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From time-temperature modelling to source and sink maps: example from the Phanerozoic in Morocco.

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We present a simple yet powerful method to quantify eroded material fluxes and to better define source, sink, and intermediate domains in non-rifted continental crusts adjacent to passive margins. Time-Temperature modelling results from Morocco and its surroundings are used to define and quantify exhumation events from the Permian to the Neogene. The results predict high denudation rates, comparable to values typical of rift flank, domal, or fault-related uplifts, in the Anti-Atlas (0.1 km/Myr) during the Early to Middle Jurassic and in the High Atlas (0.1 km/Myr) and Rif (up to 0.5 km/Myr) during the Neogene. During other periods, exhumation rates in the Meseta, High-Atlas, Anti-Atlas, and Reguibat shield are around 0.04±0.02 km/Myr.
A series of exhumation maps have been generated from which erosion patterns and volumes can be extracted. Estimates of cumulative eroded volumes from Permian onwards are between ca. 15x105 and 2x105 km3 (in the Reguibat Shield and Meseta, respectively). Periods of high rates of sediment production in the investigated source areas include the Permian, the Jurassic, the Early Cretaceous (Berriasian to Barremian), and the Neogene.
Ten paleo- erosional (quantitative) and depositional (qualitative) “source and sink” maps have been constructed, covering the period between the Variscan Orogeny and the Present-Day. The maps are based on the integration of six databases: geological maps, outcrop descriptions and biostratigraphic data, well data, paleogeography and depositional environment maps, provenance analysis, and calculated exhumation rates. The results illustrate changes in the Permian to Neogene source-to-sink systems and allow analysis of the dynamic nature of their components. We observe several shifts in sedimentary source areas through time, notably between the Anti-Atlas and the Meseta occurring at the end of the Middle Jurassic and in the late Early Cretaceous.