IASPEI Gen. Assy, 2-8 October 2005. Santiago, Chile. Abstract No 303.
Oral in session JS04 entitled:- Subduction zones with special emphasis on those in less developed countries, convenor S.Widyantoro

The ridge push mechanism of MORs as the agent of seismic coupling, tsunami, convergence partitioning and landward thrusting at subduction zones; insights on an interactive family of mostly-jerky mechanisms

Miles Osmaston

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

Geophysicists have difficulty in modelling discontinuous media. The MOR process, modelled as continuous, generates far too little ridge push to do much that is observed at subduction zones. Slab pull is an unlikely assistant in view of the way in which young plate subducts at the eastern Pacific margin, creating flat interfaces and compressive environments at many places.

A discontinuous model, consistent with discontinuous eruption along the EPR crest, offers more hope. This has a deep, narrow subaxial crack, whose sides are forced apart intermittently by the local crack closure resulting from eruption-induced phase-change bulging of the walls. The ridge push force developed, being that of solid state recrystallization, is likely to be large. This model offers the unique bonus (Osmaston, IUGG'95) that thermally controlled differential accretion to the walls explains why MOR segments become straight.

At the subduction end of the system, seismic coupling, with its alternation of interface slippage and faulting of the subducting plate, seems to arise from a step-faulting, escalator-like mode of plate downbend (Osmaston, IUGG'99). Each increment of stepfault throw offsets the interface and locks it in a positive fashion, enabling ridge push to build up large strain energy in the intervening oceanic plate. This buildup could explain why the eventual interface ruptures of such asperities include the largest earthquakes known. An association with tsunamis is common. Stick-slip of an elastically downbending plate would have far less potential for stress buildup.

Relief of the compressive stress in the oceanic plate may also occur in another way - the linkage to the upper plate may cause foreland-directed thrusting in it. In this case there is no slippage beyond that point on the subduction interface. This mechanism apparently causes the progressive foreland-directed thrusting widely seen above 'flat' subduction segments. Remarkably, it is also seen, only about 120km from the plate boundary[1], in a sonar survey of the Aceh forearc, northern Sumatra, done after the 26/12/2004 earthquake and tsunami.

Finally, the removal of repeated 'asperities' of hanging wall material is seen as the way that flat interfaces develop, the progress of the downbend position being tracked by the progress of thrusting, this process being called basal subduction tectonic erosion (STE) (Osmaston, IGC'92, IASPEI'94). Along-strike differences in STE cause segmentation in which the shape of the hanging wall mechanically guides ('tramlines') the direction of subduction. If the plate convergence vector then changes, the alteration has to be accommodated as strike slip outside the tramlined zone. Sumatra provides an example. Slab pull can hardly act 'sideways' in this manner.

In conclusion, an enhanced recognition of ridge push seems to offer valuable progress in the understanding of subduction and its related hazards.

---

[1] Postscript. This information is incorrect. This is because, frustratingly, I was refused access to the correct positional information because it had been sold by the UK official survey to a television company, which was not for broadcasting until after the submission deadline for the abstract.