Changes of Late Permian Ocean Circulation and Deep-Sea Anoxia in Response to Tectonic Changes - A Model Study with CCSM3

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The causes and dynamics of the mass extinction at the Permian-Triassic boundary (~251 Ma) are controversial. One hypothesis favors climatic responses to increased tectonic activity and associated large-scale volcanism, resulting in ocean stratification and widespread anoxia with fatal consequences for marine and land organisms. This hypothesis is supported by recent interpretation of geochemical data, suggesting that periodic upwelling of toxic hydrogen sulfide rich water masses contributed to the extinction of species. However, model results suggest that a sluggish ocean circulation did not lead to anoxic conditions in the deep sea.

In order to explore causes of deep-ocean anoxia, as well as patterns of presumably toxic deep-ocean waters, changes in deep-sea ridges are being explored with the fully-coupled climate system model CCSM3 under end-Permian boundary conditions. The model simulations are compared with recent paleoclimatic proxies and previous modeling studies. Modeling results indicate that ridges promote diapycnal mixing along the ridge-axis, but enhance lateral gradients of oxygen.

Increased nutrient input into the ocean, justified by enhanced continental weathering and tectonic activities, could have drastically changed marine productivity patterns and hence oxygen consumption in the deep sea, as simulated in the model.