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Quantifying denudation of the West African passive-transform margin: implications for Cenozoic erosion budget of cratons and source-to-sink systems

Jean-Louis Grimaud (1), Dominique Chardon (1), Delphine Rouby (1), and Anicet Beauvais (2)

(1) Toulouse University, GET (CNRS, IRD), Toulouse, France , (2) Aix-Marseille University, CEREGE (IRD, CNRS, Collège de France), Aix en Provence, France

We develop an approach based on the differential elevation of dated successive topographies of the onshore part of the West African margin to calibrate in-situ volumetric denudation over a 3.9 million km2 cratonic surface for the past 45 Ma. We obtain a regionally averaged volumetric erosion rate of 5 x 10-3 km3/km2/m.y. corresponding to a total average denudation of 300 m and a denudation rate of 6 m/m.y., which remained nearly constant over the three time spans (45- 24, 24-11 and 11-0 Ma) despite spatial variations related to epeirogenic movements. Denudation is converted into a minimum yield of 12 +/- 2 t/km2/yr with a minimum solute component of 4 +/- 2 t/km2/yr accounting for the porosity of the eroded regoliths. Our results would imply a minimum contribution of 1.6 +/- 0.4 Gt/yr of the non-orogenic landmass to the global continental yield since the last peak greenhouse.
Reconstruction of two incision stages of West Africa landscape from the reconstructed topographies combined with paleogeographic data shows that the current river catchments of the sub region have acquired their current configuration by the end of the Oligocene at the latest (24 Ma ago). The fairly steady geometry of the West African drainage since then offers the opportunity to effectively link the inland geomorphic record to offshore sedimentation.
Volumetric denudation analysis applied to West African sub-drainage areas attests to the role of drainage reorganization and epeirogenic mouvements (flexural growth of the marginal upwarp and amplification of the Hoggar intraplate swell) on the spatial and temporal distribution of continental denudation and yield. Onshore denudation and clastic sediments accumulation in the post-24 Ma Niger catchment - delta system are within the same order of magnitude. These results suggest that cratonic-type erosion fluxes estimated from the West African margin may be used to estimate the size of drainage basins from the fossil sedimentary record.