meetabst\EGU03B.sam Accepted for Session CL11.22 "Neoproterozoic Ice Ages"
Convenors: A.Nedelec, G.Ramstein, Y.Godderis & J.Laskar. EGS-EUG-AGU, Nice. 6-11April 2003.
Joined into Session BG15: "From Snowball Earth to the Cambrian bioradiation: basins, ecosystems and geochemistry (co sponsored by CL)
Convenors: H.Strauss, S.Bengtson, H.Bahlburg, and S.Bowring.
Published in CD-ROM Geophysical Research Abstracts Vol 5, 2003, Abstr.No 04775, where both references are unfortunately missing.

PLATE TECTONICS HIATI AS THE CAUSE OF GLOBAL GLACIATIONS: 2. THE LATE PROTEROZOIC 'SNOWBALL EARTH'

Miles F. Osmaston, The White Cottage, Sendmarsh, Ripley, Woking, Surrey GU23 6JT, UK. miles@osmaston.demon.co.uk/tel: +44-1483-224138

A fundamental reappraisal of the mechanisms that drive plate tectonics has yielded the remarkable conclusion that, for at least the past 130Ma, the principal agent has not been ridge-push or slab-pull but a CW-directed torque (probably of electromagnetic origin at the CMB) reaching the deep (>600km, e.g.[1]) tectospheric keel of the Antarctica craton. 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.

The thesis of this contribution is that in the Neoproterozoic the lack of cratons at high latitudes would have deprived plate tectonics of this motivation, causing MORs to die (see below) and a major fall in sea-level, leading to global glaciation as outlined in Part 1 for the Huronian events. Like that seen during that first hiatus, dyke-swarm volcanism could have arisen from thermal shrinkage of the global lithosphere, providing CO_2 and ash-covering that interrrupted glacial episodes. In oceanic settings this volcanism would have lowered pH and supplied Fe2+ for shallow bio-oxygenic action to deposit as BIF.

My multifacet studies of the subduction process convince me that the rapid development of 'flat-slab' interface profiles involves the physical removal of hanging-wall material in front of the downbend by basal subduction tectonic erosion (STE). Historically this, and its inferred ubiquity in the Archaean as the precursor to PSM (Part 1), suggests that the required subducting-plate buoyancy is thermal. Accordingly, a redesign [2] of the MOR process has incorporated the heat-containing LVZ as an integral part of the plate and luckily provides a lot more ridge-push to ensure the subduction of buoyant plates. But its action is not indefinitely self-sustaining, so could die out if not 'nudged' occasionally.

Wholly untrumpeted by seismologists, this built-in ocean-plate-heat is indeed evident as slab-reheating during active subduction. Nearly 100 circum-Pacific tomographic transects kindly provided by E.R.Engdahl consistently show the 'slab' high-Vp signature peters out at between 200 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 TZ-depth partial melting of subducted oceanic crust. Where now is the slab-pull to sustain plate tectonics?

[1] Gu et al, 1998, EPSL 157: 57-67. [2] Osmaston, 2000, 31st IGC, Gen. Symp. 4-1.