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Uplift along passive continental margins, changes in plate motion and mantle convection

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The origin of the forces that produce elevated, passive continental margins (EPCMs) is a hot topic in geoscience. It is, however, a new aspect in the debate that episodes of uplift coincide with changes in plate motion. This has been revealed, primarily, by studies of the burial, uplift and exhumation history of EPCMs based on integration on stratigraphic landscape analysis, low-temperature thermochronology and evidence from the geological record (Green et al., 2013).

In the Campanian, Eocene and Miocene, uplift and erosion affected the margins of Brazil and Africa (Japsen et al., 2012b). The uplift phases in Brazil coincided with main phases of Andean orogeny which were periods of relatively rapid convergence at the Andean margin of South America (Cobbold et al., 2001). Because Campanian uplift in Brazil coincides, not only with rapid convergence at the Andean margin of South America, but also with a decline in Atlantic spreading rate, Japsen et al. (2012b) suggested that all these uplift events have a common cause, which is lateral resistance to plate motion. Because the uplift phases are common to margins of diverging plates, it was also suggested that the driving forces can transmit across the spreading axis; probably at great depth, e.g. in the asthenosphere.

Late Eocene, Late Miocene and Pliocene uplift and erosion shaped the elevated margin of southern East Greenland (Bonow et al., in review; Japsen et al., in review). These regional uplift phases are synchronous with phases in West Greenland, overlap in time with similar events in North America and Europe and also correlate with changes in plate motion. The much higher elevation of East Greenland compared to West Greenland suggests dynamic support in the east from the Iceland plume.

Japsen et al. (2012a) pointed out that EPCMs are typically located above thick crust/lithosphere that is closely juxtaposed to thinner crust/lithosphere. The presence of mountains along the Atlantic margin of Brazil and in East and West Greenland, close to where continental crust starts to thin towards oceanic crust, illustrates the common association between EPCMs and the edges of cratons. These observations indicate that the elevation of EPCMs may be due to processes operating where there is a rapid change in crustal/lithosphere thickness. Vertical motion of EPCMs may thus be related to lithosphere-scale folding caused by compressive stresses at the edge of a craton (e.g. Cloetingh et al., 2008). The compression may be derived either from orogenies elsewhere on a plate or from differential drag at the base of the lithosphere by horizontal asthenospheric flow (Green et al., 2013).

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