Constraining Eustatic Sealevel Variations and Palaeoclimate through Reconstructions of Palaeobathymetry and Continental Topography

Muller, Dietmar, Maria Sdrolias, and John You, The University of Sydney, Sydney, Australia

We use a combined relative and absolute plate motion model, based on a moving hotspot reference frame, with a global data set of plate tectonic data to reconstruct the ocean floor through time, including the main ocean basins, back-arc basins, and now subducted ocean crust. 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-bathymetry maps, including estimates of paleo-sediment thickness as a function of latitude and plate age, and now subducted ocean floor, for the last 130 million years. We show that the mid-Cretaceous sealevel highstand was primarily caused by two main factors: (1) 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 (2) by a changing age-area distribution of Pacific ocean floor through time, resulting from the subduction of the Pacific-Izanagi, Pacific-Phoenix and Pacific-Farallon ridges. We have merged our paleo-bathymetry with reconstructed paleo-topography for key times in the Cenozoic and used these data as improved input for NCAR's CCM3 (Community Climate System Model) models for more realistic simulation of both surface and deep water circulation.