



## Dissecting Complex Magmatic Processes: an in-depth U–Pb Study of the Pavia Pluton, Ossa–Morena Zone, Portugal

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### Abstract

The build-up of large magmatic complexes can proceed piecemeal over periods of several million years through sequences of complex processes of magma production, differentiation, assimilation, final crystallization and subsequent metasomatic modification. All these stages can produce or modify minerals used as geochronometers, such as zircon, monazite and titanite. The present study exemplifies such complex relationships, also demonstrating how a systematic approach with comprehensive sampling and careful high-resolution U–Pb analyses can yield a coherent picture of the entire magmatic process. The study was conducted on the Pavia pluton, an elongated Variscan intrusion in the Ossa–Morena Zone of Portugal. The geochronological data show that the Pavia pluton was emplaced by the amalgamation of multiple magma pulses into the crust, over a period of c. 11 Myr. An early event at ~340 Ma, revealed by xenocrystic zircon, preceded the magmatic activity at the exposed level of the pluton, but is recognized as the main magmatic event elsewhere in the Ossa–Morena Zone. A second event at 328 Ma formed tonalite, trondhjemite and granodiorite, and subordinate differentiates in the central domains of the pluton (units I and II). A third event at c. 324 Ma emplaced granodiorite in the flanking domains III–V and the contemporaneous and widespread two–mica granite in domain VI, together with late rhyodacite porphyries, microgranodiorites, aplite–pegmatite and pegmatite dikes. A fourth event at 319–317 Ma was characterized by the emplacement of some microgranites and pegmatite dikes. These two last magmatic events also had an effect on the previously emplaced rocks, causing local overgrowths and isotopic resetting of minerals. The occurrence of a fifth magmatic event at depth at 313 Ma is the inferred cause of the hydrothermal activity responsible for local zircon, monazite and titanite resorption and/or recrystallization and for some of the textures exhibited by the main rock-forming minerals. The magmatic episodes were interspersed with periods of quiescence; this cyclicity presumably reflects an external control by the transtensional tectonic regime of the Ossa–Morena Zone.

**Key words** ID–TIMS U–Pb geochronology • magmatic evolution • multi-stage zircon growth • Ossa–Morena Zone • Pavia pluton

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