Tectonic controls on post-subduction granite genesis and emplacement: insights from zircon age spectra from the late Caledonian suite of Britain and Ireland

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Rates of magma emplacement commonly vary as a function of tectonic setting. The late Caledonian granites of Britain and Ireland are associated with closure of the Iapetus Ocean and were emplaced into a varying regime of transpression and transtension throughout the Silurian and into the early Devonian. Here we evaluate a new approach for examining how magma volumes vary as a function of tectonic setting. Available radiometric ages from the late Caledonian granites are used to calculate probability density functions (age spectra), with each pluton weighted by outcrop area as a proxy for its volume. These spectra confirm an absence of magmatic activity during Iapetus subduction between c. 455 Ma and 425 Ma and a dominance of post-subduction magmas between c. 425 Ma and 380 Ma. We review possible reasons why, despite the widespread outcrop of the late Caledonian granites, magmatism appears absent during Iapetus subduction. These include shallow angle subduction or extensive erosion and tectonic removal of the arc.

We propose a common causal mechanism for all Caledonian granites in which the down-going Iapetus oceanic slab peeled back and detached beneath the suture following final Iapetus closure. The lithospheric mantle was delaminated beneath the suture and for about 100 km back beneath the Avalonian margin. While magma generation is largely a function of gravitationally driven lithosphere delamination, strike-slip dominated kinematics in the overlying continental crust is what modulated granitic magma emplacement.