Eocene subduction west of North America-causes and effects

Carmen Gaina
(carmen.gaina@geo.uio.no)

Center for Earth Evolution and Dynamics, University of Oslo

‑ Fabio Crameri

Center for Earth Evolution and Dynamics, University of Oslo

‑ Johannes Jakob

Center for Earth Evolution and Dynamics, University of Oslo

Many of our planet’s “crises” were the result of sudden changes in plate tectonic configuration or catastrophic outbursts of volcanism caused by mantle plume impingement at the base of the lithosphere. At the Paleocene–Eocene boundary and in the Early Eocene several mantle plumes, continental collision and mid-ocean ridge subduction triggered a series of changes in seafloor spreading dynamics. Based on a new Paleocene to Miocene global model of oceanic lithosphere age and spreading rates, we revise evidence for changes in seafloor spreading direction in the North Atlantic, Arctic and NE Pacific oceans. At least two periods of elevated spreading rates, separated by a sharp value decrease, occurred along the entire eastern North American plate boundary from C25 to C18 time (c. 57 to 40 Ma). The collision and incipient subduction of the Early Eocene Siletzia oceanic LIP may have caused the sharp decrease in spreading rate at C23 time in the Labrador Sea and north of Charlie-Gibbs fracture zone. The post C23 rapid Farallon slab-break-off and subsequent upper mantle flow upwelling may have led to further variations in North Atlantic spreading rates at C22-21 time. Eastward Pacific subduction may have resumed at c. 43 Ma as indicated by a steady NE Pacific seafloor-spreading regime, which resumed at or shortly after C21. North American Late Paleocene–Early Eocene kimberlite magma that erupted more than 1000 km from its western plate boundary constitutes additional evidence that tectonic stresses due to changes in the mantle-lithosphere interactions may have affected the entire plate, and therefore also its eastern boundaries. We test the hypothesis that changes in the subduction regime west of the North American continent may have affected the entire plate by running 3D convection models that feature a dynamically self-consistent subduction system and realistic surface topography evolution thanks to a free surface. The modelled changes of the upper plate topography due to the subduction of an igneous plateau and subsequent modification in the slab configuration, may explain some of our observations.