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Pacific-style basal subduction tectonic erosion (STE): essential precursor to construction of the Alps/Carpathians and Apennines

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The downbends of subducting plates show big through-plate seismic ruptures and seismicity inconsistent with elastic flexure models. A through-plate step-faulting downbend process, escalator-like, seen to begin at outer trench slopes, also offers a much-needed mechanism for efficient basal STE of the upper plate. Each step-throw increment can entrap and then remove a sliver of hanging-wall material, thus advancing the downbend beneath the upper plate. Off NE Japan, latest Oligocene STE rapidly moved the downbend ~200km westward, removing the lower crust of a Cretaceous landmass in the process. In the Andean "flat-slab" sectors, surface geology shows that downbend advance, now totalling ~650km, has been 300km+ in the past 10Ma. Such rapid advance has prevented the establishment of arc-type magmatism at the surface. Progressive steepening of the downbend angle, a feature of the STE model, is evident here. Off NE New Zealand, early Miocene imbrication of the Hikurangi continental margin was evidently a sequel to much earlier very extensive undercutting by STE. The downbend is still 300km from the "trench". How much of the sliced-up margin was carried down and lodged across the steepened downbend is unknown.

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. A strip of oceanic crust lay between the trench and the continental margin. The Insubric-Giudicaria-Gailtal line marks the final downbend position. 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 seen as the Penninic nappes, the stacking order having reversed the palaeogeographic order. At the surface, as each successive imbric formed, a corresponding flysch was generated. The resulting assemblage of these is now in the Prealps. At depth, the continuance of ocean floor subduction interleaved, between each Penninic slice carried down, oceanic material now seen as the ophiolitic "sutures" .

Collisional evolution was grossly affected, along the chain, by the nature of the European margin encountered. In the W, fully continental crust was overridden, and the external massifs rose soon after being overthrust, blocking further north-vergent surface closure. Continued closure at depth was accommodated by backthrusting across the southern plate. At the eastern (Carpathian-Pannonian) end, imbrication of the undercut southern margin was minimal because the crust overridden was mainly oceanic and young, its continued heat loss thereafter being responsible for the Pannonian Basin.

For the Apennines, on the same basis, eastward Cretaceous extensive STE undercutting of the western extensions of "Italy", followed by passive margin subsidence, was halted by W-dipping subduction and E-vergent imbricate upper Tertiary closure against Corsica-Sardinia.