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Subduction Flux and Seafloor Production: Estimations and Implications

Mat Domeier (1), Andrew Biggin (2), and Mark Hounslow (3)

(1) Centre for Earth Evolution and Dynamics, University of Oslo, Norway (mathewd@geo.uio.no), (2) Earth and Ocean Sciences, University of Liverpool, UK (a.biggin@liv.ac.uk), (3) Lancaster Environmental Centre, Lancaster University, UK (m.hounslow@lancs.ac.uk)

The volume of lithosphere that is consumed along subduction zones globally over some arbitrary unit time is variable, but should be equivalent to first-order (assuming the global net-effect of crustal deformation to be near-zero) to the volume of crust produced along divergent margins over the same time interval. Although effectively balanced, the time-dependent co-variations in these rates of flux have important consequences for a variety of Earth systems, including climate, the hydrosphere, mantle convection and the geodynamo. Notwithstanding the important role that these fluxes play in these various Earth systems, the subduction flux/seafloor production rate is very poorly known prior to the Cretaceous, and prior to the Mesozoic it has scarcely been studied. Partly as a consequence of this, there has recently been a flourish of studies endeavoring to use global subduction zone lengths as a proxy for the subduction flux, which is thus estimated back into the Paleozoic or Precambrian. As shown here, the change in global subduction zone lengths is not a suitable proxy for the true subduction flux because the global average rate of convergence is not likely to be constant. Instead, we present a calculation of the subducted area flux (SAF), which represents a closer approximation of the true (volumetric) subduction flux, back to the mid-Paleozoic. We demonstrate independent support for this SAF curve from two independent subduction flux proxies (detrital zircon age distributions and strontium isotopes) and compare it against the sole published Paleozoic SAF record based on an industry-confidential geodynamic model. Finally, we discuss some important implications of the new SAF curve presented here, namely correlations to geomagnetic field behavior and potential impacts on past atmospheric CO_2 levels.