Geophysical Research Abstracts,
Vol. 11, EGU2009-10414, 2009
EGU General Assembly 2009

Pacific trench motions controlled by the asymmetric plate configuration

TJ Nagel (1), WBF Ryan (2), A Malinverno (2), and WR Buck (2)

(1) Steinmann-Institut, Bonn University, Bonn, Germany (tnagel@uni-bonn.de), (2) Lamont-Doherty Earth Observatory of Columbia University, Palisades, New York 10640, USA

We present a novel explanation for absolute trench-normal motions of slabs surrounding the Pacific. Rapid retreat on the eastern side and slow advance in the west can result from the large-scale asymmetric plate configuration. We use simple fluid dynamics to explain the mechanical workings of the idea and the results of a simple finite difference scheme to estimate the effect on trench motion velocities. The idea is based on two key assumptions. First, we follow the concept of large-scale horizontal counter flow in the asthenosphere driven by accretion into lithosphere and plate motion. Second, we assume that horizontally wide slabs without large slab windows drift passively in the mantle flow field and do not retreat as a result of flow around the slab. If the asthenosphere transfers flow related horizontal shear stress into deeper levels of the mantle, an asymmetry in the plate configuration leads to different net pressure forces on the oceanward side of the two slabs and thus controls the retreat behavior. In an ocean with an asymmetric ridge position, the slab of the smaller plate should retreat faster than the slab of the larger plate, which may even advance. Our model explains the counterintuitive negative correlation between slab age and retreat velocity observed in the Pacific as well as the topographic asymmetry observed across the Pacific Rise.