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Geoscience 98, Keele University, 14-18 April 1998, Symp.:- "Dynamics of subduction and orogenesis" N. Kusznir & M. Casey, convenors. Meeting Abstracts p.163

Pacific-style basal subduction tectonic erosion: essential precursor to construction of the Alps/Carpathians

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Downbends of subducting plates show big through-plate seismic ruptures and seismicity inconsistent with elastic flexure. A through-plate step-faulting downbend process, escalator-like, offers efficient basal subduction tectonic erosion (STE) of the upper plate. Each step-throw increment entraps and then removes a sliver of upper-plate material, thus advancing the downbend beneath it. Off NE Japan, end-Oligocene STE moved the downbend ~200km westward, eroding the lower crust of a Cretaceous landmass in the process. In both Andean "flat-slab" sectors, downbend advance, now totalling ~650km, has been 300km+ in the past 10Ma. Rapid advance has prevented the penetration of arc-type magmas to the surface. Steepening of the downbend angle, a feature of STE, is evident here. Off NE New Zealand, early Miocene imbrication of the Hikurangi continental margin was evidently a sequel to previous (J3/K1?) undercutting by STE. The downbend is still 300km from the "trench".

Application of these findings to the Alps yields the following outline. During early Cretaceous the N margin of the S Alpine plate, from the Western Alps to Transylvania, was extensively (600km?) rapidly undercut southwards by STE. In the W a strip of oceanic crust lay between the trench and the continental margin. The Canavese-Insubric-Giudicaria-Gailtal line marks the final downbend positions (2 successive subduction directions, SE then S). Imbrication and stacking of this margin began in the mid-Cretaceous, increasing in severity towards the west, where many slices were carried down successively and lodged across the downbend, to form a wedge of crustal material against the steep hanging wall and reaching to ~150km depth. This wedge, differentially exhumed, is now the Penninic and lowest Austroalpine nappes. The stacking order reversed the palaeogeographic order, so the main Piemont ophiolites came from a northernmost position. As each successive imbric formed, a distinctive frontal flysch was generated. The resulting assemblage of these is now the Prealps; other flysch went south to the Lombardian Basin.

Collisional evolution was grossly affected, along the chain, by the nature of the European margin encountered. In the W, fully continental crust was overridden. At the eastern (Carpathian-Pannonian) end, imbrication of the undercut southern margin was minimal because the crust overridden was mainly oceanic and young, its heat loss being responsible for the Pannonian Basin.