



Early Cenozoic “dome like” exhumation around the Irish Sea

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Despite decades of research the Early Cenozoic exhumation history of Ireland and Britain is still poorly understood and subject to contentious debate (see Davis et al., 2012 and subsequent comments). Previous studies have attributed the Cenozoic exhumation history of Ireland and Britain mainly to: (a) Paleogene – Neogene far-field stress between the opening of the North Atlantic Ocean and the Alpine collision (Ziegler et al., 1995; Hillis et al., 2008) or (b) early Paleogene mantle driven magmatic underplating associated with the development of the proto-Iceland mantle plume beneath the Irish Sea (Brodie and White, 1994; Al-Kindi et al., 2003).

The major differences between the two hypotheses are the pattern and timing of spatial exhumation. This project thus seeks to investigate the timing and mechanisms of late Mesozoic – early Cenozoic exhumation on the onshore part of the British Isles by using a combination of apatite fission track (AFT) and apatite (U-Th-Sm)/He (AHe) data, which we then model using the QTQt program of Gallagher (2012) to better constrain the modelled thermal histories.

Our studied area centres on the margins of the Irish Sea, but includes all Ireland and western Britain. Overall we analysed 74 samples for AFT and 66 samples for AHe dating. In particular, our results include ten pseudo-vertical profiles.

The AFT ages display a wide range of ages from early Carboniferous in Scotland to early Eocene in central Ireland. Our AHe ages range from mid Permian on Shetland to Eocene Ft-corrected. The AFT data do not show any specific spatial distribution, however, the Ft-corrected AHe ages around the Irish Sea only focus around late Cretaceous to Eocene suggesting an important thermal event around this time.

The modelled thermal histories of samples located around the Irish Sea and western Scotland show a clear late Cretaceous to early Paleogene cooling event which is not present elsewhere. The distribution of this cooling event is broadly consistent with seismic wide-angle data and gravity observations indicating the presence of crustal underplating (Al-Kindi et al., 2003) as well as sedimentation data (Jones et al., 2002). We suggest that the late Cretaceous/early Paleogene exhumation in Ireland and Britain was caused by permanent crustal underplating following a track from the Outer Hebrides in western Scotland through the Irish Sea as far as Pembrokeshire in south Wales associated with the development of the proto-Iceland mantle plume.

A second, smaller exhumation event in the Neogene is under constrained in most models but cannot be ruled out, since AFT and AHe dating are not sensitive enough.

References

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