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Reconstructing vanished ocean basins

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The large-scale patterns of mantle convection are mainly dependent on the history of subduction. Therefore some of the primary constraints for subduction models are given by of the location of subduction zones through time, and of the convergence vectors and age of subducted lithosphere. This requires the complete reconstruction of ocean floor through time, including the main ocean basins, back-arc basins, and now subducted ocean crust, and tying these kinematic models to geodynamic simulations. We reconstruct paleo-oceans by creating ‘‘synthetic plates”, the locations and geometry of which is established on the basis of preserved ocean crust (magnetic lineations and fracture zones), geological data, paleogeography, and the rules of plate tectonics. Based on this approach we have created a set of global oceanic palaeo-isochrons and palaeo-oceanic age grids. The paleo-age grids illustrate where subduction zones were located, and provide the age of subducting oceanic lithosphere as well as convergence rates and directions along active margins through time, providing constraints for geodynamic models. The grids also provide the first complete global set of paleo-basement depth maps, including now subducted ocean floor, for the last 130 million years based on a depth-age relationship. We show that the mid-Cretaceous sealevel highstand was caused by the ‘‘supercontinent breakup effect”, which resulted in the creation of the mid-Atlantic and Indian Ocean ridges at the expense of subducting old ocean floor in the Tethys, and not by a fast spreading pulse. These grids will be useful for backtracking biogeographic and sediment data from ocean drilling, for constraining the opening/closing of oceanic gateways, and for constraining long-term eustatic sea level changes based on changes in the volumes of the ocean basins.