meetabst\TSG03magCMB.rtf/pdf Talk accepted. TSG Annual Meeting, Liverpool University, UK ; 8-10 Jan 2003.

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.

Miles Osmaston,
The White Cottage, Sendmarsh, Ripley, Woking, Surrey GU23 6JT, UK.
miles@osmaston.demon.co.uk

Over the past 25 years my study of the subduction process, as manifest structurally, magmatically and seismologically, has led me to conclude firmly that the rapid development of 'flat-slab' interface profiles (essential, *inter alia*, to forming the Austroalpine sheets) involves the physical removal of hanging wall material (beit 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 (**not** the extension predicted by roll-back) during the STE process, which intermittently couples ridge push to the upper plate. Lots of ridge push is also needed to drive the subduction of such buoyant plates.

To meet the needs for young-plate thermal buoyancy and more ridge push, the MOR process has been 'redesigned' to ensure that the LVZ is 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%) lowered thermal conductivity resulting from its (say 3%) interstitial melt.

We may now ask whether this incorporated ocean-plate-heat is evident as slab reheating during active subduction. The answer, wholly untrumpeted by seismologists, is emphatically 'yes'! I will show examples from among numerous circum-Pacific tomographic transects kindly provided to me, all showing 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 derived from the partial melting of subducted oceanic crust. Where now is the slab pull beloved of modellers?

Seismological support for cratonic tectospheres that extend almost to the 660km discontinuity (e.g. Gu, Dziewonski & Agee, EPSL 1998), combined with the high (x30?) viscosity of the lower mantle, opens the door to the coupling of CMB- generated forces to cratonic keels in tectonic plates. The so-called 'westward drift' of geomagnetic field features often becomes eastwards at >45degLat (J-.L. LeMouël, pers comm) where any electromagnetic coupling should be strongest, as the field cuts the CMB steeply. There is no cratonic keel in the Arctic but a CW drive on the East Antarctica (EA) keel is clearly evident in plate motions since at least 125Ma. MORs act like gear teeth, so explain the CCW motions of the Pacific plate and of Africa. Sigmoidal FZs linking EA with Tasmania[1] and with Madagascar show that EA has 'moved on' since breakup. Pacific spreading directions changed at 121Ma, coincident with oceanic plateau generation and the onset of the Cretaceous superchron.[2]

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.

Corrections. 1. This is incorrect in respect of Tasmania but joint Australia-EA CW motion caused the separation of W Aust from India(+Africa?) ~132Ma. 2. This sentence should read:- Generation of oceanic plateaux at ~122Ma mark the onset of the Cretaceous superchron; Pacific spreading directions changed by 10^{o} when it ended at ~85Ma.