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Sedimentary Flux to Passive Margins From Inversion of Drainage Patterns: Examples from Africa

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We show that inversion of more than 14000 rivers from the African continent provides information about Cenozoic uplift and sedimentary flux to its passive margins. We test predicted sedimentary flux using a dense two-dimensional seismic dataset offshore northwest Africa. First, six biostratigraphically dated horizons were mapped (seabed, 5.6 Ma, 23.8 Ma, 58.40 Ma, 89.4 Ma and basement) across the Mauritanian margin and used to construct isopachs. Check-shot data were used to convert time to depth and to determine best-fitting compaction parameters. Observed solid sedimentary fluxes are $\sim$2x10^3 km^3 /Ma between 58.4 and 23.8 Ma, $\sim$4x10^3 km^3 /Ma between 23.8 and 5.6 Ma, and $\sim$28x103 km^3 /Ma between 5.6 and 0 Ma. Compaction errors were propagated into our history of sedimentary flux. Secondly, we inverted our drainage inventory to explore the relationship between uplift and erosion onshore and our measured flux. The stream power erosional model was calibrated using independent observations of marine terrace elevations and ages. We integrate incision rates along best-fitting theoretical river profiles to predict sedimentary flux at mouths of the rivers draining northwest Africa (e.g. Senegal). Calculated Neogene uplift and erosion is staged. Our predicted history of sedimentary flux increases in three stages towards the present-day, which agrees with the offshore measurements. Finally, using our inverse approach we systematically tested different erosional scenarios. We find that sedimentary flux to Africa's passive margins is controlled up the history of uplift and erosional processes play a moderating role. Predicted fluxes are indistinguishable if precipitation rate varies with a period less than $\sim$ 1 Ma or drainage area varies by less than 50%.

To investigate the geodynamic setting of the Mauritanian margin we backstripped eight commercial wells that penetrate Neogene stratigraphy. Wells in the central part of the Mauritania basin include 500-800 m of Neogene water-loaded subsidence that cannot be attributed to extension, thermal subsidence, salt-tectonics or glacio-eustasy. Stratigraphy mapped across the margin shows that this anomalous subsidence affected an area larger than 500 by 500 km. We suggest that this anomalous subsidence was caused by Neogene dynamic drawdown. Conversion of the Schaeffer & Lebedev (2013) velocity model to temperature and simple isostatic calculations indicate that negative buoyancy anomalies directly beneath the Mauritanian margin generate up to 500 m of drawdown today. Measured ocean-age depth residuals and calculated subsidence histories suggest that dynamic uplift of the Cape Verde swell and dynamic drawdown in the east generated a gradient in dynamic support during the last 25 Ma.