Plate tectonics versus continental tectonics: A case of Ampferer-type subduction in the Alps and Pyrenees

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More than 100 years after Gustav Steinmann's description of ophiolites and the description of subduction, or "*verschluckung",* by Otto Ampferer, the evolution of the Alpine Orogen from rifting to collision remains controversial. The characteristic geodynamic features of the Pyrenees and Alps are surprisingly distinct from features of *Wadati-Benioff-type* subduction. The latter have large subducted oceanic slabs, a long term magmatic record and intra-oceanic subduction-initiation signatures during the first 20Ma of subduction which include upper-plate extension and magmatism followed by either obduction (Neotethys ophiolites) of formation of mature arc system (e.g. Izu-Bonin-Mariana arc). Other characteristics include the minor abundances (<1%) of high-pressure lithologies in a accretionary prism (e.g. Franciscan Complex, USA) and near-absence of evidence of (ultra-)high pressure lithologies. On the other hand, the Pyrenees and Alps are characterized by amagmatic subduction initiation at passive margins and a pre-collisional lithosphere comprised of rift basins characterized by thinned continental crust, exhumation of subcontinental mantle and oceanic core complexes. The Pyrenees record no magmatism during convergence, whereas magmatism in the Alps is only recorded during collision. This leave a ca. 50-60 Ma gap in the Alps, from subduction initiation to collision, where the detrital zircon record shows no magmatism even though subduction of oceanic and continental fragments reaches ~2 GPa. Moreover, the Alpine orogen shows abundant high-pressure lithologies and coherent imbrication of high-pressure passive margins. In order to resolve these discrepancies, we revive the term of *Ampferer-type* subduction to describe a convergent setting which lacks the foundering of oceanic lithosphere and formation of Pacific-type subduction zone "characteristics". We suggest that convergence was controlled not by spontaneous subduction of oceanic lithosphere but by the forced closure of hyper-extended basins along weakened, serpentinised passive margins. This allows us to distinguish *Benioff-type oceanic subduction* resulting from the efficient subduction of oceanic lithosphere, abundant magmatism and limited exhumation of metamorphic lithologies, from *Ampferer-type continental subduction*, derived from the closure of hyper-extended continental basins, inefficient deep subduction of hydrated (serpentinites and oceanic sediments) lithologies, preservation of high-pressure units and amagmatic characteristics.

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