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The sedimentary supply of African sedimentary basins over the last 250 Ma

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The African continent is bordered by passive margins and bears intracontinental basins preserving the terrigeneous sediment resulting from its erosion, and as such, recording the dynamics of its relief variation. Our objective is to bring new constraints on the uplift and erosion of the African continent over the last 250 Ma from the perspective of the stratigraphic architecture of its sedimentary basins. The novel aspect of our approach is to integrate the evolution of both the domains in erosion and in sedimentation (i.e. from the drainage divide of the domain in erosion down to the most distal deposits over the oceanic crust), and to review published data to quantify the terrigeneous supply eroded in the drainage area and preserved in the basins. One objective is to evaluate the conditions under which this simple approach, based on already published data, can be used to infer continental relief variations, the sedimentary archives of the domain in erosion being by definition scarce and denudation evaluation by thermochronology usually relying on hypotheses on past heat flows.

We quantify the siliciclastic sedimentary volumes preserved in African basins correcting from porosity and in-situ (e.g. carbonate) production, with a particular attention to the determination of uncertainties resulting from parameters such as: velocity laws used to depth conversion of TWT data, biostratigraphic used for calibration in absolute ages, lithology assumed for porosity removal. We use two approaches with complementary spatial and temporal resolutions.

(1) When data are available (e.g along the South African and Namibian Atlantic margins), we determine the long-term signal of sedimentary supply (x10 Ma) from 3D mass balance calculations comparing sedimentary volumes deduced from offshore isopach maps on one hand and erosion volumes deduced from the present day geometry of geomorphic markers and thermochronology data on the other hand. We show that our approach provide a good estimation of the long-term denudation of the drainage basins.

(2) 3D dataset are not always available and allow most of the time only a long-term description of the sedimentary supply. We therefore develop a GIS database of 2D regional cross-sections across the major sedimentary basins established from published seismic lines. We homogenise the sections in spatial and temporal scale and then extrapolate them down to the most distal part of the basin so that geometries of our sedimentary wedges are not restricted to the platform domain (Figure 4), this, taking into account several hypotheses. On each cross-section, we then measure the 2D area of each stratigraphic interval (x1 Ma) and, in doing so, determine the average sedimentation “areas” and rates. We then determine the spatial extension of the basins for each time increment and use it to extrapolate average sedimentation “areas” and rate into sedimentation volumes.