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Plate Tectonics and Net Lithosphere Rotation over the past 150 My

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During the 20th century our description of the movement and deformation of the Earth's outer rigid layer evolved from the hypothesis of Continental Drift into Sea-Floor Spreading and to the theory of Plate Tectonics. Now a fourth shift is underway in which Plate Tectonics is being subsumed into a new Mantle Dynamics framework that requires plate motion reconstructions through time to include not only improved relative plate motions but also refined plate motions with respect to the mantle. By combining relative and absolute plate motion frames from the Indo-Atlantic and the Pacific realms we have developed an improved model of global digital palaeo-plate boundaries and plate motion to describe the distribution and history of plates since the Late Jurassic. From this history we computed net lithospheric rotation (NR) through time confirming the so-called westward drift, but only for the past 30 Myrs. The NR has significantly smaller magnitudes (0.13 deg./My, past 5 My) than for some other plate models; it averages to 0.11 $\pm$ 0.03 deg./My for the past 50 My with a small but systematic increase toward the present. The westward drift, seen only for the past 30 My, is attributed to the increased dominance of a steadily growing and accelerating Pacific plate. NR shows peaks with time but only an Early Tertiary peak of 0.33 deg./My (when the Indian plate was undergoing the largest known acceleration/deceleration) can be interpreted with some confidence. NR fluctuates and gradually increases back in time, and by removing a linear time-trend in the data, averages to $\sim$0.12 deg./Myr for the past 150 Myr. However, the oceanic area reconstructions rely on few constraints and many assumptions for older time intervals; about 60% of the lithosphere have been subducted since 150 Ma and plate motions are uncertain for this fraction. To realistically reconstruct the proto-Pacific through time, information about the oceanic crust consumed by subduction is needed. Subducted material is imaged by tomographic models and we envisage that the next generation of global plate reconstructions and plate boundaries will incorporate at least the first order estimate of the amount of subducted material based on tomography and iterative plate reconstructions.