Geophysical Research Abstracts,
Vol. 11, EGU2009-2321-1, 2009
EGU General Assembly 2009

Can Earth's rotation and tidal despinning drive plate tectonics?

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We re-evaluate the possibility that Earth's rotation contributes to plate tectonics on the basis of the following observations: 1) there is, and there has been in the past, a coherent mainstream of plate motions that forms an angle relative to the equator close to the one of the Moon revolution; 2) the flow of plates is polarized towards the „west"; 3) plate boundaries are asymmetric, being their geographic polarity the first order controlling parameter; 4) the global seismicity depends on latitude and correlates with the decadal oscillations of the excess length of day (LOD); 5) the Earth's deceleration supplies energy to plate tectonics comparable to the computed budget dissipated by the deformation processes; 6) the Gutenberg-Richter law supports that the whole lithosphere is a self-organized system in critical state, i.e., a force is acting contemporaneously on all the plates and distributes the energy over the whole lithospheric shell, a condition that can be satisfied by a force acting at the astronomical scale.

We propose a model in which the misalignment of the tidal bulge relative to the Earth and Moon gravitational line generates a permanent "westerly" directed torque. Assuming a ultra-low viscosity layer beneath the lithosphere, located within the low velocity zone (LVZ) of the upper asthenosphere, the semidiurnal tidal vibrations would be able to slowly shift the lithosphere in a "westerly" direction with respect to the underlying mantle. The differential velocity among plates would be controlled by the variable decoupling at the base of the lithosphere, combined with other forcing mechanisms of mantle convection such as mantle drag and slab pull. Numerical and analogue modeling should further test this model.