Set the cadence of basal-accretion events along the subduction interface: a geological monitoring of the Hellenic margin

Armel Menant[1,2,*], Johannes Glodny[1], Samuel Angiboust[3], Romain Augier[4], Onno Oncken[1], Laurent Jolivet[5], Eloïse Bessière[5], Taras Gerya[6]

[1] GFZ Helmholtz Centre Potsdam, German Research Centre for Geosciences - Allemagne
[2] Now at: Université Côte d'Azur, CNRS, Observatoire de la Côte d'Azur, IRD, Géoazur - France
[3] CNRS, Institut de physique du globe de Paris, Université de Paris - France
[4] Université d'Orléans, ISTO, UMR 7327 - France
[5] Sorbonne Université, UMR 7193 CNRS-UPMC, Institut des Sciences de la Terre de Paris - France
[6] Institute of Geophysics, Swiss Federal Institute of Technology (ETH) - Suisse

Subduction margins are the loci of a wide range of deformation processes occurring at different timescales along the plate interface and in the overriding forearc crust. Whereas long-term deformation is usually considered as stable over Myr-long periods, this vision is challenged by an increasing number of observations suggesting a long-term pulsing evolution of active margins. To appraise this emerging view of a highly dynamic subduction system and identify the driving mechanisms, detailed studies on now-exhumed, high pressure-low temperature (HP-LT) accretionary complexes are crucial as they open a window on the deformation history from the plate interface to the surface.

In this study, we combine structural and petrological observations, Raman spectroscopy on carbonaceous material, Rb/Sr multi-mineral geochronology and thermo-mechanical numerical models to unravel with an unprecedented resolution the tectono-metamorphic evolution of the Late-Cenozoic HP-LT nappe stack cropping out in western Crete (Hellenic subduction zone). A consistent decrease of peak temperatures and deformation ages toward the base of the nappe pile allows us to identify a minimum of three basal accretion episodes between ca. 28 Ma and ca. 15 Ma. On the basis of structural evidences combined with numerical modeling results, we argue that this succession of mass-flux events triggered (i) pulses in the strain rate, sometimes associated with a switch of the stress regime (i.e., compressional/extensional) and (ii) vertical surface oscillations eventually resulting in the growth of a high forearc topography. This accretion-controlled, Myr-scale tectonic and topographic signal plays a part in active deformations monitored at subduction margins, though it may remain invisible to most of geodetic methods because of superimposed shorter-timescale transients, such as seismic-cycle-related events.

Keywords: Tectonic underplating; High pressure-low temperature metamorphism; Transient deformation; Forearc topography; Hellenic subduction zone

*Intervenant