My Ref. meetabst/IGC92STE.sam/doc 29th IGC, Kyoto, Japan. Abstr.v.1, p.63. Symp.I-1-05, P-4

A new model of subducting plate downbend, subduction tectonic erosion, and the large-scale tectonic evolution of convergent margins.

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Large earthquakes located at the downbends of subducting plates demonstrate the occurrence of major ruptures extending through the plate to depths exceeding 50km. Below the Japan Trench microseismicity extends to 100km depth within the plate. These features are inconsistent with elastic flexure models of plate downbend, which demand much smaller values of elastic thickness.

A new model of plate downbend has been developed (in conformity with observations in trenches and with the occurrence of outer rises) in which downbend results from the progressive evolution of a succession of steps, in a manner analogous to that seen at the top of a descending escalator. Graben in trenches result where the step-faults gape as the throw increases. Most of downbend, and therefore most of the increments in step-fault throw, occur well beneath the forearc. Each such increment offsets the subduction interface, creating a downward asperity composed of forearc material, which may lock subduction until it is sheared off.

This model not only can explain the apparent alternation of major downbend-type and interface-slip earthquakes but yields a highly efficient mechanism for subduction tectonic erosion (STE) of the hanging wall. Therefore the well-known segmentation of circum-Pacific subduction zones, involving landward displacement of the downbend by 200-600km in some segments, is attributed to differences in STE of the hanging wall. Apparently it is the profile of the hanging wall, as modified by STE, that controls the position of the downbend, and not the properties of the slab.

Large-scale tectonic consequences of the model are:-

1) Across-strike steps in the hanging wall, due to segmentation by STE, will tramline future subduction so that any change in plate convergence vector must be accommodated by strike-slip motion extraneous to the tramlined zone, e.g. Sumatra, Philippines, Canada-Alaska, early San Andreas (?).

2) STE may kill and undercut arcs, progressing far beneath any back-arc basin. Structural instability of such an extensive thinned plate margin could result in imbricate collapse and juxtaposing of arc and other terranes. This process could eventually move any intra-oceanic subduction zone to a continental margin position.

3) Large-scale STE removal of lower crust under a continental margin could explain the early development of basement thrust sheets seen in collision orogens, e.g. Alps, Scandinavian Caledonides.