Thermal evolution of continental rifting in Corsica

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Advances over the last twenty years greatly refined our understanding of the structure of hyperextended magma-poor margins. However, the mechanics of rifting and resultant thermal effects on continental crust are still not fully understood. The multi-phase model of Lavier and Manatschal [1] accommodates lithospheric extension via spatially offset crustal and mantle strain, producing depth-dependent thinning along ductile shear zones and exhumation of subcontinental mantle. Lower-crustal reheating of the upper plate is a predicted thermal consequence, but data to test this hypothesis are lacking.

LASS-ICPMS depth profiling of U-bearing accessory phase geo/thermochronometers offers a new approach to resolve the thermal history of amphibolite to granulite facies lithologies, typically outside the thermal sensitivity range of conventional thermochronology. Here we integrate zircon, rutile, and apatite geo- and thermochronometry with geothermometry to provide time-temperature constraints on a Mesozoic fossil hyperextended rift margin in Corsica, where upper-crustal tonalites and lower-crustal gabbronorites are juxtaposed along the ductile Belli Piani Shear Zone (BPSZ) [2]. Zircon U-Pb ages from the entire crustal section record primary igneous crystallization between 275-300 Ma, while 165-210 Ma metamorphic overgrowths are present in lower crustal zircons. The latter ages indicate that the margin reached temperature conditions sufficient for zircon saturation and growth, and coincide with out-diffusion of Zr from resorbed garnets. Ti-in-zircon thermometry yields temperatures of ~700°C (+/- 20°C) in the hanging wall and ~800°C (+/- 60°C) in the footwall, supporting activity of the BPSZ during Jurassic rifting. Apatite and rutile show ~200 Ma cores with ~150 Ma rims consistent with zircon overgrowth ages and feature rounded [Pb] profiles attributed to thermally-activated volume diffusion at temperatures above 400°C. Inverse modeling [3] yields a two-stage cooling path with initial fast cooling from >700°C at 200 Ma to 500°C at 160 Ma followed by slow cooling to 400°C by 130 Ma.

[1] Lavier & Manatschal (2006) *Nature* **440**, 324-328. [2] Beltrando *et al*. (2013) *Lithos* **168-169**, 99-112. [3] Smye & Stockli (2014) *EPSL* **408**, 171-182.