Thermal evolution of the European margin during Jurassic continental breakup: constraints from U–Pb thermochronology of rutile

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U–Pb thermochronology of rutile is an ideal tool to constrain the cooling and exhumation history of the lower crust, given its moderate closure temperature and the occurrence of rutile in appropriate lithologies. Here, we apply U–Pb geochronology and Zr thermometry of rutile to a lower crustal section in Alpine Corsica. This work aims to constrain the thermal evolution of the distal European margin during the Jurassic continental rifting that culminated in the opening of the Alpine Tethys.

The Belli Piani unit of the Santa Lucia nappe (Corsica) experienced minimal Alpine overprint and bears a striking resemblance to the renowned Ivrea Zone lower crustal section. At its base, a 2–4 km thick mafic magmatic complex contains slivers of entrained granulite facies metapelite that are rutile-bearing. Textural evidence for rutile formation during Permian granulite facies metamorphism is corroborated by high Zr-in-rutile temperatures of dominantly 850–950 °C. Lower Zr-in-rutile temperatures of 750–800 °C in a few grains are partly associated with elongate strings of rutile within quartz ribbons, interpreted to record recrystallisation of some rutiles during high-temperature shearing. The high Zr-in-rutile temperatures demonstrate that both crystallisation and re-crystallisation of rutile occurred above the closure temperature of Pb in rutile (~550–650 °C). U–Pb ages of rutile can thus reliably be expected to record cooling through this temperature, providing a T-t point uncomplicated by effects such as later re-crystallisation.

U–Pb ages were measured by LA-ICPMS for rutiles from three metapelitic slivers, sampled from the uppermost to lowermost Mafic Complex. Careful sample selection and analytical protocols yielded precise ages that are remarkably consistent between samples, ranging from 160 ± 2 Ma to 161 ± 2 Ma. No other age populations were detected. The new data indicate that the Santa Lucia lower crust last cooled through ~550-650 °C at ~160 Ma, coeval with the first formation of oceanic crust in the Tethys. We exploit these data to constrain the tectonothermal evolution of the European margin during the continental rifting associated with the opening of the Tethys.