al. 2019: Elevated passive continental margins: Numerical modeling vs observations. A comment on Braun (2018). *Gondwana Research*.

