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Thermochronological response to rifting and subduction in the Corsica-Sardinia block

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The linkage between deep-seated tectonic processes and surface processes provides a key to investigate the geological evolution of complex plate boundaries starting from the analysis of low-temperature geochronological systems. Here, we integrate published thermochronological data from Corsica (Danišík et al., 2007) with a new multi-thermochronological dataset (i.e. zircon and apatite fission track (ZFT and AFT), and apatite (U-Th)/He (AHe) data) from Sardinia, in order to tackle the Western Mediterranean tectonic issue and constrain the problematic transition in space and time between the opposite-dipping Alpine (European) and Apenninic (Adriatic) subductions.

Mesozoic AFT ages (169-201 Ma) and AHe ages (133-204 Ma), found on mountain ridges of central Sardinia and on the eastern coast of the island, indicate that rocks now exposed at the surface have resided since Jurassic times at very shallow depth, i.e. above the partial annealing zone of the AFT system (∼60-110°C) or even above the partial retention zone of the AHe system (∼40-80°C). The observed age pattern and track length distributions are consistent with those predicted after rising of isothermal surfaces during rifting and subsequent thermal relaxation after continental break-up. We demonstrate that the crustal sections now exposed in central and eastern Sardinia were originally located closer to the Tethyan rift axis than crustal sections exposed in NW Sardinia and Corsica, pointing to a NNE trend for the continental crust isopachs of the northern Tethyan margin (ENE before Corsica-Sardinia rotation), with burial depth progressively increasing from SE to NW. In Alpine Corsica, the low-T geochronological evidence of Jurassic rifting was largely obliterated by Cenozoic metamorphism, but it is still recognized in high-T systems.

AFT and AHe ages set after Tethyan rifting but not thermally affected by Neogene backarc extension, define a SE-NW trend of decreasing ages from southern Sardinia to northern Variscan Corsica (N-S in Paleogene coordinates). Modelled time-temperature paths show that this age trend is consistent with an erosional pulse migrating northward during the Paleogene, which led to the re-exposure of the Mesozoic planation surfaces previously buried by Paleogene detrital sequences. The northward migration of erosional pulses mirrors the coeval northward trajectory of Adria relative to Europe as inferred by magnetic anomalies.

Preservation of the low-T fingerprint acquired during Tethyan rifting indicates that no European continental subduction took place south of Corsica since the Mesozoic, and suggests that the post-Jurassic Adria-Europe convergence along the Sardinia transect was possibly accommodated on the Adriatic side of the subduction system, consistent with the onset of Cenozoic orogenic magmatism. The inferred tectonic reconstruction for the Paleocene - early Eocene time frame thus includes a northwestward (Apenninic) subduction that was active along the Sardinia transect, and an eastward (Alpine) subduction that was still active along the Corsica transect and choked in middle-late Eocene times, when Adria started moving towards the NNE (Malusà et al., 2011). The northward translation of the Adriatic slab beneath Sardinia and Corsica is mirrored by the coeval migration of exhumation pulses at the surface, until the slab reached the remnants of the Alpine wedge of Corsica in Oligocene times shortly before the onset of slab rollback.

Danišík, M., Kuhlemann, J., Dunkl, I., Székely, B., Frisch, W., 2007. Burial and exhumation of Corsica (France) in the light of fission track data. Tectonics 26(TC1001).

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