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Changes in plate motion and vertical movements along passive continental margins

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The origin of the forces that produce elevated, passive continental margins (EPCMs) has been a hot topic in geoscience for many years. Studies of individual margins have led to models, which explain high elevations by invoking specific conditions for each margin in question. We have studied the uplift history of several margins and have found some striking coincidences between episodes of uplift and changes in plate motion.

In the Campanian, Eocene and Miocene, pronounced events of uplift and erosion affected not only SE Brazil (Cobbold et al., 2001), but also NE Brazil and SW Africa (Japsen et al., 2012a). The uplift phases in Brazil also coincided with three main phases of Andean orogeny (Cobbold et al., 2001, 2007). These phases, Peruvian (90–75 Ma), Incaic (50–40 Ma), and Quechuan (25–0 Ma), were also periods of relatively rapid convergence at the Andean margin of South America (Pardo-Casas and Molnar, 1987). 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, we suggest that all these uplift events have a common cause, which is lateral resistance to plate motion (Japsen et al., 2012a). Because the uplift phases in South America and Africa are common to the margins of two diverging plates, we also suggest that the driving forces can transmit across the spreading axis, probably at great depth, e.g. in the asthenosphere (Japsen et al., 2012a). Similarly, a phase of uplift and erosion at the Eocene–Oligocene transition (c. 35 Ma), which affected margins around the North Atlantic, correlates with a major plate reorganization there (Japsen et al., 2012b).

Passive continental margins clearly formed as a result of extension. Despite this, the World Stress Map shows that, where data exist, all EPCMs are today under compression. We maintain that folds, reverse faults, reactivated normal faults and strike-slip faults that are typical of EPCMs are a result of post-rift compression that leads to the formation of EPCMs and that the necessary forces build up during changes in plate motion (e.g. Leroy et al., 2004; Cobbold et al., 2010; Japsen et al., 2012a,b).

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