

The north Gondwanan margin in Iberia: P–T–t constraints from high-pressure rocks (Malpica–Tui Complex, Galicia)

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The Malpica–Tui complex (MTC) in the NW Iberian Massif consists of rocks of Gondwanan affinity. It preserves evidence of late Devonian high-pressure (HP) metamorphism varying from eclogite (P~26 kbar and T~650 °C) to blueschist facies conditions (19–22 kbar and 460–560 °C). Thermodynamic modelling on the HP rocks reveals a P–T evolution characterised by a subsenthalpic decompression to ~10 kbar, 480°C in the blueschist-facies rocks and 650 °C in the eclogites, followed by cooling to ~5 kbar at 380°C and 500 °C, respectively. New ⁴⁰Ar/³⁹Ar data indicate a minimum age of ~ 370 Ma for the subduction-related HP metamorphism. Subsequent decompression to pressures of about 10 kbar started at ~ 360 Ma and was contemporaneous with thrust-and-fold nappe tectonics and intrusion of early Variscan granodiorites dated at ~ 350–340 Ma. Final, “post-nappe”, exhumation is interpreted to have taken place from ~ 340–335 Ma to 320±5 Ma, which is the age of the syntectonic leucogranites emplaced in the autochthon of the MTC.

Peak P–T conditions correspond to an approximate depth of 70–80 km and a geothermal gradient of 6–7°C km⁻¹, attributable to a cold subduction zone. Age differences between the HP event and the beginning of the post-nappe tectonics indicate that the exhumation of the MTC lasted ~ 15–20 Ma. A nearly isothermal decompression from ~ 26 to 10 kbar provides a vertical component exhumation rate of ~ 2–2.5 mm/year from ~ 80 to 30 km depth. The last stages of exhumation from 8 to 5 kbar occurred within a period of ~ 10–15 Ma (from 340–335 to ~ 320 Ma) and from ~ 480–380°C, indicating a cooling rate of 7°C Ma⁻¹ (or a geothermal gradient of 10°C km⁻¹). These rates suggest that exhumation took place in two stages: (1) a fast, almost isothermal one, followed by a (2) slower episode with substantial cooling once the rocks reached the upper crust.