

## **WHAT DRIVES PLATE TECTONICS? SLAB PULL, RIDGE PUSH OR GEOMAGNETIC TORQUE FROM THE CMB? A NEW LOOK AT THE OLD PLAYERS VIS-A-VIS AN EXCITING NEW ONE**

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Fundamental reappraisal of the mechanisms that drive plate tectonics suggests the remarkable conclusion that, for at least the past 130Ma, a major agent has been a CW-directed torque (probably of electromagnetic origin at the CMB) reaching the deep (>600km, e.g. Gu et al 1998 EPSL) tectospheric keel of the Antarctica craton, via the high-viscosity lower mantle. Major changes in spreading direction marked both ends of the 122-85Ma Cretaceous Superchron and started by forming the Ontong Java Plateau. Action of MORs as gearlike linkages has driven Africa and India CCW since Gondwana breakup and continues to drive the Pacific plate CCW. In the Arctic there is now no cratonic keel to pick up any corresponding polar torque, so northern hemisphere plate tectonics is far less active.

My multifaceted study (over 25 years) of the subduction process has indicated that the rapid development of 'flat-slab' interface profiles involves the physical removal of hanging wall material (be it lower crust or mantle) in front of the downbend by basal subduction tectonic erosion (STE). Historically this, and its active seismological manifestation known as seismic coupling, only occurs where the subducting plate was/is <70Ma old. Hence the requisite subducting plate buoyancy must be thermal and slab-pull an unlikely agent for such subduction - a conclusion reinforced by the abundant development of progressive foreland-directed thrusting during the STE process, which intermittently couples ridge push to the upper plate. Lots of ridge push is needed to drive that thrusting and the subduction of such buoyant plates.

Accordingly, a redesign of the MOR process has incorporated the LVZ as a physically integral part of the plate (Osmaston 2000 IGC Rio). This model not only generates much more (but still being quantified) ridge push, as required, but has turned out to be very successful in relation to MOR structures. The heat content takes the form of a superadiabatic gradient in the now-stiff LVZ, and is partially trapped (until subduction) by the much (>30%) lower thermal conductivity resulting from its (say 3%) interstitial melt.

Perhaps surprisingly, this incorporated ocean-plate-heat is indeed evident as slab reheating during active subduction. Examples from among numerous circum-Pacific tomographic transects, kindly provided to me, all show that the 'slab' high-Vp signature peters out at between 175 and 350km (plate age-dependent and even at 130Ma) and a second high-Vp signature then begins close to the top of the TZ and goes on into the lower mantle. This latter signature must be mineralogical, not thermal, and arguably is not mantle but is only a stream of dense stishovitic lumps residual from partial melting of subducted oceanic crust at TZ pressures. Where now is the slab pull beloved of modellers? A different cause exists for 'roll-back'.

I conclude that CMB torque initiated the Atlantic and is probably the primary driver of plate tectonics, that ridge push comes second and slab pull a doubtful third. To generate such torque may require the presence of semiconductor properties in the CMB region. [491 words]

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Message to convenors:- Bob Engdahl supplied the >90 transects and Tibor Gasparik the info on TZ melting.