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Exploiting a paleobiological database to constrain sub-plate support: Examples from western North America, northeast Brazil and northern Africa

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The shape of the Earth's surface is the result of complex interactions between deep and surface processes operating on a range of spatial and temporal scales. However, generating sufficient geological observations at the spatial and temporal scales relevant to investigating deep-Earth processes (~100–1000 km, ~1–100 Ma) remains a challenge. To address this challenge, I exploit a paleobiological database to generate a new compilation of >24,000 spot measurements of net surface uplift across all continents. The present-day elevation of marine fossil assemblages that crop out at the Earth's surface provides a direct constraint on the timing and amplitude of net surface uplift on geological timescales. I explore how these surface observations can be used to explore the evolution of sub-plate processes in three key regions: Western North America, Borborema Province in northeast Brazil, and Northern Africa. This new data compilation provides self-consistent, and in places high resolution measurements for Cretaceous to Recent net uplift. Geophysical observations (e.g., free-air gravity, shear-wave topography) and isostatic calculations are combined with net uplift measurements from these regions to explore how mantle thermal anomalies and lithospheric thinning might generate the observed uplift patterns. Uncertainties associated with paleo-bathymetry, post-deposition compaction and glacio-eustasy are assessed. The results emphasise the importance of large inventories of paleobiological data for understanding the history of tectonic and mantle convective processes as expressed at the Earth's surface.