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Asymmetric Earth

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The net rotation, or so-called W-ward drift of the lithosphere, implies a decoupling of the plates relative to the underlying asthenosphere, and a relative “E-ward” mantle flow. This polarized flow can account for a number of asymmetries. When comparing the W-directed versus the E- to NE-directed subduction zones, as a general observation, they have the subduction hinge diverging versus converging relative to the upper plate; low versus high topography and structural elevation respectively; deep versus shallow trenches and foreland basins; shallow versus deep decollement; low versus high basement involvement; high versus low heat flow and gravity anomaly; shallow versus deep asthenosphere; etc. The western limbs of rift zones show S-waves faster in the lithosphere and slower in the asthenosphere with respect to the eastern limb.

The asymmetry can be recognized when moving along the “tectonic equator”, which describes the fastest flow of plates relative to the mantle, and it undulates relative to the geographic equator. In our reconstructions, the best fit for the tectonic equator has a pole of rotation at latitude $-56.4°$ and longitude 136.7°, with an angular velocity of 1.2036°/Ma.

Shear-wave splitting alignments tend to parallel the tectonic flow, apart along the subduction zones where they become orthogonal, as a flow encountering an obstacle. The tectonic equator lies close to the revolution plane of the Moon about the Earth.

All these data and interpretations point for an asymmetric Earth, whose nature appears to be related to the rotation and its tidal despinning, combined with the thermal cooling of the planet. However, this model has been questioned on the basis of the high viscosity so far inferred in the asthenosphere.

Preliminary modelling shows that the tidal oscillation can generate gravitational wave propagation in the lithosphere, and the wave velocity can increase with the decrease of the asthenospheric viscosity.