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MORGEN – The Mid Ocean Ridge GENERating algorithm

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Paleo-digital elevation models (paleoDEM) based on plate tectonic and paleogeographic reconstructions use age grids of ocean floor to determine ocean bathymetry. In recent years, such age grids have also been developed for now-subducted oceans from the far geological past, as far back as the Neoproterozoic, using geology and paleomagnetism-based estimates of ocean opening. In such reconstructions, mid ocean ridges are drawn based on estimated Euler poles and rotations, and conceptual knowledge on the geometry consisting of spreading ridges and transform faults.

Current procedures to draw mid ocean ridges in plate tectonic reconstructions are laborious, as new ridges are drawn every time the Euler pole location changes. Fortunately this is also a task that can be automated. We have written an algorithm using pyGPlates that takes as input a smooth curve at the approximate position of the reconstructed mid ocean ridge at the moment of its formation, and then calculates spreading and transform segments according to their typical geometries in modern oceans, assuming symmetric spreading. The algorithm allows gradual readjustment of ridge orientations upon Euler pole changes comparable to documented cases in the modern oceans (e.g., in the Weddell Sea). The algorithm also contains modules that can convert the calculated mid ocean ridges with other plate boundaries to boundary topologies – which can be used as input for the recently published TracerTectonics algorithm, produce isochrons which can be converted to age grids, check for subduction of isochrons and subsequently create bathymetry grids. We illustrate the use of the MORGEN algorithm with recently published reconstructions of subducted, as well as future oceans.